InSITE 2020

Proceedings of the Informing Science and Information Technology Education Conference

Online
July 7 – 8, 2020

http://InSITE.nu

Edited By Eli Cohen

Papers have been blind reviewed by three or more external referees
(except as noted in the paper).

InSITE 2020: Proceedings of the 2020 Informing Science and Information Technology Education Conference:

Published by

Informing Science Institute
131 Brookhill Court
Santa Rosa, California 95409 USA

Email: Publisher@InformingScience.org

Website: http://InformingScience.org

ISSN: 1535-0703

ISBN: 978-1-68110-061-6

Printed in the USA

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Welcome

InSITE 2020

Dear Colleagues and Delegates,

Welcome to the 23rd Annual conference of Informing Science + IT Education.

Thank you all for submitting your papers and attending the presentations. While this is our 23rd annual event, it is our first in a virtual space. We hope that, despite the boundaries of time and space, you will find this conference useful and informative. We further hope that future conferences will return to our normal mode of operation.

The theme of this conference was Digitally Integrated Scholarship. This may have been prophetic given that now, not only is this conference solely reliant on digital technology to operate, but our lives also, no matter who we are or where we are, are now far more reliant on digital technology for work and for pleasure than they were just three months ago. The world is now in a different place, and Digitally Integrated Scholarship is now the staple for most of our working lives.

I look forward to meeting many of you online, and again, once more in person at our next annual conference.

Michael Jones
Conference Chair

InSITE 2020 Conference Chair

Michael Jones

Associate Professor, Faculty of Business
University of Wollongong
Wollongong, NSW, Australia

Keynote

T. Grandon Gill

President, Informing Science Institute and
Professor, University of South Florida
Tampa, FL, USA

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Schedule Overview
(Times shown are UTC)

Tuesday, July 7, 2020

11:00-11:45 ..... **Opening Remarks**
..... T. Grandon Gill, President, Informing Science Institute
.....Michael Jones, Conference Organizer

12:00-13:45 .....Paper Presentations

14:00-15:45 ..... Paper Presentations

16:00-17:45 .. Keynote: **What is Informing Science?**
..... T. Grandon Gill, President, Informing Science Institute

18:00-19:45 .. Workshop: **Writing Research Papers**
.....T. Grandon Gill

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8:00- 9:45 ..... Paper Presentations

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J. Jelsey and A. Zaliwski
FREEOS: Application of Direct Democracy Applied to Blockchain Based Economics

Changing Business Education Paradigm Toward Sustainable Solutions Based on Maori Business Practice

12:00-13:45 .....Paper Presentations

14:00-15:45 .....Workshop: **Online Badges**
..... Terry McGovern

16:00-17:45 .....Paper Presentations

18:00-19:45 .....Paper Presentations

20:00-20:30 ..... **Closing Remarks**

About the Informing Science Institute

Informing science is the transdisciplinary study of systems that employ information to impact clientele. The mission of the *Informing Science Institute* is as follows:

- Support transdisciplinary research that furthers our understanding of the construction and evolution of systems that inform, providing free and open access to such research,
- Foster communication among disciplines that study informing and education, and
- Nurture a supportive global community of informing science researchers through mentorship and through providing opportunities and venues for collaboration.

The *Informing Science Institute's (ISI)* primary reason for existence is to promote the advancement of the informing science transdiscipline across the global research community. Three principles guide the ISI's research and publication agenda:

- *Open access*: All ISI publications, including conference proceedings, journals, repository contents and books, shall be accessible in their electronic form at no cost to readers.
- *Global outreach*: The ISI's research agenda shall always be framed with the global community in mind, and shall not be limited by the perceptions and priorities of a particular nation.
- *Mentorship*: Helping researchers develop and refine their craft is as central to ISI's philosophy as providing outlets for the efforts of established researchers. This mentorship mission applies to both the conferences run by ISI and to the review and publication policies of its journals.

Join us in making academic better and more inclusive. Put your skills and abilities to work to help your colleagues and to build a better academy.

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Innovations in Practice ..... **http://jiteIIP.org**

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Albertus Buitendag
Eli Cohen
Michael Cohen
Agyei Fosu
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Yahel Giat
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Proceedings Papers - Overview

Copies of individual papers can be downloaded from the *2020 Informing Science & Information Technology Education Conference Proceedings* at **http://www.informingscience.org/Conferences/InSITE2020/Proceedings**

Review Process

Unless otherwise noted in the paper, all papers were reviewed blindly (that is, with author and affiliation information removed) by a panel of three or more external reviewers. The reviewers did not know the identity of the authors nor the authors the identity of the reviewers. Reviewers were matched to papers using a formula to minimize the cognitive distance between reviewers' stated expertise and interest and the topics covered in the paper.

Reviewers were instructed to mentor the authors by providing feedback on how to improve the submission. They were further required to recommend whether or not the paper should be accepted using a nine-point scale (from "reject" to "must accept").

Selected proceedings papers were revised and published in the 2020 volume of one of the Informing Science Institute journals.

Proceedings of the 2020
Informing Science and Information Technology Education Conference
(I^nSITE)
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Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
InformingScience.org

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Online July 7-8, 2020

THE EXPERIENCE OF RECEIVING AND GIVING PUBLIC ORAL AND WRITTEN PEER FEEDBACK ON THE TEACHING EXPERIENCE OF PRESERVICE TEACHERS

Gila Cohen Zilka — Bar-Ilan University and Achva Academic College, Israel — gila.zilka@gmail.com

ABSTRACT

Aim/Purpose	This study examined how peer feedback, received and given face-to-face and on the course site, shapes the teacher's image, from the student's point of view as the one providing and receiving feedback.
Background	This study examined the effect of receiving and giving peer feedback, face-to-face and on the course site, on forming the teacher's image, from the student's point of view as someone who provides and receives feedback.
Methodology	The research question was, "How do preservice teachers experience giving and receiving public, oral and written, peer feedback on the teaching experience?" This is a qualitative study. Two hundred fifty-seven preservice teachers educated in teacher training institutions in Israel participated in the study.
Contribution	The study attempted to fill the missing pieces in the experience of providing and receiving peer feedback in the process of training for a teaching certificate. The topic of feedback has been extensively researched, but mostly from the point of view of experts providing feedback to the student, whereas this study examined peer feedback. In addition, many studies have examined the topic of feedback mainly from the point of view of the recipient. By contrast, in this study, all the students both gave and received feedback, and the topic was examined from the perspective of both the feedback recipient and the feedback provider. It was found that receiving feedback and providing feedback are affected by the same emotional and behavioral influences, at the visible, concealed, and hidden levels.
Findings	It was found that in oral feedback given by students face-to-face they took into account the feelings of the recipient of the feedback, more so than when feedback was given in writing on the course site. It was found also that most students considered it easier to provide feedback in writing than orally, for

Accepted by executive review by Editor Michael Jones | Received: November 8, 2019 | Revised: January 27, 2020 | Accepted: June 12, 2020.

Cite as: Zilka, G. C. (2020). The experience of receiving and giving public oral and written peer feedback on the teaching experience of preservice teachers. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 1-13. Informing Science Institute. https://doi.org/10.28945/4502

	two reasons: first, it allowed them to edit and focus their feedback, and second, because of the physical distance from the student to whom the feedback applied. About 45% noted that the feedback they provided to others reflected their own feelings and difficulties. It was found that both giving and receiving feedback was influenced by the same emotional and behavioral layers: visible, concealed, and hidden.
Recommendations for Practitioners	When an expert gives feedback, the expert has more experience than the students and wants to share this experience with others. This is not the case with peer feedback, where everybody is in the process of training, and the feedback is not necessarily expert. Therefore, clarification and discussion of feedback are of great importance for the development of both feedback provider and recipient.
Recommendations for Researchers	About 45% of preservice teachers noticed that the feedback they provided to others stemmed from their own internal issues, and therefore dialogic feedback stimulated a sense of learning, empowerment, and professional development. Dialogic feedback may clarify for both provider and recipient what their habits, needs, and difficulties are and advance them in their professional development.
Impact on Society	People must ask themselves whether they are in a position of conducting a dialogue or in a position of resistance to what is happening in the lesson. A sense of resistance to what is happening in the lesson may cause one to feel attacked and in need of defending oneself, and therefore to criticize. It is difficult to establish fruitful and enriching dialogue in a state of resistance, and with the desire to defend oneself and go on attack.
Future Research	Knowledge of virtual feedback needs to be deepened. Does the feedback stem from the desire to advance the student who taught the lesson? Does the feedback stem from anger? etc.
Keywords	preservice teachers, written feedback, oral feedback, peer feedback, social emotional learning (SEL), public feedback, virtual feedback

INTRODUCTION

The importance of feedback in the pedagogical process of preservice teachers and the effect of feedback on the formation of their professional and personal identity has been increasingly recognized. Therefore, it is important to accept and give effective feedback that advances learning (Bransford et al., 2000; Maier et al., 2016; Muis et al., 2015). One of the instructional practices found to be useful in cultivating social-emotional skills is the giving and receiving of feedback after a teaching practice, during the students' education as preservice teachers. In this study, all feedback, oral and written, was public, given by peer preservice teachers. The feedback related to professional knowledge (concepts, facts), methodics (teaching methods), interactions in class and the use of verbal language (forthcoming, distancing, tagging, shaping, reprimanding, clarifying words), and body language (movement around the classroom, use of voice, looking, facial expressions). Oral feedback was given after the student had finished teaching. Written feedback was given to the student in a special forum that was opened on the course site for each student, following each lesson taught. The students practiced providing dialogic feedback—orally in class and in writing on the course site. Students responded to other students, deepened one another's feedback, addressed other students' responses, asked clarification questions, and so forth. The feedback can strengthen the recipient of the feedback and bring

about a sense of value and meaning, but it can also weaken the recipient. The feedback allows experiencing visibility, and in some situations it may create a sense of exposure, criticism, and potentially harm the recipient's feeling of self-worth (Brown et al., 2016; Butler & Winne, 1995; Dempsey et al., 1993; DeNisi, 2015; Duchaine et al., 2011; Llorens et al., 2016; Poulos & Mahony, 2008; White et al., 1993; Witzel et al., 2014).

SOCIAL EMOTIONAL LEARNING (SEL)

Participating students studied according to the Social Emotional Learning (SEL) approach. Researchers (Husaj, 2016; Maurice & Harriett, 2006; Zins, 2004) have argued that teaching according to the SEL method focuses on five sets of interrelated skills: self-awareness, self-management, social awareness, management of interactions, and taking responsibility. The researchers' assumption (Husaj, 2016; Maurice & Harriett, 2006; Zins, 2004) was that social-emotional skills are acquired skills and therefore can be learned and practiced. Emphasis has been placed on conducting social-emotional discourse among preservice teachers; their sense of ability to conduct an emotional-social discourse; their awareness of their own feelings and the feelings of others, while promoting the ability to conceptualize and express emotions; skills needed to conduct a respectful discussion with preservice teachers who practice teaching and watch their peers practice teaching; fostering empathy and acceptance of the other by preservice teachers who practice teaching and watch their peers practice teaching; nurturing a sense of confidence in their personal identity and the emerging professional identity of preservice teachers who practice teaching and watch their peers practice teaching (Husaj, 2016; Maurice & Harriett, 2006; Zins, 2004).

Students learned how to provide feedback orally (at the end of the lesson) and in writing (on the course site) and how to analyze the feedback they received. Participants also learned what aspects of their behavior to observe, such as the nature of interactions with their pupils, use of words that increase or decrease distance, the way they taught a concept or a phenomenon, how they moved around the classroom, how they used their voice (spoke quietly, loudly, etc.), how they made eye contact with pupils, and more.

In the course of their studies, preservice teachers should be exposed to emotional-social learning and experience. As future teachers, preservice teachers should use these skills in their interaction with pupils and the school staff and nurture these skills in their own pupils. SLE learning and experience in the course of their studies toward a teaching certificate is an arena that serves as a "training ground" for students' social-emotional development—an inseparable part of their mental wellbeing, cognitive development, and the expansion of their knowledge space. It is important to provide preservice teachers with an enjoyable learning process and experience. Enjoyment is not a luxury but a deep psychological need (Branden, 1989, 1994); the absence of enjoyment and a state of emotional suffering prevent people from experiencing and realizing dreams. They must learn and teach how to focus on the process because the process is likely to lead to a change in behavior (Emmons & McCullough, 2004; Watson, 2002). To make a change, individuals must understand their own needs and those of others, observe and investigate, be able to better understand emotional and social situations, try to identify the various pressures faced by themselves and by others, and how these pressures affect them and others, and their respective positions. This increases the chances that empathy for oneself and others would develop, together with an understanding of the reasons behind their own behavior and the behavior of others. As noted above (Husaj, 2016; Maurice & Harriett, 2006; Zins, 2004), social-emotional skills are acquired and can be learned and practiced. It is advisable to practice giving compliments, reinforcement, or both. One of the teaching practices found to be useful for cultivating social-emotional skills is videotaping students' lessons in the course of their teacher training.

FEEDBACK

DeNisi (2015) and Kluger and DeNisi (1996) define feedback as information given to a person performing a task regarding various aspects of task performance. Feedback provides learners with information allowing them to validate, correct, reconstruct interdisciplinary or metacognitive knowledge, and change perceptions of themselves, cognitive tactics, and strategies (Butler & Winne, 1995; Ching & Hsu, 2016; King, 2016). Differences in feedback depend on the way feedback is conveyed to the recipient (Kluger & DeNisi, 1996). Studies show that feedback is likely to result in a feeling of empowerment in the recipient or in a feeling of humiliation and regression in the performance of tasks (Brown et al., 2016; Butler & Winne, 1995; Dempsey et al., 1993; DeNisi, 2015; Duchaine et al., 2011; Llorens et al., 2016; Poulos & Mahony, 2008; White et al., 1993; Witzel et al., 2014).

According to researchers (Hattie, 2012; Wiggins, 2012), measurement, assessment, and feedback are three interrelated components. We measure, evaluate, and then give feedback; feedback that helps growth and progress derives from the goal and refers to it. Therefore, the feedback provider must focus on a particular goal, so that the feedback can help the recipient grow and develop.

Feedback can help both the receiver and the provider stimulate self-awareness in different aspects and patterns of behavior. Giving feedback usually happens on the same three planes as receiving feedback: visible, concealed, and hidden.

At the visible level, the person is aware of the emotions, qualities, and needs expressed in one's behavior. There is an overlap between individuals' perception of themselves and the perception of the environment of their behavior. At the concealed layer, people are aware of the feelings, qualities, and needs that they choose to conceal from the environment, either because of fear of criticism or because of fear of undermining their image. The hidden layer is referred to by some researchers as the "blind spot," a behavior that is visible to the environment but which the individual does not notice. At times, the environment allows a person to continue to be unaware in order to avoid hurting or insulting the person, and also to avoid confrontation, because on occasion individuals express opposition to being told about their behavior at the hidden layer. Effective, dialogue-based feedback could expand the visible plane of the recipient and of the provider of feedback and reduce the concealed and the hidden planes. It may help feedback providers acknowledge their own behavior patterns in different areas, find out what bothered them, and whether the difficulty in question reflects on their own difficulty (Hattie, 2008, 2012; Marzano et al., 2001; Mazur, 2009; Sutton et al., 2012; William, 2011).

FACE-TO-FACE FEEDBACK AND WRITTEN FEEDBACK ON THE COURSE SITE

The process of teaching-learning face-to-face is based on verbal and nonverbal communication, such as facial expressions and gestures. In recent years, several studies focusing on the feedback process on virtual course sites have been conducted (Magill et al., 2015; Twigg, 2015). Face-to-face interaction allows recognition of verbal and nonverbal cues, whereas a virtual learning environment is characterized by absence of nonverbal cues such as facial expressions and gestures (Clark & Mayer 2016; Garrison, 2012; Yeager & Dweck, 2012). In written feedback on the course site, the clues are in the writing style: writing in a style that increases or decreases distance, labels or shapes, lectures or reprimands, questions, etc. (Birch, 2016; Bruff et al., 2013; Francis & Shannon, 2016; Leners & Sitzman, 2006; Olivier, 2016; Poon, 2013; Tan, 2016; Tempelaar et al., 2015; Zeichner & Zilka, 2016; Zilka et al., 2018; Zilka & Zeichner, 2017).

This study aims to close the gaps in knowledge in the field of peer feedback, regarding the role that the reception and giving of peer feedback face-to-face and on the course site plays in forming the teacher's character. It examined the process of accepting and giving peer feedback face-to-face and on the course site, on forming the teacher's image from the preservice teacher's point of view. The research questions were: How do preservice teachers experience, receive, and give public, oral, and

written peer feedback on teaching experience? Is it easier to receive and provide feedback in writing on the course site, or orally, or face-to-face?

METHOD

The research is a qualitative study. Discourse analysis was performed on the findings that were obtained, based on the approach described by Adler and Adler (2008), Atkinson and Delamont (2006), and Hammersley (2008).

SAMPLE

The sample included 257 preservice teachers who study in academic institutions for teacher training in Israel to be teachers of social sciences: 77.8% women, 22.2% men; 47.6% aged 20-30; 34.9% aged 30-40; and 17.5% aged 40 and over.

Data collection was conducted during 2016-2017.

The students were in their last academic year of study toward a teaching certificate. All of them had a BA, and some of them a MA (32%) and a PhD (20%) degrees.

RESEARCH TOOLS

The research tools below were derived from previous studies (Zeichner & Zilka, 2016; Zilka, 2017; Zilka et al., 2019; Zilka & Zeichner, 2017, 2019). The research data were of two kinds:

1. Receiving feedback, orally and in writing
2. Giving feedback, orally and in writing

RECEIVING FEEDBACK

In your opinion, is the feedback you received important for your personal growth and did it become a resource for your personal growth and that of the feedback providers?

Did you feel that the feedback you received from other preservice teachers was useful, challenging, professional, related to professional knowledge, to methodology, to interactions with pupils, and related to verbal or body language?

As a result of the verbal or written feedback you received, did you feel reinforced or weakened?

As a result of the feedback you received, did you decide to change your teaching methods?

What did you feel when reading the feedback written by other students in the course?

Which type of feedback is easier to face: written or oral?

PROVIDING FEEDBACK

In your opinion, was the feedback you gave important and did it become a resource for your personal growth and that of the feedback recipients?

Did you feel that the feedback you provided to other preservice teachers was useful, challenging, professional, related to professional knowledge, to methodology, to interactions with pupils, and related to verbal or body language?

As a result of the verbal or written feedback you provided, did you feel reinforced or weakened?

As a result of the feedback you provided, did you decide to change your teaching methods?

Is it easier to give feedback orally or in writing?

RESEARCH PROCESS

Participants in the study were students enrolled in 15 courses; approximately 20 students were enrolled in each course. In every course, about 20 preservice teachers participated, teaching classes and watching their colleagues teach classes. Each student taught lessons, which were recorded with a digital video camera. The feedback provided orally to the student at the end of the lesson was also recorded, and the recording was provided to the student on a flash drive. Written feedback was provided by students on the course website. Both written and verbal feedback were public.

FINDINGS

This section presents the findings regarding receiving/giving oral and written feedback and general findings on receiving and giving oral and written feedback.

RECEIVING FEEDBACK AND PROVIDING FEEDBACK

Table 1: Did you feel that the feedback you received was ...

	Receiving feedback		**Providing feedback**	
	Yes	**No**	**Yes**	**No**
Effective	%75	%25	%75	%25
Challenging	%60	%40	%70	%30
Professional	%60	%40	%60	%40
Related to professional knowledge	%70	%30	%70	%30
Related to teaching methods	%65	%35	%65	%35
Related to interactions with learners	%85	%15	%80	%20
Related to verbal language	%40	%60	%30	%70
Related to body language	%50	%50	%45	%55

Table 2: Following the feedback you received / gave ...

	Receiving feedback		**Providing feedback**	
	Yes	**No**	**Yes**	**No**
Did you feel strengthened by the oral feedback?	%75	%25	%75	%25
Did you feel weakened by the oral feedback?	%15	%85	%15	%85
Did you feel strengthened by the written feedback?	%70	%30	%75	%25
Did you feel weakened by the written feedback?	%15	%85	%15	%85
Did you decide to make a change in your teaching methods following the feedback you received?	%75	%25	%75	%25

Quotations of Preservice Teachers Regarding Feedback from Their Peers

In your opinion, is the feedback you received important for your personal growth and did it become a resource for your personal growth and that of the feedback providers?

> It is possible to learn from feedback how to improve what was good, and how to retain and strengthen it.
>
> They see you as their equal and want you to succeed.
>
> It gives different perspectives and exposes how pupils experience us during the lesson.
>
> It makes transparency possible. Students can shed light and point out additional tools for improving teaching abilities.
>
> Their point of view as future teachers is meaningful.
>
> It allows you to see how others feel and think when watching you.
>
> It sharpens points that I must strengthen as a future teacher.
>
> The feedback was constructive, corrective, giving more perspective.
>
> They can see things I didn't pay attention to. For example, body movements.
>
> Peer feedback enables you to get feedback from many people at once and from people who also understand where you are, as they are teachers in training, like you.
>
> Providing peer feedback enables you to learn directly and indirectly about the good and not so good things to do when teaching a lesson.
>
> I think it helps because they see things a little differently from myself, and some advice I took and I think it's right to act along these lines.
>
> I received the feedback as a learning task for professional development.

What did you feel when reading the written feedback provided by other students in the course?

> There were a few feedbacks on my weaknesses that I found difficult to accept, but eventually I learned from them and improved myself.
>
> At first, I was a little surprised, but then the general feeling was good, the students put up a mirror in front of me, brought to the surface things I have to pay attention to.
>
> There were things that I didn't see even while repeatedly watching the recording of the lesson I taught. I learned a lot from the written feedback I received.
>
> From the feedback I learned things about myself that I was not aware of.

Which feedback was easier to deal with, written or oral?

> 22.2% oral feedback
>
> 60.3% written feedback
>
> 17.5% the two complemented each other

Providing Feedback

About 45% of preservice teachers noted that the feedback they provided to others reflected their own feelings and difficulties. It was found that the respondents' attitudes toward providing feedback were related to their own feelings, their own difficulties, and to the fact that they were giving feedback to other students regarding aspects that they had not yet clarified for themselves. Therefore,

many noted that the dialogue between feedback providers and feedback recipients was important in building their professional identity as teachers.

Is it easier to provide feedback in writing or orally?

> It is easier to provide feedback orally: 24.6%
>
> It is easier to provide feedback in writing: 62.3%
>
> The two complemented each other: 13.1%

It has been found that it is easier to provide oral feedback about positive aspects, but weaker points are easier to point out in writing. In writing, it is easier to get down to details, and it is less embarrassing for feedback provider. Written feedback is more accurate than oral feedback because at the time the oral feedback is provided students feel affected by the way their feedback may be accepted by the feedback receiver and by others.

Do you feel that you have provided significant feedback to other students?

> I think that relatively speaking I tried to be precise and convey the main messages in the feedback, so I hope that it was meaningful.
>
> I have always tried to provide both feedback and suggestions for improvement, so that the student would know what is good and what is not so good.
>
> I felt that in my feedback to the students I was referring especially my weakness, my difficulty with interaction.
>
> I realized that the feedback I received from some of the students was about things that were difficult both for them and for me, and this is interaction with the learners during the lesson.
>
> I tried to give positive feedback. Sometimes it was hard for me to give feedback orally, but I managed to give feedback in writing. I wrote some things to keep and some to improve.
>
> I felt that I was giving feedback about things I was still unsure about, which bothered me personally.
>
> When I read the written feedback provided by the students, at first I felt that they were "getting even" with me, that they were writing back things that I had written to them before. But when I looked in-depth at what the students wrote to me, and in addition after another round of watching the recording of my lesson, I realized that my difficulty in managing interactions during the lesson made me give feedback to other students about issues related to classroom interactions. It made me look at my behavior and my way of giving and receiving feedback from others. I think this experience was one of the most important lessons I learned in the course of my studies toward a teaching certificate.

GENERAL

In your opinion, what is the difference between written and oral feedback?

> There are things that people perhaps didn't feel comfortable saying but they put them in writing.
>
> Written feedback is more honest.
>
> In writing, one feels more at ease expressing oneself.
>
> In oral feedback, one tries to be more delicate, choosing words not to hurt. Sometimes it's unpleasant to tell the truth "in your face."

In oral feedback, people are usually more careful about what they say, and the feedback may be less truthful. In writing, people tend to be more honest, and in writing, the dialogue is deeper and leads to a deeper understanding of what is being communicated.

Oral feedback is more stressful both for the recipient and for the provider of feedback.

It is easier to write because you're not facing the person to whom you give your feedback. In addition, there is time to think about constructive and empowering formulations, and to go deeper.

In my opinion, it is harder to accept oral feedback because one always thinks about how the feedback will be perceived not only by the student who teaches but by the entire group.

Face-to-face feedback is more complicated for the feedback provider because it requires dealing with the person who receives the feedback. For the recipient, face-to-face feedback is more complicate because you have to behave politely and graciously even if the feedback makes you angry, is insulting, weakens you, etc.

DISCUSSION

This study attempted to fill gaps in the knowledge area of peer feedback, of accepting and providing oral feedback face-to-face, and of written feedback related to the shaping of the teacher's character. The study examined the acceptance and giving of peer feedback orally, in person, and in writing. The examination was carried out from the perspective of preservice teachers who provided and received feedback.

It was found that in oral peer feedback, provided face-to-face, the students took into account the feelings of the recipient of the feedback more so than when feedback was provided in writing. It was found that generally, the students' feedback was characterized as positive with respect to behavior that was meant to be retained, keep and as negative for behavior meant to be improved. In-depth feedback and in-depth dialogue were more characteristic of feedback provided in writing than orally.

There was a connection between the students' experiences receiving and giving feedback. It was found that the students related to the feedback given and received on the same planes, emotional and behavioral visible, concealed, and hidden. For example, a student who felt that it was difficult for him to conduct meaningful interactions during the lessons he had taught provided feedback to others focusing on interactions in the classroom and addressed at length the feedback given to him about interaction management.

Although written feedback was public, it was more focused than oral feedback from the point of view of in-depth engagement with respect to a particular point. It was easier for most students to provide written feedback than oral feedback for two reasons: (a)writing allowed them to shape and focus their feedback; (b) physical distance between themselves and the receiver of feedback allowed students to express their opinions more clearly and openly than in oral feedback. This finding is consistent with reports in studies that examined differences in face-to-face behavior vs. behavior in a virtual environment (Birch, 2016; Bruff et al., 2013; Francis & Shannon, 2016; Leners & Sitzman, 2006; Olivier, 2016; Poon, 2013; Tan, 2016; Tempelaar et al., 2015; Zeichner & Zilka, 2016; Zilka et al., 2018; Zilka & Zeichner, 2017).

The findings show that most preservice teachers felt that the feedback they received and the feedback they gave was useful, challenging, related to professional knowledge, teaching methods, and interactions with learners. Most of them felt that both written and oral feedback, received and given, strengthened and did not weaken them.

PROVIDING FEEDBACK

About 45% of preservice teachers noted that their feedback to others reflected their own feelings and difficulties. They provided feedback to other students regarding aspects about which they had not been sure themselves yet. Many noted that the dialogue between providers and recipients of feedback was important in the process of building their professional identity as teachers.

Many noted that it was easier for them to provide feedback in writing than orally, to be able to get into greater detail. In addition, written feedback was less embarrassing for the receiver. Students stated that when giving oral feedback, they felt affected by the way feedback was accepted by the recipient. It was found that giving feedback to others led to self-reflection by the providers of feedback regarding their own behavior and feelings.

About 45% of preservice teachers noticed that the feedback they provided to others stemmed from their own internal issues, and therefore dialogic feedback stimulated a sense of learning, empowerment, and professional development. Dialogic feedback may clarify for both provider and recipient what their habits, needs, and difficulties are and advance them in their professional development. When an expert gives feedback, the expert has more experience than the students and wants to share this experience with others. This is not the case with peer feedback, where everybody is in the process of training, and the feedback is not necessarily expert. Therefore, clarification and discussion of feedback are of great importance for the development of both feedback provider and recipient.

About 47% of students stated that the feedback given was about the characteristics and behavior of the feedback provider. Feedback in writing allowed them to observe their own behavior and what disturbed them in the behavior of the preservice teacher conducting the lesson. If, when providing feedback, students feel anger or discomfort with the behavior of the preservice teacher who taught a class, they should look at these reactions as a mirror that reflects their own anger or discomfort. When individuals are angry because of someone else's behavior, they must look at the anger itself and use the anger that arose as a path for discovering their own inner life, so that they can begin working with pupils from a cleaner and healthier starting place. The other "helped" the anger arise, but the anger developed inside the angry person. One's self is measured by one's ability to attain self-esteem and recognition, develop a fruitful communication with the environment, and accept those around as a mirror of one's own self. A dialogue that can promote awareness in the other is a dialogue that creates a reflection, gently and politely placing a "mirror," so that the other would be aware of the chosen behavior, with high sensitivity to the other's ability to contain. Anything beyond the capacity of the other to accept will lead to withdrawal and avoidance of meaningful interaction. Students noted that they were angry with the preservice teacher who conducted the lesson, wanted to give some blunt feedback, but remembered that they had to understand where their feedback was coming from. Does the feedback stem from the desire to advance the student who taught the lesson? Does the feedback stem from anger? If the feedback is prompted by anger, it is advisable to look at the anger and see why it developed, because probably the anger was already in them, and the behavior of the student just brought it to the surface. Thus, the feedback was actually self-feedback, stemming from self-reflection and self-awareness of those who wanted to give feedback to others.

People must ask themselves whether they are in a position of conducting a dialogue or in a position of resistance to what is happening in the lesson. A sense of resistance to what is happening in the lesson may cause one to feel attacked and in need of defending oneself, and therefore to criticize. It is difficult to establish fruitful and enriching dialogue in a state of resistance, and with the desire to defend oneself and go on attack.

CONTRIBUTION OF THE STUDY

The study attempted to fill the missing pieces in the experience of providing and receiving peer feedback in the process of training for a teaching certificate. The topic of feedback has been extensively researched, but mostly from the point of view of experts providing feedback to the student, whereas

this study examined peer feedback. In addition, many studies have examined the topic of feedback mainly from the point of view of the recipient. By contrast, in this study, all the students both gave and received feedback, and the topic was examined from the perspective of both the feedback recipient and the feedback provider. It was found that receiving feedback and providing feedback are affected by the same emotional and behavioral influences, at the visible, concealed, and hidden levels.

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BIOGRAPHY

Gila Cohen Zilka, Ph.D., Director of the Department for Teaching Social Studies and Communication at Bar-Ilan University; Head of the program for training mentors to work with children at risk, Achva Academic College, Israel.

Zilka's research focuses mainly on ICT, children in the digital environment, and communication in the diversified media.

Integration of ICT in academic teaching. Zilka's research deals with feelings of challenge and threat, self-efficacy, motivation, and emotional-social skills of students in virtual and blended courses in multicultural campuses.

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Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

DEVELOPING AN IT COURSE FOR EMERGING TECHNOLOGIES USING A FRAMEWORK – AN EXAMPLE OF AN IOT COURSE V1.0

Norman van Wyk	Noroff University College, Kristiansand, Norway, and University of Cape Town, Cape Town, South Africa	norman.van.wyk@noroff.no VWYNOR002@myuct.ac.za
Kevin Johnston*	University of Cape Town, Cape Town, South Africa	kevin.johnston@uct.ac.za
Klaus Möller	Pforzheim University, Pforzheim, Germany	klaus.moeller@hs-pforzheim.de
Florian Haas	Pforzheim University, Pforzheim, Germany	Florian.haas@hs-pforzheim.de

* Corresponding author

ABSTRACT

Aim/Purpose	Academics are often requested to create and teach courses for emerging technologies with perhaps no experience or guidance on how to do so.
Background	A Framework to develop IT courses for emerging technologies was created and tested to assist academics; the framework was then tested by developing an IoT course.
Methodology	A literature review was conducted to discover theories, models and methods that could be used in the creation of IT courses, followed by interviews with academics who had created many courses. The interviews were analysed using a thematic analysis process, and a Course Development Framework was created. The framework was tested by using it to build and deliver an IoT course.
Contribution	The Framework could be used to support academics who have to create and develop IT courses for emerging technologies.

Accepted by executive review by Editor Michael Jones | Received: December 16, 2019 | Revised: January 29, 2020 | Accepted: February 5, 2020.

Cite as: van Wyk, N., Johnston, K., Möller, K., & Haas, F. (2020). Developing an IT course for emerging technologies using a framework – An example of an IoT course V1.0. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, 15-45. Informing Science Institute. https://doi.org/10.28945/4521

Findings	By combining a learning theory such as constructivism, the ADDIE Instructional design model, ARCS-V Motivational model, and Bloom's Taxonomy, a Course Development Framework was constructed, which could be used to support academics who have to create courses for emerging technologies.
Recommendations for Practitioners	The Course Development Framework could be used to develop other IT courses including online courses.
Recommendations for Researchers	Future research could be conducted in the effectiveness of using the Course Development Framework to develop other courses including online courses.
Impact on Society	Support academics to develop better IT courses for emerging technologies.
Future Research	Research in the field of Brain Compatible Learning Principles and combining or using it with the Framework could provide further insights into advancements in course design and development.
Keywords	instructional design, framework, motivation, course development, educational technology, emerging technology

INTRODUCTION

Learners today expect exciting and engaging activities with diverse instructional styles, but unfortunately, many academics have been slow to adopt changes in learning approaches (Arghode et al., 2017). Information technology (IT) is continually evolving and new IT is emerging; this requires academics to develop courses for these emerging technologies, many of which are required to be taught online (Horvitz et al., 2015). Consequently, developing courses for emerging technologies presents new challenges for academics. Researchers have stressed the need for diverse didactic principles for learning, instruction design and learning philosophies (Arghode et al., 2017). For this reason, there is a current need for a framework that could guide academics to develop courses, especially courses in emerging technologies (Panetta, 2018). Van Wyk (2019) developed a Framework for developing online courses, and this paper is based on and builds on Van Wyk's work.

Academics are increasingly likely to be required to develop courses for emerging technologies such as the Internet of Things (IoT), Virtual Reality (VR), Digital Twins, and Smart Dust (amongst others) for learners who prefer to use mobile web-enabled devices in the classroom (Johnston, 2016), and may also prefer using online learning (Panetta, 2018).

From a general institutional perspective, developing a new course requires an academic to consider not only the content required, but also a multitude of additional factors across a range of disciplines (McCaffrey, 2017). For example, to develop an IoT course, one would need to consider the IoT content itself, as well as possibly utilising a framework to build the course. For this reason, the primary aim of this empirical research was to create a general-purpose Course Development Framework that could aid academics in developing emerging technology courses. Within the scope of this research study, IoT was used as a test case of an emerging technology, and an IoT course was developed and presented in Germany in late 2019.

IoT could, on the one side, be seen as a cross functional development. On the other side, each discipline in a corporation has to consider the potential of applications of IoT in depth within its own environment. And hence there is a high relevance for the education of future managers, for example, in manufacturing or purchasing and logistics. In logistics, IoT will have huge implications for the business. Macaulay et al. (2015) predicted that we would move from 15 billion connected devices in 2015 to some 50 billion by 2020. The resulting visibility will transform our business processes, in particular in logistics. Consequently IoT will increase supply chain visibility and agility as well as its resilience to un-precedented events. A literature review on the potential for added value of IoT in Supply Chain Management shows that the applications are still in an early stage (Ben-Daya et al., 2017). But with

the promising areas in mind, academics must reflect today how they will transfer the uprising potential of IoT into the education environment. So, the Course Development Framework could also be used for other courses for emerging technologies, such as Augmented Reality, Mixed Reality, and Virtual Reality, as well as for developing online courses.

To begin the research, a review of the literature was conducted (van Wyk, 2019), this was followed by interviewing academics who had developed several courses (including online courses) at universities in Europe and Africa. Responding academics were regarded as experts in the field of IT education due to the nature of their work, experience, research, and positions in academia. Data from the literature review and the interviews was gathered and analysed and a Course Development Framework developed. The Framework was then presented as a proof of concept to several of the academics interviewed and refined based on their comments and suggestions. Finally, a course outline for an emerging technology, IoT in this case, was developed using the Framework. The course was presented at a university in Germany, and feedback was obtained from the students who completed the course.

There were concerns over personal and organisational information of the respondents being obtained and kept.

To address the ethical and privacy concerns of the responding academics and students, all identifiable information of the respondents (and higher educational institutions in which they were operating) has been removed, and respondents have been given pseudonyms.

LITERATURE REVIEW

A systematic literature review process taken from Brereton et al. (2007) was followed. Three stages as outlined by Brereton et al. (2007) of planning the literature review, conducting the literature review, and finally validating the literature review were followed. Literature was sourced mainly from Google Scholar and the Educational Resources Information Center (ERIC). Only papers published in English were included; all other languages were excluded. Furthermore, the literature search focused on results from the last five years, 2015-2019. Published and peer-reviewed journals were primarily used, and, where necessary, books and relevant websites were cited. Older references were used where appropriate to describe research based on prior research and findings such as Keller (2010). The literature review discusses learning theories, instructional design methods, and motivational design models that could be used to develop a Course Development Framework for emerging technologies. The literature review has the following main themes: learning theories, course development, design models, Bloom's taxonomy, and the IoT course request.

LEARNING THEORIES

Literature suggests that academics could benefit from research and support in the form of best practices in instructional design and student learning for creating new courses (Horvitz et al., 2015). Kizilcec et al. (2017) stated that student focusing research and best practices regarding student interactions would be welcome additions to instructional practices, especially if they are easy to apply.

In the twenty-first century the way academics address learning depends a lot on their experience, but additionally, and perhaps more importantly, academics will need to have a shift in perspective of learning as this type of learning is different from the learning in the more structured learning environments of the classroom (Yilmaz & Cagiltay, 2016). The question of how learning takes place in a human being is a fundamental question in instruction and teaching (Illeris, 2018). Developed from learning psychology with additional influences such as pedagogical, sociological and medical research mainly in the form of cognitive and brain research has led to the development of learning theories (Illeris, 2018).

The literature review discussed learning theories and models that could be used to develop a Course Development Framework specifically for emerging technologies. Learning theory is a vast subject

that has many different aspects such as neuroscience, psychology, and education (Juvova et al., 2015). Fundamental learning theories that are used within a broad spectrum of course material include cognitivism, connectivism, behaviourism and constructivism as shown in Figure 1.

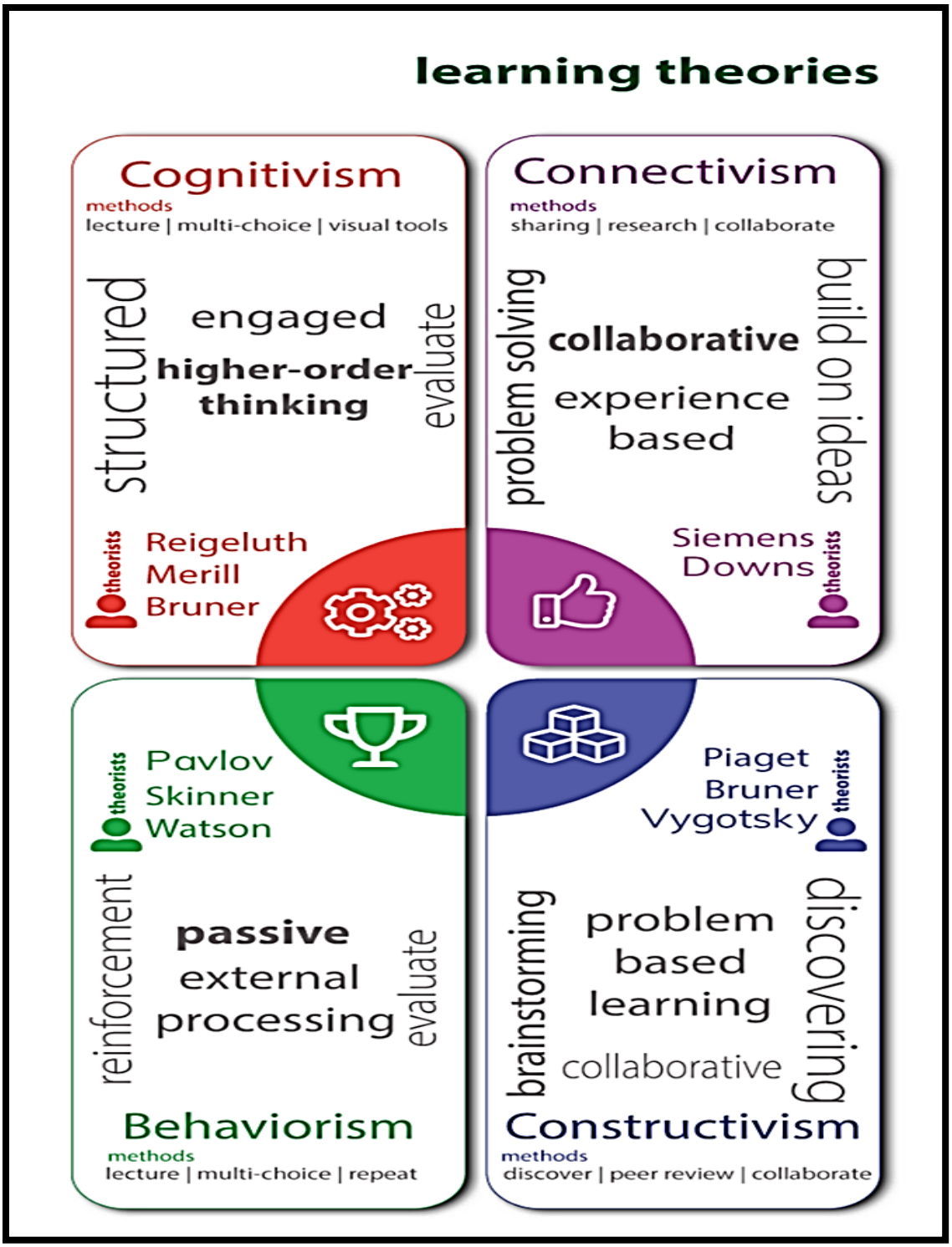

Figure 1. Popular learning theories (Davis, 2019).

The literature review identified learning theories that could be used in the development of a Course Development Framework by looking at key elements of the learning theories that would prove useful for a course on emerging technologies such as IoT.

Learning theories outline how a student learns and acquires knowledge, retains knowledge, and recalls the knowledge by describing some general principles (Sahin & Dogantay, 2018). Reflecting on the studies regarding learning theories, the paper by Arghode et al. (2017) states, "Learning theories deserve more attention in an online learning environment. The study of learning theories combined with an in-depth analysis of psychological and human resource literature will enable researchers to delve deeply into the subject. More qualitative studies are needed to explore further how an instructor's ability to utilize theoretical principles to improve instruction can make a difference in learning" (p. 604).

This led to the research question RQ1: Which learning theories could be useful as a basis to construct a framework for developing courses on emerging technologies?

Behaviourism

The behaviourism theory concentrates on measurable and observable behaviour or actions and on the importance of the consequences that follow the behavior or action (Saari, 2019). Behaviourism evolved from a positivist worldview related to cause and effect. Behaviourism ignores that which cannot be observed, thus it ignores the internal knowledge, previous knowledge, or mental process in determining the knowledge (Yarbrough, 2018). In education, behaviourism examines how students behave while learning. More specifically, behaviourism focuses on observing how students respond to certain stimuli that, when repeated, can be evaluated, quantified, and eventually controlled for each individual (Yarbrough, 2018). Consequently, the behaviourism theory establishes the theory as an idea that the learning behavior can be controlled by establishing consequences that will guide the behavior of the learner by providing negative or positive feedback as a response (Saari, 2019). The learning can then only be successful when students connect required responses with desired outcomes through conditioning (Arghode et al., 2017).

The behaviourism theory has established a very rigid and structured approach (Meier, 2016; Yarbrough, 2018). The idea is that by rewarding correct responses to solving a problem or answering a question correctly and punishing an incorrect answer by giving a negative response, the student will learn the correct behavior. Behaviourism does not take into account the mental processing by the learners but instead focuses solely on observable behavior (Robinson, 2018). Behaviourism teaches by enforcement and reinforcement of pre-conceived and designed outcomes (Saari, 2019). Behaviourism theory is often used in linguistic learning programs and training of animals (Meier, 2016; Saari, 2019).

Behaviourism started to show limitations when it could not explain many social behaviours, and this limitation gave rise to the Cognitivism theory (Harasim, 2017). Behaviourism could be used where the learning material could be developed so that it emphasizes a response conditioning approach.

Behaviourism theory could be appropriate when designing courses as it encourages the development of:

1.) Measurable and observable learning outcomes (Yan, 2017).

2.) Using rewards and feedback to improve performance (Arghode et al., 2017).

3.) To guide students to master predictable skills (Arghode et al., 2017).

Connectivism

The connectivism theory is described as learning in the information or digital age where learning knowledge is distributed across networks where connections and connectedness inform learning,

based on the future not the past (Kizito, 2016). Students find meaning and make connections between data, ideas, and concepts as a crucial part of the learning experience (Reese, 2015). The clustering (gathering of information) of the nodes allows the students to share ideas, interact, and experience learning together (Goldie, 2016).

Technological advancements have occurred rapidly and traditional learning theories like behaviourism, have struggled to keep up with emerging technologies (Yumurtaci, 2017). Connectivism aims to bring together the networked nature of society into the learning constructs. In contrast to theories, such as behaviourism and cognitivism, which place learning as a separate inner construction of knowledge, connectivism emphasizes the importance of how and where to access information instead (Goldie, 2016). Moreover, the connectivism theory takes the stance that the information that exists would be too much for one person to be able to make sense of and is treated as internalized knowledge even though it is coming from external nodes (Goldie, 2016). By connecting a set of nodes of diverse opinions, knowledge, data, and meaning, continued learning is promoted. Thus, connectivism lends itself well to online learning where a learner can keep on learning no matter where they are based (Veletsianos, 2016). Without guidance the connectivism theory has the risk of adding information that is not relevant (Veletsianos, 2016).

Connectivism interestingly also adds that learning can happen between non-human instances, for example, in artificial intelligence uses (Reese, 2015). While connectivism fits exceptionally well with modern technological advancements to learning, it relinquishes control of the academic to a wealth of information that is dispersed and unstructured (Reese, 2015). Connectivism would be beneficial to a course where:

1.) Learning is collected in the diversity of opinions (Reese, 2015).

2.) Social collaboration is of high importance (Bair & Stafford, 2016).

3.) Decision making itself is a process (Reese, 2015).

Constructivism

Constructivism as a theory suggests that learning is a learner focused constructive process and that students create and construct their own reality of learning using prior knowledge in constructing new knowledge (Jiang, 2019). The premise stated by constructivism emphasizes the active role that learners themselves play in constructing knowledge and inspires them to construct meaning from what they have seen, heard, did, and experienced. (Arghode et al., 2017). Forming the constructs is based on prior knowledge as well as constructing knowledge from others, and this leads the learning and knowledge formulation to be subjective in nature (Harasim, 2017). Thus, learners demonstrate understanding not just by repeating information but from demonstrating theoretical knowledge. (Juvova et al., 2015). In other words, the learner makes sense of their world by experiencing the learning and then constructing meaning (Johnston et al., 2018). Constructivism promotes a learner centred theory where experimentation and active participation is encouraged so that the learner can create more new knowledge and reflect on what was learned. By building on previous experience and knowledge, new learning can take place from a shared understanding between student and academic.

In the teaching environment, constructivism may be helpful where complex skills such as critical thinking and problem-solving must be grasped. The role of the teacher is set as a participant who encourages interactivity and helps the learner construct knowledge (Arghode et al., 2017; Hood Cattaneo, 2017; Usher et al., 2015). Critics of constructivism point out that constructivism is a reiterative process that re-examines problems continually (Tan, 2017). Furthermore, the argument is made that there is no emphasis on correct answers to problems, but a focus on the interpretation of the students' constructs (Tan, 2017). Proponents, however, argue that by engaging the learner by building on their experience, it promotes testing of knowledge in a meaningful manner.

Constructivist learning theory should be implemented with a suitable design method of motivating the student to encourage their willingness to participate and find meaning in the content. Cognitive and social presence are part of the constructivism view of shaping learning using interaction, collaboration, and dialogue (Scoppio & Luyt, 2017). Constructivism is considered one of the leading learning theories in education (Amineh & Asl, 2015).

Constructivism theory could be appropriate when developing courses where:

1.) The learner is in control of their learning (Usher et al., 2015).

2.) Group learning is encouraged (Amineh & Asl, 2015).

3.) The process of knowledge construction is important (Tan, 2017).

4.) Tutoring and apprentice roles are required (Amineh & Asl, 2015).

5.) Problem-based learning and brainstorming are implemented (Khalil & Elkhider, 2016).

This led to the research question RQ2: Which learning theories would be best suited for developing a course for an emerging technology?

Course Development

Students understand the benefit, impact and use of mobile web-enabled devices in their learning, and wish to use mobile web-enabled devices in classrooms (Abachi & Muhammad, 2014; Benham et al., 2014). An impact on academics is that academics need to change and adapt their course development and teaching methods to incorporate mobile web-enabled devices into the classroom (Johnston, 2016).

Online teaching and learning have become commonplace and are widely accepted as an alternative to, and in addition to classroom-based courses (Kumi-Yeboah, 2018). Online learning has become an inherent part of many institutions' strategy and forms an essential facet in their plans (Kumi-Yeboah, 2018).

As the growth of online course delivery has expanded there has been an increased drive towards quality instructional design methods and the quality of the course material developed (Kumi-Yeboah, 2018). As a result, while technology evolves and more learners are considering online learning as an alternative study path, it is essential to further develop frameworks to develop online courses (Dumford & Miller, 2018). Scoppio and Luyt (2017) stated that using connectivism and constructivism paradigms as theories to develop instructionally comprehensive learning could be beneficial to the course designer so as to develop online courses.

Since most academics have valuable experience in creating classroom-based courses, the fact that it requires a specific pedagogical approach to develop online courses is often not considered when they make the transition from classroom-based models of teaching to online teaching (Scoppio & Luyt, 2017). Learning and perception can change depending on the technological situation (Scoppio & Luyt, 2017). When classroom teachers are expected to teach online courses it has resulted in physical and conceptual gaps in communication and misunderstandings between teacher and student as Scoppio and Luyt (2017) discussed. The instructional model plays a significant role in the teaching design and learning process (Hess & Greer, 2016).

Design Models

The purpose of an instructional design model is to support learning designers and teachers to ensure that their teaching material and content is aligned in an optimum manner to aid the students learning development (Cheung, 2016). Instructional Design is the principles and procedures that apply to the consistent and reliable development of instructional material, content, information sources, lessons, and whole learning systems (Hess & Greer, 2016). Instructional Design is a system based approach

that follows guidelines, procedures and models as well as allows for evaluation of the educational design process (Hess & Greer, 2016). Three design models, ADDIE, ARCS with the extension to ARCS-V and Bloom's taxonomy were reviewed.

ADDIE Instructional Design Model

The ADDIE instructional design model consists of five categories, namely, Analysis, Design, Development, Implementation, and Evaluation (Budoya et al., 2019). The ADDIE model is widely used in the instructional design and development field and often described as being instrumental to the improvement of teaching and learning (Cheung, 2016; Hess & Greer, 2016). ADDIE continues to be one of the most popular and widely used models for instructional design (Ghani & Daud, 2018). It is used as the blueprint to design applicable instruction and aids in providing methods for continuous evaluation and analysis of the content (Hess & Greer, 2016). However, as described earlier by Hattie (2015), all learning design models have some form of improvement but that the specific model of design chosen, might not be the optimal way of delivering that particular learning content.

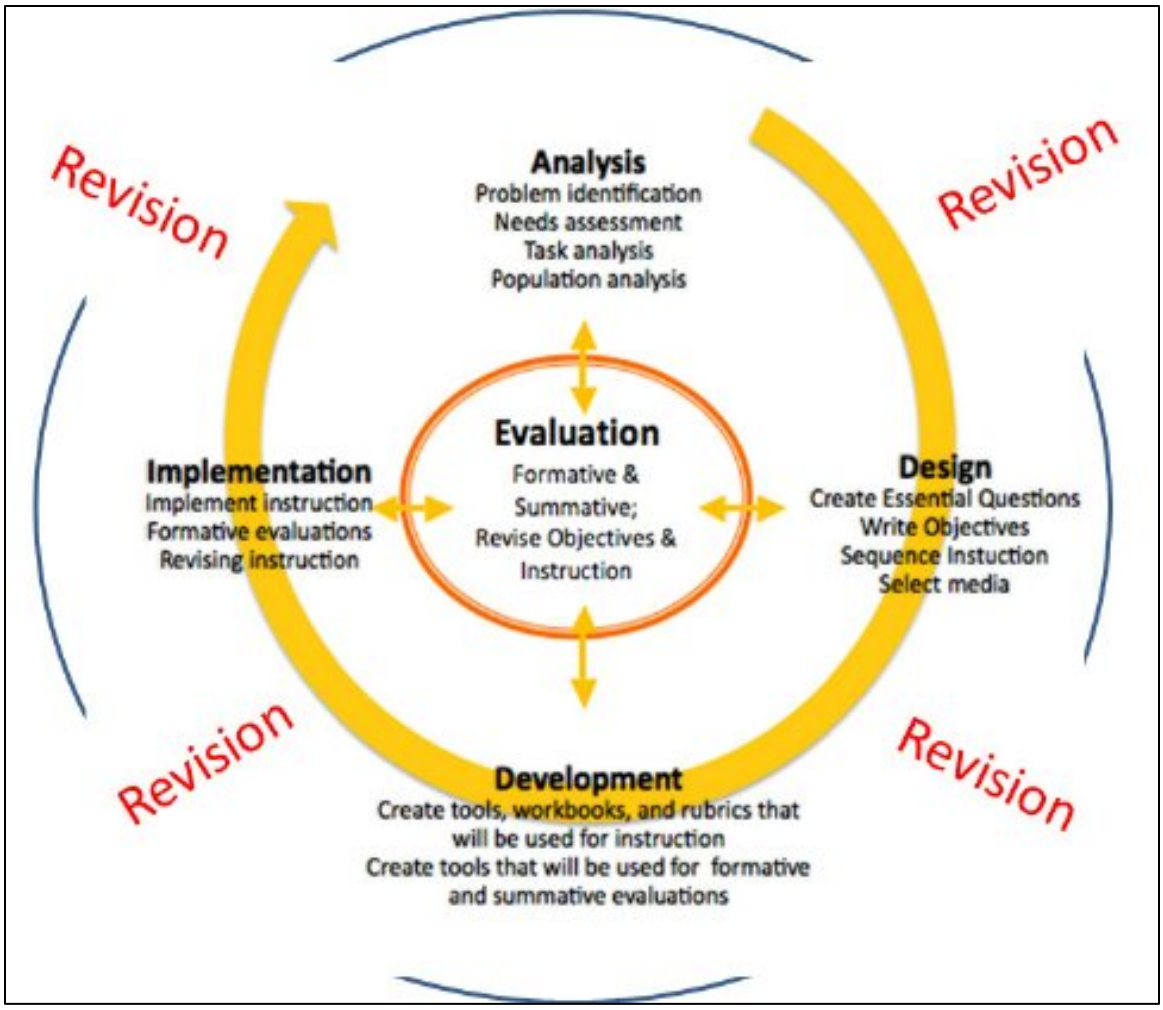

Figure 2. ADDIE Instructional design model (Shahril et al., 2015).

The different steps of the ADDIE instructional design model are used as follows, in the order ADDIE:

> *Analysis*: In the analysis step the academic analyses the needs of the learners by looking at the educational objectives of the course and designing the outcomes to align with the

educational goals (Cheung, 2016). Some of the topics that need to be analysed could be how long a course should be or what evaluation criteria needs to take place (Trust & Pektas, 2018).

Design: In the design step, academics need to develop the learning activities, assessment, and methods of delivery. In addition, they should develop the strategies on how to present the course material (Hess & Greer, 2016; Trust & Pektas, 2018).

Development: In the development step, the course creators develop the content assets and put all the materials together from the design step. Project review and fixes or changes are implemented and iterated upon, until the development of the course content is complete (Cheung, 2016). The reviews and iteration can be based on feedback from pilot studies or test participants (Hess & Greer, 2016).

Implementation: Implementation is the next step in the ADDIE model. This step requires the designed course to be launched or delivered. In this step it is crucial to be aware of feedback from learners should there be any unforeseen issues in the delivery (Cheung, 2016).

Evaluation: In the final evaluation step the response from feedback and general usage of the course must be taken into consideration. These responses would then be used to re-analyse the course for a new design or to fix issues (Cheung, 2016).

Revision as on the arcs between the steps implies constant revision and assessment.

Even though the ADDIE model has been used in a vast number of instructional developments the model shows some disadvantages (Alnajdi, 2018; Jung et al., 2018; Nadiyah & Faaizah, 2015). Although the ADDIE model focuses on systematic design procedures, the model has received criticism for being too inflexible and linear in nature, often being too drawn out and time-consuming for modern fast-paced learning (Jung et al., 2018). However, by applying some Agile methods to the ADDIE model it is suggested that these limitations can be overcome. Research done in improving ADDIE for multimedia and software development instruction found that adding a Feature Driven Development Process (FDDP) to the ADDIE model suitably addressed the limitations (Budoya et al., 2019). Furthermore, research has been conducted into extending ADDIE to include a course piloting step (X_ADDIE) (Constancio et al., 2018).

By using ADDIE in the instructional design process, it aids in keeping the complexities of learning design and instructional design at bay and increases the impact of the learning. A further benefit of using the ADDIE instructional design model is that different learning methods can be applied to establish knowledge acquisition by students of different learning styles (Alnajdi, 2018).

ARCS/ARCS-V Motivational Design Model

Motivation can be thought of as the learner's inclination to participate and engage in the learning, through cognitive, emotional, and practical application usually in an independent way, through difficulties and disappointments (Du Boulay & Del Soldato, 2016). Motivation in learners is a key principle that drives learning, but in order to keep learners motivated it takes more than adding new technology to the online classroom. Using new technology helps, but when the novelty has worn off, academics need to have implemented instructional effective design and motivationally sound learning theories and models to keep the motivation level of the learner high (Libao et al., 2016). Keeping a learner motivated is a key factor in developing a successful instructional content (Khan et al., 2019). Whether online or face-to-face learning is taking place, positive learning cannot occur without the learner's efforts and willingness to learn and apply the concepts presented in the learning material. At the core, effective instructional practices should be accompanied by a sound motivated learner in order to promote learning (Arghode et al., 2017).

Each new technology application is accompanied by a predictable wave of publications describing its benefits and applications. However, the novelty effect associated with each of these innovations soon

fades, leaving researchers with the continuing problems of providing learning experiences that are motivating to the learners and are instructionally effective (Keller, 2016). Certainly, adaptations of basic knowledge of motivation and learning have to be made by following the specific characteristics of a given technology or delivery system, but there are fundamental principles of motivation and learning that transcend these differences (Keller, 2016). Motivating and focusing on learning key skills is an integral part of building a functional and useful framework, and it begins with a discussion of issues related to technology and motivation.

The ARCS motivational model states that, "In order to motivate students, the instructor or instructional materials need to (1) catch and sustain students attention; (2) state why the students need to learn the content; (3) make students believe that they are able to succeed if they exert effort; and (4) help students feel a sense of reward and pride. The ARCS model utilizes a systematic process which can be specified into four steps: define, design, develop, and evaluate" (Li & Keller, 2018, p.54).

The ARCS model presents a systematic design model to assist academics in creating course material and content with motivational elements for the learners (Keller, 2010, 2016; Loorbach et al., 2015). Intrinsic motivation creates a learner who is committed to learning the subject matter. The intrinsically motivated learner enjoys exploring and mastering the content and is more committed to doing so (Keller, 2016; Khan et al., 2019; Ucar & Kumtepe, 2016). Figure 3 is a creation aid instructors can use to assess motivation (Keller, 2016). The ARCS model was based on previous research on human motivation. It is shown that intrinsic motivation increases learning engagement and improves academic performance in learners (Libao et al., 2016).

Categories	Instructor's Self-Analysis	Instructor's Analysis of Learners
Attention	Am I excited about this learning experience and how I can make it interesting?	Are the learners going to be interested? What tactics will stimulate their curiosity and interest?
Relevance	Do I believe that this learning experience will be valuable for my learners?	Will learners believe it is valuable? What can I do to help them believe it is important?
Confidence	Am I confident in my ability to lead this learning experience effectively and interestingly?	Will the learners feel confident about their ability to learn this? What do I need to do to help them be confident?
Satisfaction	Do I expect to have positive feelings about this learning experience?	What can I do to help the learners feel good about their experience and desire to continue learning?
Volition	Will I provide effective supervision and support to the learners throughout this learning event?	What can I do to help the learners maintain their goal orientation and task-focus throughout this learning event?

Figure 3. Creation aid for motivational strategy design (Keller, 2016).

Keller first presented the ARCS model as a way to put the motivation of the student at the centre of the teaching and learning design (Chu, 2017). ARCS places motivation of the learner at the centre of the learning model in its entirety, meaning the motivational aspect continues through each step of the model. In time ARCS proved problematic in one aspect - the research showed that it did not account for learner persistence (Keller, 2016). Keller (2016) explains that some learners persisted in their learning and completed the studies even when motivation faded, while others would give up even though the end results were essential to them. To account for these differences in motivation a fifth category was added to the ARCS model, called Volition (see Table 1), creating the ARCS-V model (Keller, 2016).

Table 1. Adapted ARCS to ARCS-V table.

Attention	Relevance	Confidence	Satisfaction	Volition
A1 Perceptual arousal	R1 Goal orientation	C1 Learning requirements	S1 Intrinsic reinforcement	V1 Commitment to learning
A2 Inquiry arousal	R2 Motive matching	C2 Success opportunities	S2 Extrinsic rewards	V2 Perseverance
A3 Variability	R3 Familiarity	C3 Personal control	S3 Equity	V3 Willpower

By using the constructivism theory as a guiding theory and applying the ARCS-V systematic design model to the design of the framework, a motivationally effective course outline can be developed that keeps attention, relevance, confidence, satisfaction and volition as guiding principles.

Bloom's Taxonomy

Bloom's taxonomy fundamentally organises thinking skills into six hierarchical organized categories that go from lower zones of thinking complexity through to higher zones of thinking complexity, as shown in Figure 4 (Fastiggi, 2019). The hierarchies are constructed from the verbs that the academic chooses when describing expectations for thinking skills and behavior in a learning outcome (Stanny, 2016). The lower complexity thinking zones attempt to establish a basis for the 'knowing' and 'understanding' aspects of cognitive skills, whilst the higher complexity cognitive thinking zones establish the basis of 'applying', 'analysing', 'evaluating', and 'creating' (Bertucio, 2017; Stanny, 2016).

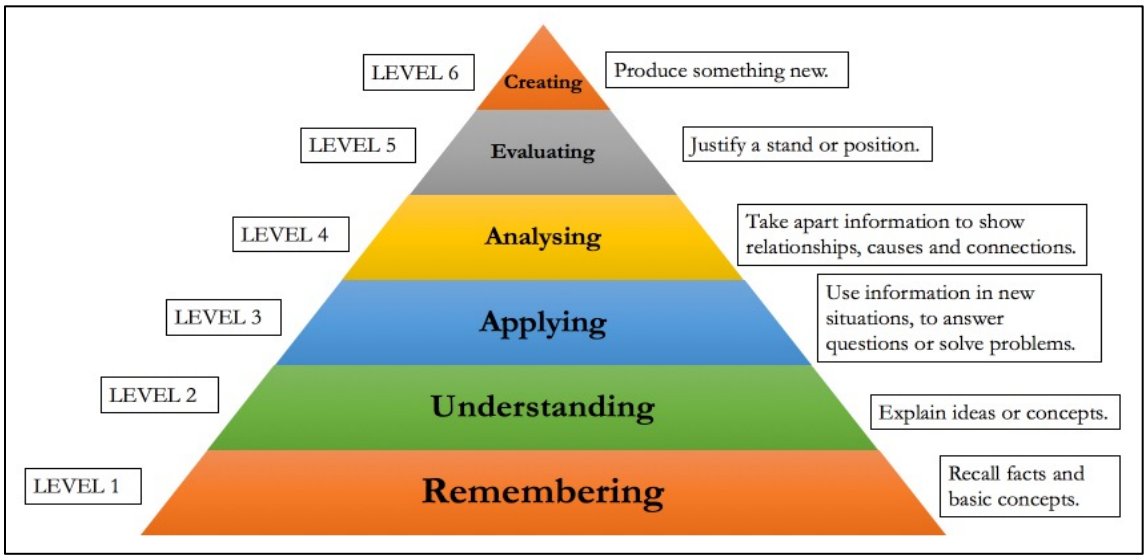

Figure 4. Bloom's Taxonomy (Fastiggi, 2019).

The guiding principle built around Bloom's taxonomy assumes the keyword verbs in each category describe a progressive advancement of thinking skills. Thus, keyword verbs at the lower zones of Bloom's taxonomy define knowledge acquisition and fact memorization, in contrast the higher zones define more complex thinking skills such as applying the knowledge gained in lower zones to practical problems, analysing concepts and the creation of new knowledge or different interpretations of existing knowledge (Rahman & Manaf, 2017; Stanny, 2016). Thus, by building learning activities based on these different levels of thinking skills, the progression from fundamental understanding to eventually creating new knowledge can be accomplished (Agarwal, 2019).

The literature led to the research question RQ3: Which design models could be used to construct a Course Development Framework for courses on emerging technologies?

THE INTERNET OF THINGS (IOT) AND A COURSE REQUEST

There is a sense that IoT will transform companies into digital business and change business models (Hung 2017; Tervonen et al., 2018). IoT applications and services will cover almost every aspect of the Supply Chain. For example, in transport management IoT will not only enable the monitoring of the precise location of transported goods but also control the conditions of the transport (e.g., shock, temperature) or storage conditions (e.g., flammable materials). Another example for IoT being the driver for a digitalized inventory management is the introduction of intelligent shelving and pallets (Witkowski, 2017). Future managers need to be prepared to manage this constant change not only by knowing the success factors but also the challenges, such as security, data integrity, decentralization, and confidentiality, by combining business excellence, process design and knowledge gathering. The very rapidly evolving IoT especially in combination with other emerging digital technologies like Big Data, Blockchain and Smart Contracts (Hong-Ning et al., 2019) will further stress the need to adapt also the educational approaches taken.

An Institute of Higher Learning requested a course be developed which aimed to provide students with an understanding of the complexities and issues involved in the Internet of Things (IoT). The name of the Institute has not been divulged for ethical reasons. IT professionals need to understand what IoT is, how it works, what the potential of IoT is, and how to use IoT to improve business. The course was to examine the broad concept of IoT in business, the sensors and devices (the 'things') that make up IoT, how the data is gathered and analysed, how the 'things' are connected, how cybersecurity is handled, and where the components sit, and how to manage IoT projects and the change they create. The course was to conclude with students creating and presenting an IoT concept design that solves a problem, and is ready to prototype and test.

The IoT course was to use five approaches to ensure the student is active in constructing knowledge.

1. Supported learning – providing scaffolding and bite-sized chunks plus feedback. Providing students with readings.

2. Exploratory learning – students are encouraged to explore and discover new knowledge, to source videos.

3. Collaborative learning – students obtain multiple perspectives and critical thinking skills, and collaborate to produce presentations.

4. Problem based learning – students are encouraged to post problems, questions as well as answers on the topics.

5. Evidence Based Management (EBM) or practice, which uses four main sources of evidence: Scientific literature, Professional expertise, internal organisational data, and Stakeholders values and concerns. The EBM approach is Ask, Acquire, Appraise, Apply and Assess.

This led to the research question RQ4: How can the Course Development Framework be used to develop courses on emerging technologies?

RESEARCH METHODOLOGY

A research design methodology was used in the collection of the study data to develop and test a Course Development Framework. The research design choices were analysed using the methods Saunders et al. (2019) stipulated and depicted with the 'research onion' approach as a guide.

The research methodology explains the time horizon, research strategy, methodological choice, and approach. Furthermore, it explains the study's research philosophy. It continues to discuss the sample size and population, the research instrument, and the procedure of data collection as well as the validity. It then continues to cover some assumptions and finally discusses the study ethics. Figure 5 provides a summary of the research methodology.

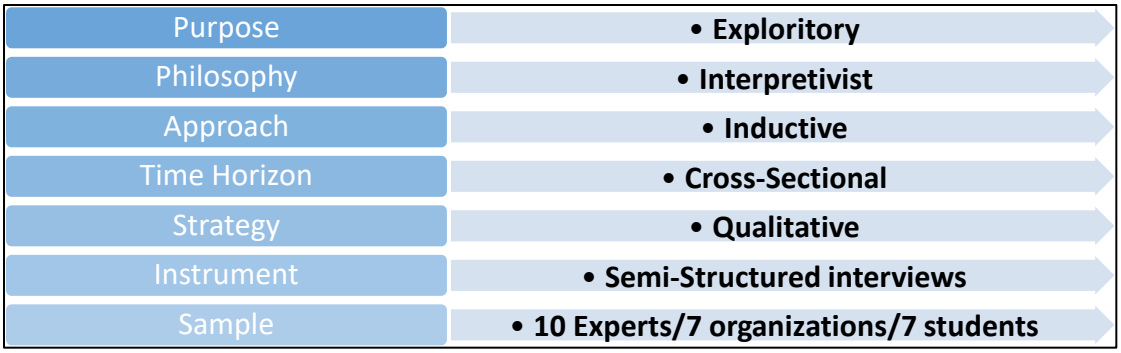

Figure 5. Summary of research methodology.

The research conducted a literature review to discover and explore learning theories, learning design methods, and models that would prove useful in developing a Course Development Framework.

To validate and test the framework, an IoT course was developed and delivered using the Framework.

The study was conducted only after consent was requested and received from the respondents. After approval and consent was received, data was collected by recording interviews using video chat services such as Skype, face-to face interviews, and email. The interviews were coded using qualitative data analysis methods to analyse the data inductively. The interviewee's behavior was also observed and noted where applicable.

The study used qualitative methods to gather information about past implementations and views about theories and frameworks as the respondents could discuss their experiences and provide insights.

The study chose an inductive approach as it is more flexible and can explore extra phenomena before making conclusions (Saunders et al., 2019). The respondents are skilled subject matter experts in education, Information Technology, and online education, thus each have possibly unique viewpoints based on their experience. Subject matter experts in Information Technology were approached from South Africa, Netherlands, Norway, and Germany. The sampling size was 10 respondents from 7 different educational organisations that have expertise in IT course development. Using the expert sampling method, the study could gather data directly from specialist individuals. The names of the respondents were omitted for ethical reasons and were replaced by pseudonyms. The sample could be kept relatively small as the subject matter experts have relevant expertise in developing IT courses, learning theories, and online pedagogy.

The research instrument (available on request) takes the form of semi-structured interview questions. The questions were formulated from the literature review to verify elements from a learning development framework perspective and discover if the research aligns with current industry perspectives.

Ethical permissions were obtained, and permission to conduct the interviews from each of the respondents.

The data gathered from the semi-structured interviews followed the six step approach of the thematic analyses defined by Clarke and Braun (2013). The thematic analysis approach is a method for identifying, classifying and examining the content in qualitative data (Clarke & Braun, 2013). Thematic analysis is useful when analysing data from a wide range of questions, experiences, and understandings. Furthermore, it is useful when working with large or small datasets across varying data types such as secondary data, transcripts, interviews and other text (Clarke & Braun, 2013). The six steps of the thematic analysis approach that the study used are shown in Figure 6.

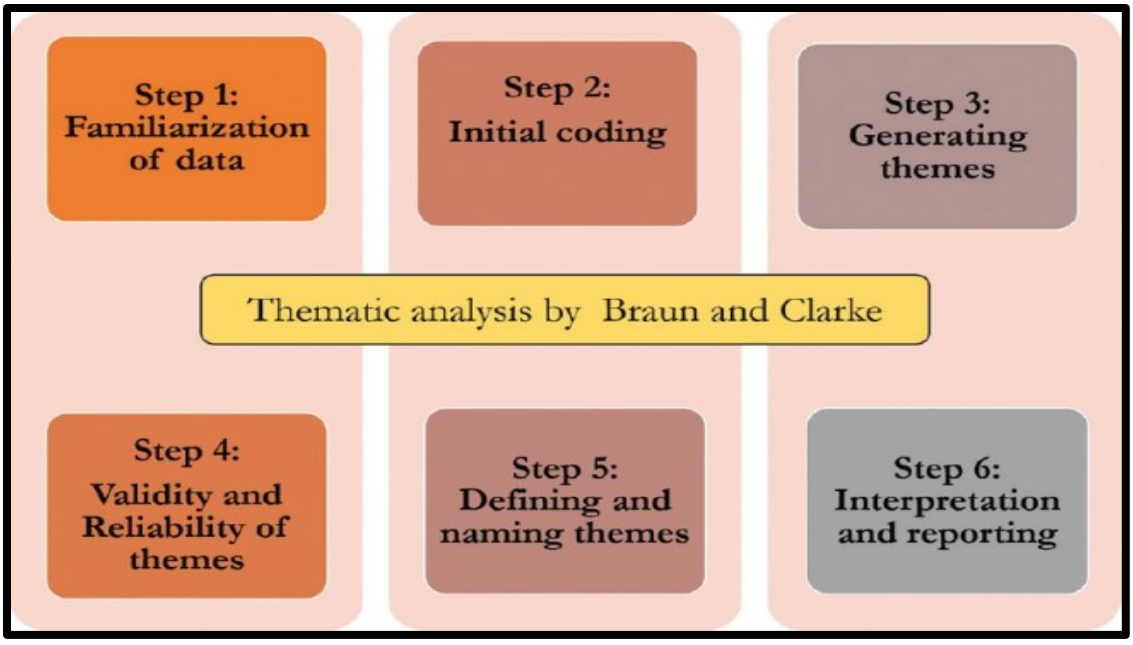

Figure 6. Thematic analysis (Eachempati, Kiran Kumar, & Sumanth, 2016).

At the coding stage the respondents' real names were omitted and replaced with pseudonyms, those starting with an S (Sam, Seb, Sue, Sara, and Saul) were from a South African organisation, respondents pseudonyms starting with an N (Noa, Ned, and Nora) were from a Norwegian organization, respondents from a Dutch organization started with a D (Dave), and respondents from a German organization started with a G (Gavin). Seven students (or learners) who completed the course responded with feedback, each was given a pseudonyms starting with L (Liam, Lucy, Luna, Luke, Levi, Leo, and Leah), comments from four of the learners were used in this report.

RESEARCH FINDINGS

The research questions RQ1 to RQ4 are discussed in two separate sections. The first section on RQ1 and RQ2 reflects the answers to the structured interviews with the academics. The following two sections on RQ3 and RQ4 give answers separately how to construct and how to apply the Course Development Framework.

LEARNING THEORIES IN DEVELOPING COURSES ON EMERGING TECHNOLOGIES

To answer RQ1 and RQ2 on the use of learning theories within the Course Development Framework both the literature review and the respondents results were taken into account.

The literature review identified several learning theories that could be used to develop courses, as Arghode et al. (2017) pointed out. One specific theory seemed to be especially suited for developing courses for emerging technologies, namely the constructivism theory (Scoppio & Luyt, 2017). Educational experts were interviewed with regards to learning theories and course design. The respondents had a wide range of opinions of which learning theories are used, if at all, and what constitutes a good course design process. These varied opinions can be put down to varied experience within given areas of teaching.

Within course design and development, seven out of ten respondents claimed to use some form of learning theory. The research findings from the respondents indicate that three specific theories were considered, namely, Activity Based Learning, Bloom's Taxonomy, and Constructivism. One respondent (Ned) said he uses "no theories, but close adherence to Brain Compatible Learning principles, BCL", however BCL is not a learning theory, but an educational approached based on neuroscience and the biology of learning (van Niekerk & Webb, 2016). The respondents' replies indicate that they might be using aspects of learning theories even though it is not explicit. Respondent Dave said that he does not use a theory, but he knows what works in his courses and what does not. "I don't use that. I just work with a structured course structure. I don't follow any particular method. It's a personal thing, but over the years you develop a feeling for what works in the particular area and in may of these theories is not applicable, especially in a field that is fairly new and where you are starting to discover what is important." Gavin said, "Although I am aware of several learning theories, I don't follow one, I rather use aspects of theories at various times. I can't believe that there is one theory which can explain how all individuals learn, I believe that each individual is unique and as such uses a blend of how to learn." Nora said, "the constructivism theory is a relevant view of reality,……the theory aligns well as I draw on previous knowledge."

When the respondents were asked to place a value on a scale of 1 to 5 (1 being not closely, 5 being very close) on how closely they followed a learning theory, the results in Figure 7 indicate that of those using a learning theory three respondents followed a learning theory relatively closely by selecting a rating of 4 out of 5.

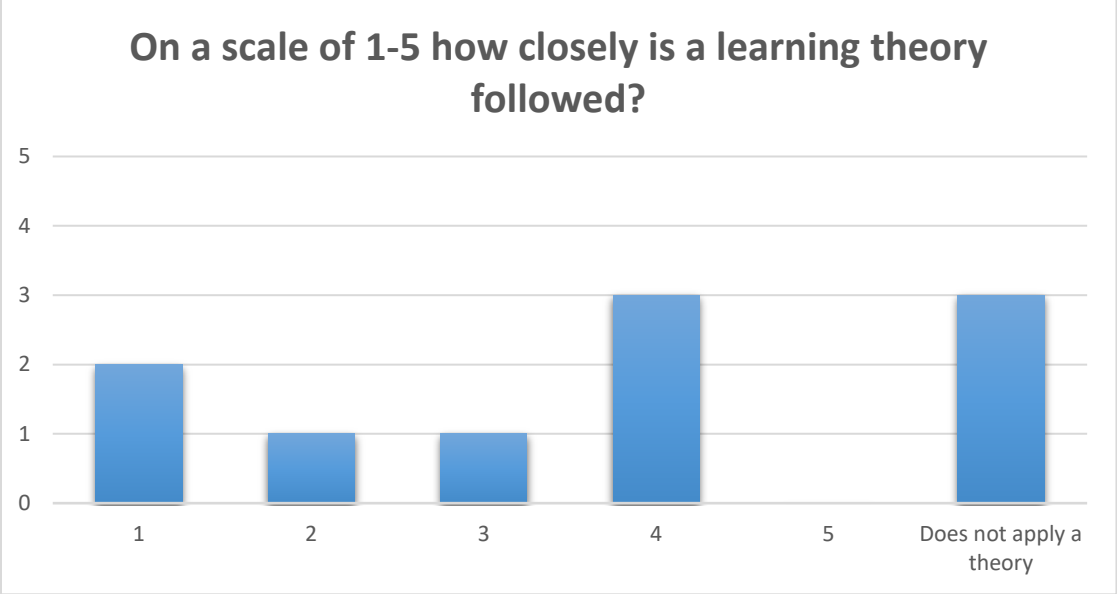

Figure 7: How closely are learning theories followed on a scale 1-5?

When inquiring why respondents follow or do not follow a learning theory, it was established that the lack of time and resources played a role when they did not use it. However, those that did use it mentioned that it plays a role in how the courses are developed. This is in line with the literature

reviewed on learning theories. Those who follow the learning theory indicated that it's a good indication of how to develop a specific course. Noa said "This is a good indication of how one should develop a course to fit the different purpose and group that one targets. This has a major input into the assessment criteria and delivery model."

The finding is quite noteworthy especially in relation to RQ2 in that by outlining how a student learns and acquires knowledge, a learning theory can be used as a guiding principle so that courses can be developed in such a way that aligns to the specific area of study. A learning theory for courses in emerging technologies, such as an IoT, can make use of the constructivist learning theory for example and can be very useful from a course design approach to establish the importance of what types of learning takes place. The types of learning that are especially useful to an IoT course is contained within constructivism (Harasim, 2012; Tan, 2017; Usher et al., 2015).

Saul stated that he used the Constructivism learning theory, this is in line with the findings that were discovered through the literature review for use with courses where the focus is significantly learner centric (Arghode et al., 2017).

However, even though four of the respondents said that they do not use a learning theory, many said that they might use elements of a learning theory without knowing it. Thus, it is probably fair to assume that the respondents have acquired a 'feel' for what works for the students, and thus unknowingly use elements of theories even though they don't align it to the specific topics, as stated by Dave, "you develop a feeling for what works". This could also indicate that using a learning theory to guide the overall design of a course is perhaps not as important as that of experience in course design and teaching.

RQ1 - Which learning theories could be useful as a basis to construct a framework for developing courses on emerging technologies?

Many learning theories could be used to develop courses such as behaviourism, cognitivism, connectivism and constructivism. However, choosing a fitting learning theory would enable the academic to better decide which types of learning activities and assessments to create.

RQ2 - Which learning theories would be best suited for developing a course for an emerging technology?

Regardless of the fact that only three respondents used constructivism this research has recommended that constructivist learning theory should be used for an emerging technology course such as an IoT course. Constructivism theory is a suitable theory for emerging technologies as it encourages active learning and builds on previous knowledge.

Design Models for the Course Development Framework

The original research question was: RQ3 - Which design models could be used to construct a Course Development Framework for courses on emerging technologies?

Both the literature review and the respondents results from the pre-framework questions were considered in answering this research question. When the literature review was conducted it became apparent that the ADDIE Instructional Design model was touted as very significant in the learning field (Budoya et al., 2019). When the respondents were asked if they have heard of the ADDIE model, surprisingly, four of the respondents had not heard of the model and only four had used the model as shown in Figure 8, one respondent declined to answer this question.

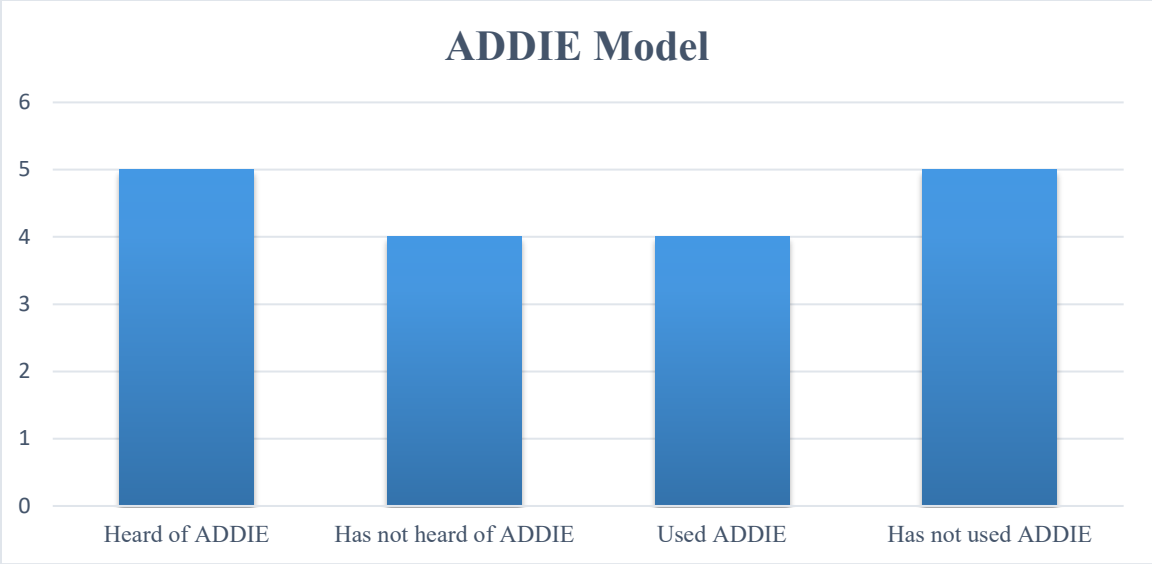

Figure 8: ADDIE Knowledge and use.

Sam said "One doesn't use one approach alone. I read a lot about teaching and learning….it's difficult to keep the motivation……I probably use parts of it but I don't use it in a formal manner. I may use aspects of ADDIE but I wouldn't necessarily follow it to the T." Gavin said, "Of course I know ADDIE, and of course I use ADDIE, it a very typical process, nothing special." Seb said he had never heard of ADDIE or ARCS models.

Through the literature review, it was discovered that ADDIE is an excellent instructional design model and still in extensive use with a valid design model (Cheung, 2016; Hess & Greer., 2016). For the reasons listed in the literature review, the ADDIE model was subsequently chosen as an Instructional Design Model for the Course Development Framework.

Although Bloom's taxonomy was not looked at when the literature review was first conducted, many of the respondents used Bloom's taxonomy, either as a learning theory or as a method to design learner outcomes or in a design process. Respondents that mentioned Bloom's taxonomy in the Pre-Framework interview included Noa, Sam, Saul, and Gavin. Sam said, "I use the Bloom Taxonomy most of the time and then that's also what I share with the class." Gavin said, "I use Bloom's taxonomy to develop learning outcomes at the beginning of designing a course, and when developing examination questions."

The researchers then conducted a literature review regarding Bloom's taxonomy and found that it could indeed be a valid and useful method to incorporate into the Course Development Framework to establish the levels of learning of the learning outcomes as a whole (Agarwal, 2019; Bertucio, 2017; Stanny, 2016).

The researchers discovered through the literature review that keeping the learner motivated is an essential aspect of developing successful instructional content (Keller, 2016; Khan et al., 2019). Similarly, motivation and keeping motivation high in courses resonated with the respondents as an important aspect and an issue. However, none of the respondents followed specific formal models or theories to motivate students in their learning or course creation.

The ARCS-V motivational model was identified in the literature review as a potentially positive model to introduce as an overarching motivational design in the Course Development Framework. When inquiring from the respondents if they had heard of the ARCS-V model or had used the ARCS-V model only two respondents had heard of the model, and no respondents had used the model at all. This could indicate that the ARCS-V model is not as popular as thought, or that the

respondents did not know about the model. However, given the experience level of the respondents and the high level of interest in the motivational aspect of learners, the researchers expected that the respondents would use some sort of motivational design or model in their course development. Further data from the interviews concluded that no respondents used any models or frameworks as a guide to motivate students. This finding is quite surprising when considering how high the importance of keeping learners motivated ranked with the respondents.

The following comments with regards to learner motivation were made by the respondents. Dave said, "….once they've lost interest it is very difficult to pick it up again," and "If you don't force them to do assignments to keep busy, they will tend to drop out." Sue said, "It depends on why the student is there doing the course, is it because they were told that they have to be there or because they are interested. Part of the motivation is why they are there in the first place." Gavin said, "I try to motivate students by providing facts, examples and stories. I try provide students with ideas to help them imagine their tomorrows". Noa said, "I like to motivate students by showing them a functional and practical use of every concept they learn. I try to make it relevant to them as individuals." Sara mentioned that they do not use a model, but that "Group work" or "Group activities" are used to help motivate learners.

The data from the answers toward the motivational model questions indicates that the respondents do not use motivational design models in the course design. However, the qualitative data analysis produced data that shows that it does not necessarily mean that there are no motivational elements included in the design. When theming the responses from the respondents and mapping it to the ARCS-V motivational model discussed by Keller (2016), the academics were describing elements of ARCS-V unknowingly, the responses showed that many of the respondents are indirectly considering elements of ARCS-V as necessary. The relevance of the course and keeping the attention of learners ranked highly when academics are designing courses, which was supported by the literature review and the discussion of the ARCS-V model (Keller, 2010, 2016). The finding is significant as this indicates that including the ARCS-V model into a course design framework would prove to be of use to academics and provide a positive impact. This led to the incorporation of the ARCS-V as a motivational model in the Course Development Framework.

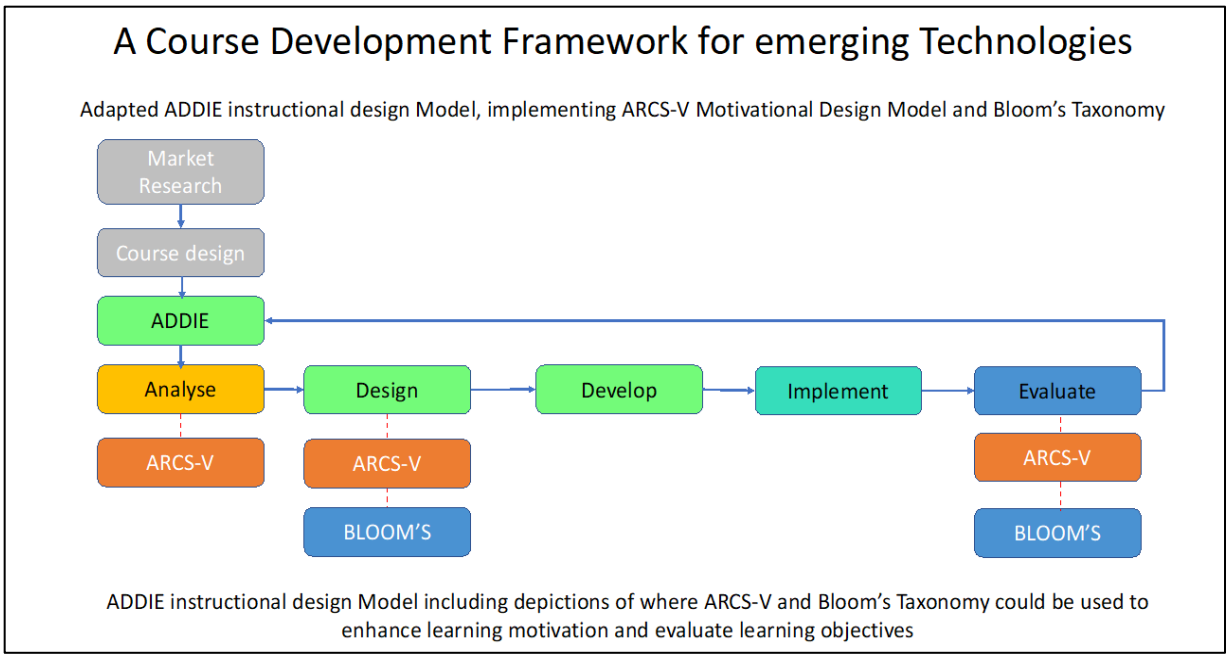

Figure 9: Course Development Framework for Emerging Technologies (van Wyk, 2019).

With the findings from the literature review and the feedback from the respondents it was found that there are a few established models and methods available for course design that can be incorporated into an Course Development Framework.

A relatively well used instructional design model, ADDIE, can be used to design a course, as it provides for the analysis, designing, developing, and evaluation of a course as discussed earlier. However, it lacks the motivational design elements that ARCS-V can provide. Motivational design elements proved to be an issue for the respondents as can be seen from the responses. The ARCS-V motivational model could be used in an Course Development Framework to provide motivational design elements. Furthermore, Bloom's taxonomy could be incorporated in the Course Development Framework as a method to evaluate the learning levels of the learning objectives as was discussed in the literature review. By using the answers a Course Development Framework was created as shown in Figure 9.

Analysis Phase

Figure 10 details the Analysis phase of the Course Development Framework. In this phase, a course designer should do a variety of activities, including: considering the relevance of the course (which emerging technologies or concepts will be delivered?), conduct market research (what are others doing, what is relevant to the industry or field?), consider the target audience and pre-requisites (age-group, education level, skills, admission requirements, career possibilities, etc), identify and gather relevant academic and research papers. Additionally, learner outcomes (purpose of course) and Learning Objectives of the course have to be defined, and module and assessment criteria defined.

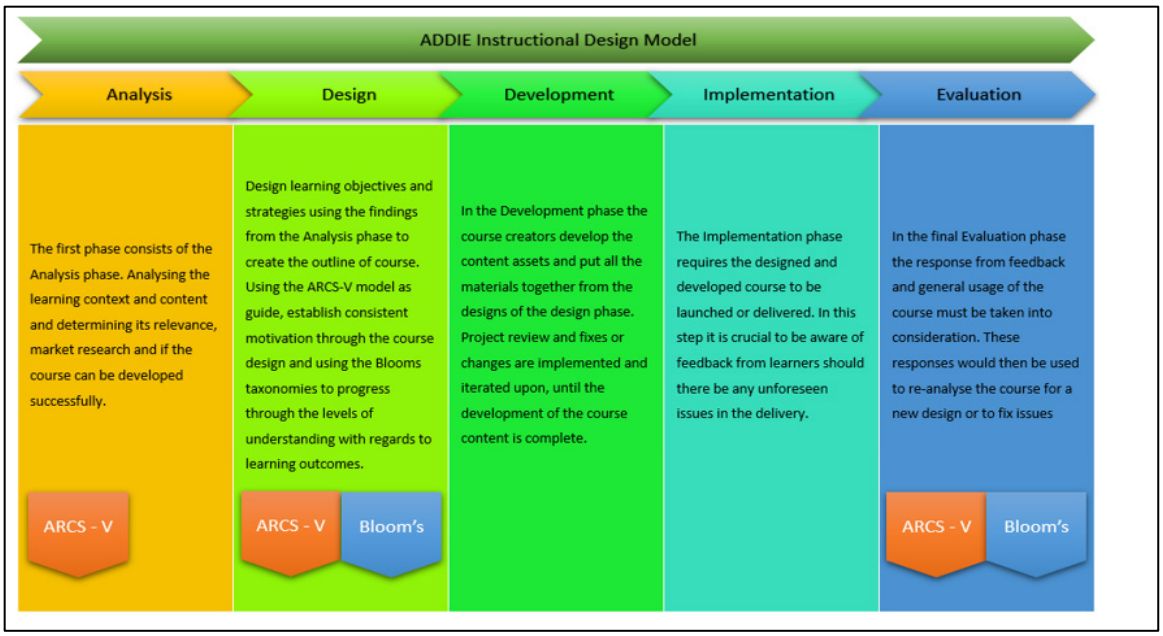

Figure 10: The Analysis Phase of the Course development Framework (van Wyk, 2019).

Design Phase

In the Design phase, academics need to develop the learning activities, assessment, and methods of delivery. In addition, they should develop the strategies on how to present the course material.

When designing the course, a learning theory and philosophy can be considered. Constructivism theory fits well for technologies, such as IoT, VR, AI, Robotics, Game Development, or 3D Design, since it encourages active learning. Choosing a fitting learning theory will enable the educator to decide which types of learning activities and assessments to create. The Design phase should be

developed by building in learner motivation by using the ARCS-V elements (Attention, Relevance, Confidence, Volition) as guide to see if each element of the course contains one of these aspects and all aspects in each module or lesson if possible. Bloom's Taxonomy should be used to design the learning objectives using ARCS-V to guide the motivational aspects of the course design.

Figure 11: Using ARCS-V in the Design stage of ADDIE (van Wyk, 2019).

Figure 11 shows a course designer how to use ARCS-V in the Design stage of ADDIE. In the Design phase of the Course Development Framework, a course designer needs to decide on IT requirements, platforms, systems, bandwidth, etc. for course delivery, facilitation, and student participation, taking user experience and accessibility options into consideration. Learning activities should be designed by using motivational aspects in learning (use ARCS-V to guide the motivational design). Learning objectives and assessment methods should be designed using Bloom's Taxonomy (Planning verbs), clear evaluation criteria need to be created and made available. Designers should consider designing interactive content (Attention, Satisfaction, Relevance), using short videos to grab learner's

attention, include examples that might be useful and relevant to the students. Frequent feedback should be provided (Confidence, Satisfaction). Appropriate assessments (Relevance, Confidence, Satisfaction) need to be defined, and Game-based learning considered (Attention, Confidence, Satisfaction, Volition). Ensure the learning activities use multiple methods of learning if possible, and reflect on the learning objectives from the learner's perspective and align the learning activities to them.

Development phase

Figure 12 shows the Development phase of the Course Development Framework.

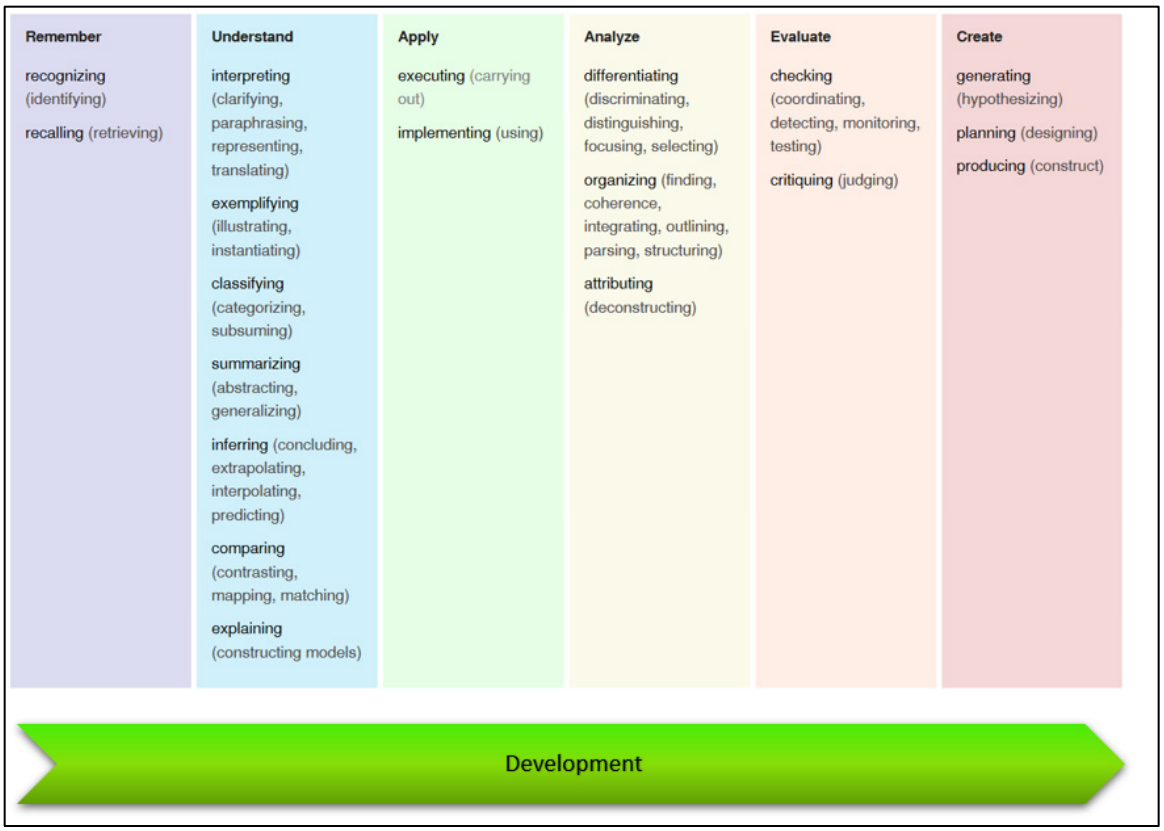

Figure 12: The Development Phase of the Course Development Framework (van Wyk, 2019).

In the Development phase of the Course Development Framework the academic analyses the needs of the learners by looking at the educational objectives of the course and designing the outcomes to align to the educational goals. The academic needs to develop activities and content that will help the learner improve performance. The content and activities need to be developed, and one must consider how it will integrate with the Learner Management System (LMS). When developing content consider the tone, readability and context of the writing style, and try develop interactive content. An academic should set up and develop social interaction areas.

Implementation phase

In the Implementation phase of the Course Development Framework, the learning material and activities are put into practice and the learners are given access to the course. This phase is an active involvement phase and the educator should be well prepared to deal with learner questions and issues. Use ARCS-V to check if initial analysis is correct. Use Bloom's taxonomy to check if learning outcomes and objectives are still in line with data from the Design phase.

Evaluation phase

In the Evaluation phase of the Course Development Framework, a course designer could assess if the course was successful and effective. It also identifies if there are any issues present and if any aspects of the course can be improved upon. The designer will then go through the Analysis, Design, Development and Implementation steps iteratively to improve the course. Look at ways to continually enhance the course. Collect data on learner engagement and activity (Did learners' access and start the course, where did they spending the most time and the least time)? Collect feedback from learners (Survey/Polls/Reflections) to determine satisfaction and performance of the course.

The Development of the IoT Course using the Framework

Research question RQ4 was, "How can the Course Development Framework be used to develop courses on emerging technologies?"

An IoT course outline was chosen to build a test case for the Course Development Framework as such a s course was requested by an institution. The Course Development Framework detailed in Figure 9 was used to build an IoT course. Figure 13 shows the Course Description for the IoT Course, including the topics or modules to be covered, and Figure 14 shows the overall assignments and grading values.

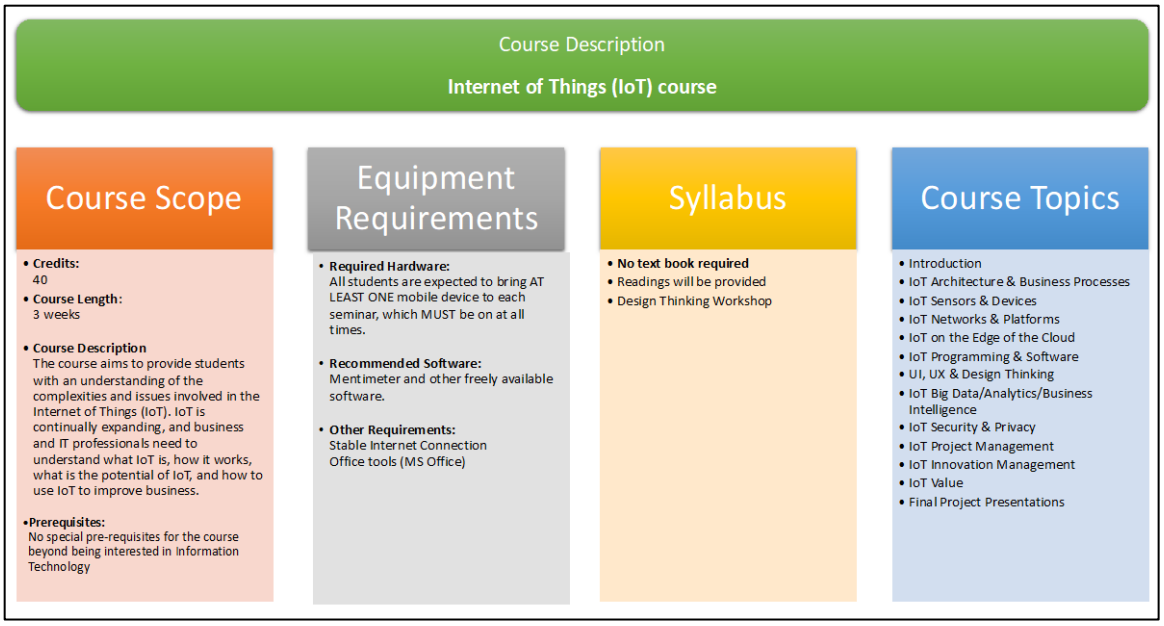

Figure 13. Course Description for the IoT Course.

Assignments		Grading Total Values
Participation/Answers/Questions in seminar		20%
Videos in Seminar		20%
Reflection		10%
Final Project Presentation		50%
Total:		100%

Figure 14. The assignments and grading values.

Figures 15 and 16 show two of the topics (modules 3 and 8) for the IoT course– obviously one would need need to build one for each module of a course. The blue blocks shows the Bloom's Taxonomy levels for each part of the Learning Outcomes, while the orange blocks show the ARCS-V criteria for each of the chosen activities, assessments and course content.

The mixed project-based approach that an IoT course required the need for a theory that can be used to draw knowledge from various different areas (Liagkou et al., 2019). Thus, the framework needed to make use of a learning theory that promotes an open approach to design interpretation as well as build upon previous knowledge gained as the student progresses through the course. Constructivism fulfils these requirements as discussed (Harasim, 2017; Jiang, 2019).

ARCS-V was used in combination with the constructivist theory and Bloom's taxonomy to develop a framework for an IoT course outline. The ARC-V motivational model was used to establish motivation as a fundamental guiding principle in the course outline. ADDIE has been previously used with the constructivist theory as shown in the paper by Trust and Pektas (2018); ARCS-V adds the required motivational elements as it allows for a motivationally aligned learning methodology while being flexible and focuses on learners. Bloom's taxonomy establishes the learning levels of the learning objectives.

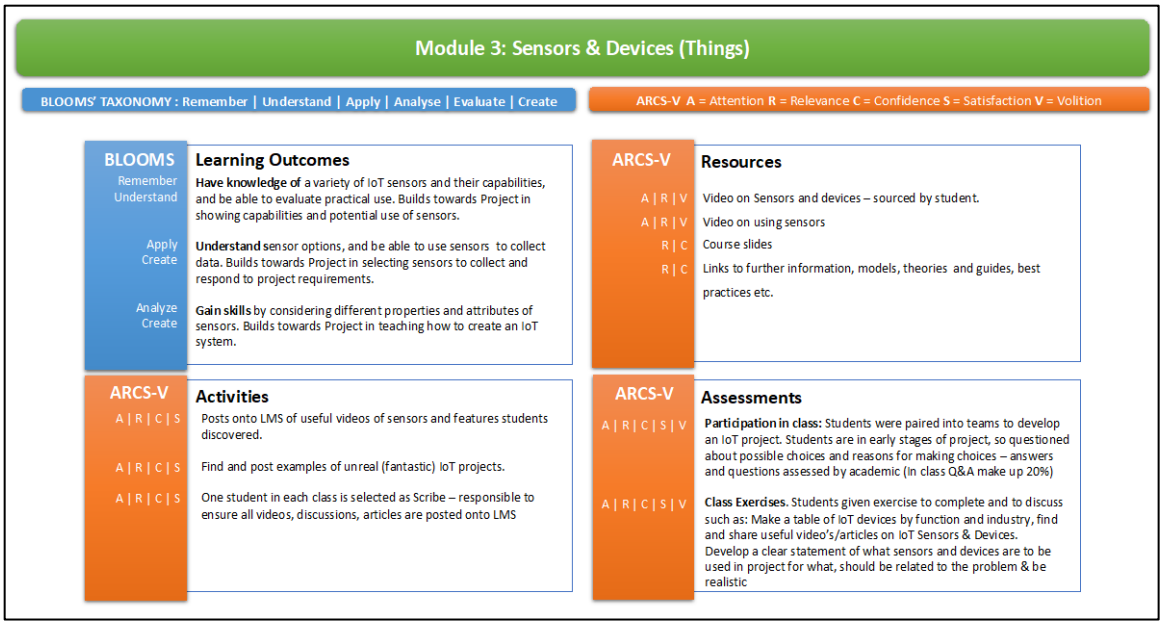

Figure 15. Module 3 of the IoT course.

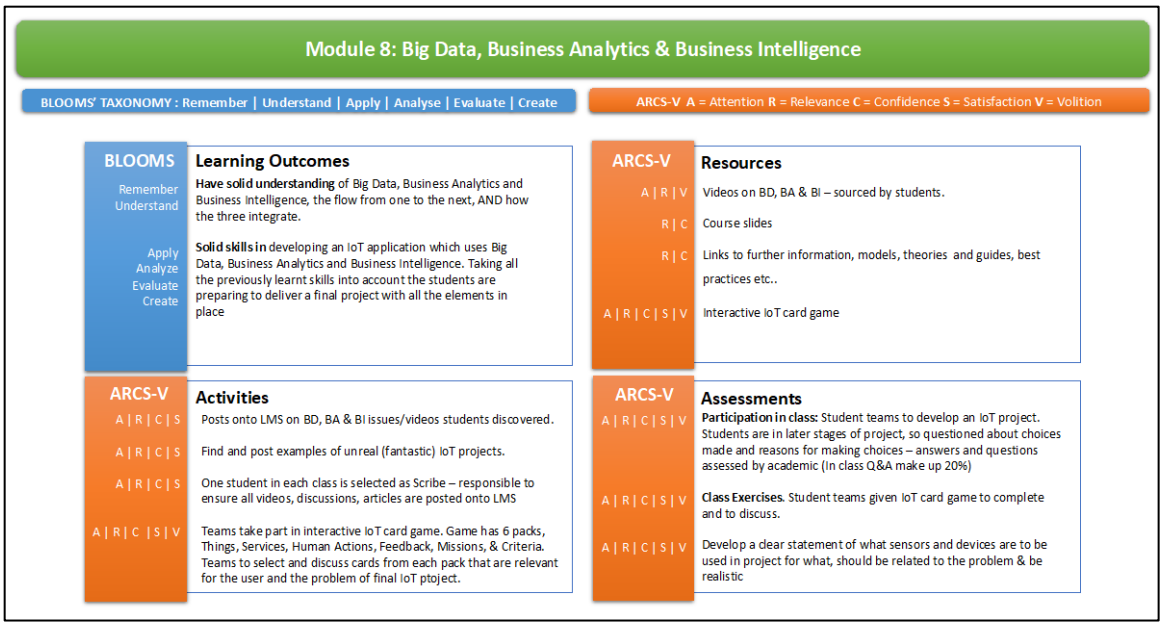

Figure 16. Module 8 of the IoT course.

Similarly to the ARCS-V model, the constructivist theory focuses specifically on learners. When considering the learner, the constructivism theory takes into account learners' previous experiences and knowledge around the subject (Juvova et al., 2015). The ARCS-V model emphasizes the learners' motivation and strives to engage by first grabbing attention, showing the relevance and instilling the confidence that is needed (Keller, 2010; Li & Keller, 2018). Building a course, the instructor needs to establish motivation as well as provide a non-rigid approach to the students' delivery of activities. The course activities should provide a choice of themes or ask the students to choose their own ideas as a development project and in doing so, provide satisfaction by seeing their ideas brought to reality through the coursework (Keller, 2016; Trust & Pektas, 2018).

The course design for the IoT course began by describing to students what the course will cover, what the students can expect, and what the students are expected to deliver. Using examples that bring the previous experience into consideration, the academic developed activities that show how the learning made use of existing skills (Arghode et al., 2017). The material clearly pointed out the learning outcomes that students will accomplish by participating in the learning material and activities (Czerkawski & Lyman, 2016).

Responses from Students

As part of the course students were expected to submit a reflection piece (maximum 250 words) a maximum of a week after the final lecture.

Liam stated that the course taught him to "Never stop asking questions. …I have unfortunately often neglected to do this." Lucy agreed, "I learned to ask without any hesitation."

Lucy commented about IoT as follows, "Maybe I knew how the all thing worked but I realised more about it in the class," and Luke said, "I learnt many new things and I found the course really beneficial for my career." Luna said, "This course really helped me to gain perspective about IoT in overall. … I learned much about IoT and IoT applications."

Luke stated, "The methodology COLLECT, CONNECT, ANALYSE, ACT gave me the key strategy to work on any project and in any environment." Lucy added, "I realised more about it in the class that everything you do in projects, class, work or life it's almost to collect information, to connect them, to analyse them and then act on them."

Liam said, "The class exercise which we did, it showed me, that by exchanging your ideas with others will lead you to some greater and better ideas." Lucy commented, "By giving us a small project to encourage us to think about new ideas the way IoT can work further."

Luna said, "This course really helped me to gain perspective about IoT in overall," and "I gained perspective about IoT in an interactive way." Luke added, "This course helped me out to understand the broader aspects of IT and internet of things with real picture (discussion) and real examples with analytical thinking and scope in future.

Luna said, "The course changed my opinions about DATA as I always thought the data analysis are kind of useless thing in today's world but I realised that data management gives you real information to act and helps the person to identify problems, making decisions and bringing in new criteria."

There were supringly few negative comments, although students were asked to list both positive and negative comments. Lucy said, "Class afterwards were not that enthusiastic as the first ones," Liam said there were "to few classes, more of such classes are more beneficial."

CONCLUSION

On the outset of this research study, the aim was to discover if a useful Course Development Framework could be developed that would support academics in the development of courses for emerging technologies.

Through the literature review it was discovered that learning theories could play a significant guiding role in the development of courses. However, the study found that academics don't explicitly use learning theories when developing courses and that this was attributed to academics feeling that having developed courses, they had a 'feel' for what works and what does not. This study found that constructivism is well suited for emerging technology courses because of the nature of building on previous knowledge and putting the learner at the centre of the learning experience.

The ADDIE instructional design model was found to be relevant and well suited for course development. It was found that academics do not use motivational models in their course design, but that they once again use the experience to guide them as to which aspects would guide learners and keep them motivated. This research found that the ARCS-V motivational design model is an excellent model to use as a guiding model for designing motivational elements into a course. This was especially valid and useful when using motivational elements at each stage of the ADDIE design process, as this could be used as a check to add attention, relevance, confidence, and volition driving activities and content to the Course Development Framework. Through this research it was discovered that Bloom's taxonomy was useful in guiding learning outcomes, as academics used Bloom's quite extensively when developing courses and often used, perhaps mistakenly, as an instructional design model.

A Course Development Framework was developed by discovering what learning theories were useful, as well as which models and methods could be used. The Framework combined the ARCS-V motivational model and Blooms taxonomy with the ADDIE model to develop a Framework that can guide academics when creating a course for emerging technologies.

Future research could be conducted in the effectiveness of using the Course Development Framework to test other courses on emerging technologies.

Research in the field of Brain Compatible Learning Principles and combining or using it with the Course Development Framework could provide further insights into advancements in course design and development.

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BIOGRAPHIES

Norman van Wyk is an online teacher at Noroff University, Norway. Norman has worked in a variety of multi-disciplinary fields which allowed him to combine his knowledge in digital learning, instructional design, cyber security and interactive multimedia in a multitude of projects and environments. Norman is actively involved in education, virtual reality, serious games and information technology. Online education and research is a passion of his and he would love to see online learning technology open doors to a brighter future for many, no matter where they are in the world.

Kevin Johnston is an Emeritus Professor and former Head of Department of the Department of Information Systems at the University of Cape Town, South Africa, and a visiting Professor at the University of Pforzheim, Germany. His principal research areas are ICT strategy and management, IS educational issues, Social and Networking systems, Emerging technology, and Entrepreneurship.

Dr.-Ing. Klaus Möller is Professor for Distribution Logistics in the Business School at Pforzheim University, Germany. He has 20 years of teaching experience in higher education in international universities and is actively conducting research in Supply Chain Management and Applied Information Systems in Logistics, in particular in Warehouse Management Systems.

Dr. Florian Haas is Professor for Purchasing and Supply Management at the Business School of Pforzheim University, Germany. He has more than 15 years of experience in Supply Chain Management. Amongst others he was responsible for the implementation of a central sea and air freight transport management at Bosch and cooperated with ocean carriers to pilot the application of blockchain technology for sea freight transports.

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Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

A DECISION SUPPORT SYSTEM FOR PRICING AND MINIMIZING PRODUCT RETURNS

Yahel Giat*	Jerusalem College of Technology, Jerusalem, Israel	yahel@jct.ac.il
Dan Bouhnik	Jerusalem College of Technology, Jerusalem, Israel	bouhnik@jct.ac.il

* Corresponding author

ABSTRACT

Aim/Purpose	The first goal is to develop a decision support system for pricing and production amounts for a firm facing high levels of product returns. The second goal is to improve the management of the product returns process.
Background	A food importer and manufacturer in Israel with a significant product returns rate.
Methodology	A decision support module was added to the plant's information system. The module is based on a supply chain pricing model and uses the sales data to infer future demand's distribution. Ergonomic models were used to improve the design of the returns warehouse and the handling of the returns.
Contribution	The decision support system allows to improve the plant's pricing and quantity planning. Consequently, it reduced the number of product returns. The new design of the returns process improves worker's productivity, reduces losses and results in safer outcomes.
Findings	The results show the promise of incorporating pricing supply chain models into informing systems to achieve a practical business goal.
Recommendations for Practitioners	This work can be replicated for different suppliers, manufacturers and retailers that suffer from product returns. They will benefit from the reduction in returns, as well as the decrease in the losses associated with these returns.

Accepted by executive review by Editor Michael Jones | Received: December 28, 2019 | Revised: January 27, 2020 | Accepted: January 28, 2020.
Cite as: Giat, Y., & Bouhnik, D. (2020). A decision support system for pricing and minimizing product returns. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 47-59. Informing Science Institute. https://doi.org/10.28945/4522

Recommendations for Researchers	It is worthwhile to research whether decision support systems can be applied to other aspects of the organizations' operations.
Impact on Society	Product returns is a lose-lose situation for producers, retailers and customers. Moreover, mismanagement of these returns is harmful for the environment and may result in the case of foods, in health hazards. Reducing returns and improving the handling improves sustainability and is beneficial for society.
Future Research	The DSS's underlying pricing model assumes a specific business setting. This can be extended using other pricing models and applying them in a similar fashion to the current application.
Keywords	supply chain, pricing model, Israel, food industry, product returns, decision support system, ergonomics

INTRODUCTION

Information systems have many important roles in complex business environments, ranging from simple information-keeping to complex analysis and decision making. In this paper, we describe an in-house upgrade that transformed a basic marketing and sales information system into a decision support system (DSS) for the control of product returns by determining the sales quantities and prices and the onsite warehouse management of these returns.

This system was developed in a midsized food manufacturer and importer in Israel (henceforward, the manufacturer). The manufacturer imports, produces and markets almost a thousand different product types ranging from legumes, grains, spices, dry fruits, candies and packaged snacks. Its annual sales are near 150 million NIS (approximately 45 million USD) and operations are conducted in a single facility. Distribution to the retailers is generally done by the manufacturer's own fleet of trucks. Many of its items are seasonal and correlate with the Jewish holidays and therefore workload and sales, fluctuate throughout the year. The manufacturer is unique in that it is very popular among the religious population in Israel who demand that all its products are Kosher-certified (see, Giat, 2018 for considerations about certification). The religious population in Israel has a small per capita purchasing power compared with other population segments and therefore, retailers in this market face fierce competition with small profit margins. Returns are a very costly component in this market (Reagan, 2016) and, therefore, minimizing these costs is of outmost importance to the manufacturers and the retailers alike.

For our manufacturer, the main source of returns is the manufacturer's policy to ship the retailer any amount that the retailer demands even though it is quite likely that the retailer will be unable to sell it. As part of the deal the manufacturer guarantees the retailer that it will accept any returned amount. The producer's reasoning behind this sales scheme is to gain as much presence in the retailer's shelf space in order to attract as much market share as possible.

For many types of products, however, there is no such advantage to the manufacturer. These are mainly products that only the manufacturer produces and, therefore, does not face competition from other manufacturers. Since, however, the agreement with the retailer about accepting back any amount that it wishes to return is still binding, the only way to reduce the retailer's order size is by employing pricing schemes that will cause the retailer to order the optimal amount. The first goal of this study is to implement such a scheme in the manufacturer's information system.

The second goal of this study is to redesign the facility and the operations of the returns process. Regrettably, the current managing and handling of the returns is inadequate. This mismanagement results in monetary losses not to mention the potential for health hazards if spoiled foods are returned to the market. We use ergonomic methods to redesign the facility in which returns are received and handled and implement procedures on how they are to be handled.

LITERATURE REVIEW

We use a supply chain coordination model that is described in Cachon and Lariviere (2005) to calculate the optimal prices and quantities. They show that the competition between the supplier (or producer or manufacturer) and the retailer leads to losses to all the parties involved including the customers. They explain that to eliminate these losses and achieve the optimal solution the supply chain must be coordinated. They analyze a few models that achieve this goal. The two main schemes are revenue sharing and buyback.

The revenue sharing scheme is when the retailer and the supplier contract to share revenues from customers and was famously applied by Hollywood studios and the video chain Blockbuster (see Warren & Peers, 2002). Recent research in these types of contracts includes Hu and Feng (2017), Hou et al. (2017), Gamchi and Torabi (2018), and Gerchak and Schwartz (2018).

Buyback contracts dictate that the supplier agrees to purchase back from the retailer some or all the quantity that the retailer was unable to sell, thus mitigating the classical "newsvendor" problem (Arrow et al., 1951). Recent research about buyback supply chain coordination models include Adhikari (2016), Duc et al. (2018), and Sainathan and Groenevelt (2019).

One of the variants of the buyback schemes is the supplier agreeing to buy back at the full wholesale cost part or all of the unsold items. The agreements are prevalent in the retail business and as a result many suppliers deal with a large returns volume. Rogers et al. (2002) presents an overview of the returns' management process and Mollenkopf et al. (2007) provide a supply chain logistics perspective to this managerial challenge. The returns problem is an important component of the field of reverse logistics (see Dekker et al., 2013, and Srivastava & Srivastava, 2006) and the more recent term "closed-loop supply chain", which also deals with broader issues such as waste management, sustainability, end-of-life, cannibalization (e.g., Dreyfuss et al., 2018) and repair (e.g., Dreyfuss & Giat, 2017, and Dreyfuss & Giat, 2018a). Recent reviews of the field are Govindan, Soleimani, and Kannan (2015), Govindan and Soleimani (2017), and Wang et al. (2017).

The supply coordination models assume there is information sharing between the supplier and the retailer. In fact, this information sharing is essential to mitigate many types of supply chain disruptions. For example, the "bull-whip effect" (also known as the Forrester effect), is a phenomenon in which small fluctuation of demands tend to amplify as they move up the supply chains (Forrester, 1961; Lee et al., 2004). Information sharing is key to mitigating the bull-whip effect. A famous example of this is Grean and Shaw's (2002) description of the successful relationship between Proctor & Gamble and Wal-Mart. Information coordination and sharing between these corporates was key to their successful relationship and to the elimination of the bull-whip effect.

Information systems for business management are known as ERP (Enterprise Resource Planning) systems and cover the whole scope of the business operations (see Jacobs, 2007; Soh et al., 2000). The disadvantage of "off the shelf" ERP systems (by vendors like SAP, Oracle, Microsoft and others) is that they may not address the specific idiosyncratic needs of the business. Moreover, businesses' needs are not only complex but rapidly changing requiring numerous updates and special software patches to address these complexities and changes. Consequently, many businesses opt to develop their ERP system in house so that they are tailored to their specific needs and requirements (see a similar approach with government websites in Bouhnik et al., 2013). Another advantage of in-house development is the ability to install investments, thus expending the costs only when it is profitable to do so (Giat, 2013).

Another advantage of developing in-house systems is that the user of these systems knows best what tasks must be achieved. This is crucial for any successful informing system, as Cohen (1999) points out that "the driving force behind the creation of informing environments and delivery systems is that a task needs to be accomplished" (page 217). In the case of a for-profit business enterprise the

required tasks are very complex and therefore require sophisticated informing systems. See more on the relationship between task complexity and informing systems in Gill (2006).

In our particular case the informing system is required to help decide prices and quantities. As such, it also serves as a decision support system (DSS). There are various ways to model such systems (e.g., Aggarwal, 2001) and they are used in a wide array of applications (e.g., Cornforth et al., 2014; Dreyfuss & Giat, 2018b; Mbugua & Suksa-ngiam, 2018).

To organize the returns warehouse in the factory, we employ methods from the field of ergonomics. This field of research combines human factors with operations, engineering and design and is overviewed in many publications, including Sanders and McCormick (1993), McCauley-Bush (2011), Salvendy (2012) and Stanton et al. (2017). Of interest to this paper is Wilkinson and Aerodrome (1992) who develops a design methodology that uses an analysis of operational procedures and requirements for the design of a fighter jet cockpit. Although their model was developed in the military aviation context, it is in fact generic and can be applied to other domains. Badihi and Trabelsi (2016) extend Wilkinson's and Aerodrome's model in their model for an ergonomic design and organization of operations. Their model details many aspects of the mission and the user profiles and then uses this information for a detailed design of the workplace physical and operational structure.

THE INFORMATION SYSTEM

The information system contains two modules:

1. A database that stores all the sales and returns data.
2. A decision support system that evaluates the sales data and makes specific recommendations.

Sales and return data are the information generated along the sales-returns process. This process comprises a number of steps:

1. Determining the amounts and prices through negotiation with the retailer.
2. Distribution to the retailer. This is done by the manufacturer's trucking fleet.
3. The retailer gives the manufacturer's driver the returns
4. Returns' management within the plant. This may result in discarding, repackaging and/or reselling,

DATABASE

The information generated during the sales-returns process is recorded in the database. It serves many purposes such as for general accounting, determining performance of the sales marketing/sales agents and so forth.

The database includes two main modules:

Sales module – Includes screens updating the sales of the different products. It records the salesperson who made the deal, the retailer, amount, prices and other relevant information.

Return's module – Includes information regarding the returns. Who initiated the return, reason for return, retailer details, driver that delivered it back, the person in charge in the returns facility in the plant, what corrective actions were taken, was it resold, and so forth.

As with any database it is imperative that the user interface is as friendly as possible. This is especially true in this particular project in which the users speak different languages (only part of the employees are native Hebrew speakers, whereas the others are either Arabic speakers or Russian speakers). Moreover, the computer skills of the prospective users are varied. Many of the employees (especially

the drivers and those receiving and handling returns in the facility) have a very basic level of education (some did not even graduate high school) and their digital literacy may be minimal.

The importance of information that is stored in the database goes beyond its accounting value and is used as a critical source of input for the DSS module. It provides the data needed to determine the consumer demand, which is necessary for the supply chain pricing model that determines the recommeneded prices and amounts. To show how this is done we first describe the pricing model.

THE PRICING MODEL

At the heart of the DSS is the supply chain model described in Cachon and Lariviere (2005). This is a simplified supply chain that comprises two stages; the supplier and the retailer. Each of the stages is monopolistic (i.e., single supplier and single retailer). The supplier sells to the retailer at the wholesale price, denoted by w, and the retailer sells to customers at the customer price, denoted by p. Demand is stochastic and is assumed to be D (D is a random variable) with a known distribution. See Figure 1 for a schematic overview of the supply chain. The supplier has a marginal production (or import) cost, c_s. In our plant, these costs could be manufacturing costs (for items manufactured in the plant) or purchasing costs (for imported items) in addition to the packaging, shipping and handling costs. In the more general case, costs need not be linear with the amount of production (or import). However, after consulting with the operations and finance staff it was agreed that a constant unit cost is a good approximate for the true costs. The following derivations are basic economic theory and are provided to introduce readers that are not from the field to the basic concepts.

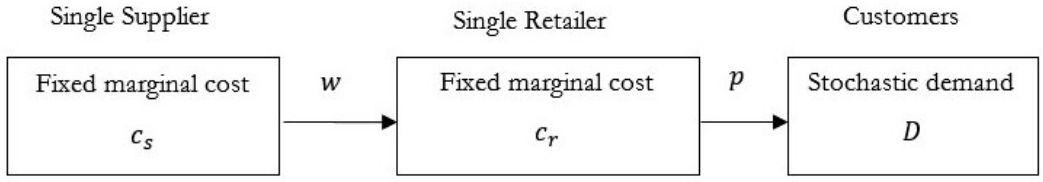

Figure 1: Supply chain structure

The plant and the retailer are separate entities and are (currently) not coordinated, therefore, each party's goal is to maximize its own profits. More precisely, they are assumed to be risk-neutral and therefore their goal is to maximize their expected profits. Their actual decisions, however, are different. Whereas the supplier determines the wholesale cost, the retailer responds with ordering the amount that will maximize its expected profits' given by

$$E[\pi_r(q)] = E[pMin\{q, D\} - wq - c_r q]$$

In the profit function, the revenue is the customer price, p, multiplied by the amount sold, which is the smaller of the quantity that the retailer ordered, q, and the realized demand, D.

Anticipating this, the supplier will carefully set the wholesale price and the amount (w, q) to maximize its own profit, given by

$$\pi_s = wq - c_s(q)$$

To derive equilibrium outcome, we begin with analyzing the retailer's best response (i.e., the quantity that maximizes its profit) to the wholesale price, w.

$$\max_q E[\pi_r(q)] = E[pMin\{q, D\} - wq - c_r q]$$

$$= pE[Min\{q, D\}] - (w + c_r)q$$

$$= p[\int_{-\infty}^{q} f(D)DdD + \int_{q}^{+\infty} qf(D)dD] - (w + c_r)q$$

If, for example, we assume that demand is distributed uniformly between a and b (i.e., $D \sim U(a,b)$), then $E[Min\{q,D\}] = \frac{1}{b-a}(-0.5q^2 + bq - 0.5a^2)$, and the retailers optimization problem is

$$\max_q \frac{p}{b-a}(-0.5q^2 + bq) - (w + c_r)q.$$

The first order optimization condition is

$$\frac{-p}{b-a}q + \frac{bp}{b-a} - w - c_r = 0$$

That is, the retailer's best response is $q = b - \frac{(w+c_r)(b-a)}{p}$. From the supplier's perspective, the retailer's demand follows

$$w = \frac{p(b-q)}{b-a} - c_r$$

Anticipating this response, the supplier optimization problem is

$$\max_q \pi_s = wq - c_s q = \left(\frac{p(b-q)}{b-a} - c_r\right)q - c_s q$$

and therefore, the equilibrium quantity that solves the supplier's problem is: $q = \frac{b}{2} - \frac{(c_r+c_s)(b-a)}{2p}$

In the above we assume internal solutions (which obviously depend on the parameter values). The problem with this equilibrium solution is that it is suboptimal for the supply chain as a whole. One can easily show, that to optimize the total (retailer and supplier) profits then the optimal quantity is $q_M = b - \frac{(c_r+c_s)(b-a)}{p}$, which is double the equilibrium quantity of the uncoordinated supply chain. Assigning this to the profits reveals that the total supply chain profits are 4/3 times higher than the sum of the profits of the retailer and supplier in the uncoordinated supply chain. Therefore, if the supplier and the retailer could agree to cooperate optimally, they could not only each earn more profits, but also provide more benefit to the customers, which will purchase more at a lower cost.

One model that coordinates the supply chain with this goal in mind is the buy-back model in which the supplier agrees to purchase back all the unsold items for price B. Without the coordination, the retailer bears all the risk (that demand will fall short and she will be unable to sell all her order) and therefore the retailer is inclined to purchase suboptimal amounts. Since risk is non-linear, when the supplier shares part of the risk with the retailer, the total negative effect of risk is lower, allowing both parties to gain.

For this model to obtain optimal coordination the relationship between the buyback price and the wholesale price must follow $w = c_s + B(1 - (c_r + c_s)/p)$. The specific values of B and w determined how profits are divided between the retailer and the supplier.

We note that the equations above are for the uniform demand case. Similar techniques are employed for other distributions. We refer the interested reader to Cachon and Lariviere (2005) for more details about the buyback contract model as well as other models for supply chain coordination.

DESCISION SUPPORT SYSTEM

The purpose of the DSS module is to assist managers with the task of making pricing decisions and deciding on production and import amounts. To do so it uses sales data from the IS's database module as input for the pricing model that was described in the previous section as follows. The information's support system's general structure is given in Figure 2.

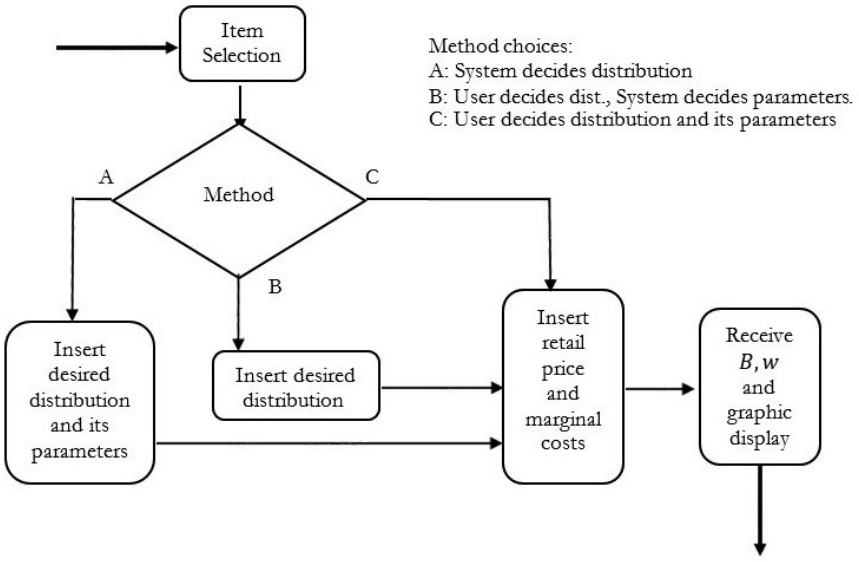

Figure 2: DSS pricing schema

For example, a few months before the holiday seasons, managers negotiate with major retailers (this is frequently done with the store's procurement officer, even with stores that are part of a major chain) the amount they will ship to them as well as the wholesale price.

The pricing model's output crucially depends on the customer demand function (see in detail in Section 'The Pricing Model'). Therefore, to determine the optimal price and amount according to the economic model it is necessary to determine the expected demand distribution. The system offers three ways to do this.

1. The system determines the distribution based on past sales.
2. The user sets the general distribution and the system find the distribution's best parameters based on past sales. For example, the user may decide that demand is Normally distributed whereas the mean and standard deviation are determined by the system.
3. The user determines the distribution in full. For example, the user could set the distribution as Normal and set the mean and standard deviation.

In the second and third schemes, the user may choose any one of a given menu of distributions. The basic menu includes the Uniform, Normal and Exponential distributions. When needed, adding other distributions can be done very easily by the system's maintenance team.

In the second scheme, the system determines the distribution's parameters by matching the first moments (as many as necessary). For example, if a Normal distribution is desired, then the system uses past data to compute the average past sales and its variance. These are then used as the parameters of the distribution.

In the third scheme the user determines both the distribution and its parameters. This can be used when there is insufficient historical sales data or when the user feels that past sales are irrelevant to determining future sales.

Once the demand distribution has been determined the system provides the recommended prices.

RETURNS MANAGEMENT

The purpose of the DSS is to improve the returns process. In our examination of the factory's returns handling we found four main problems in the management of the returns:

1. There is deficient documentation and classification of the returned item when taken from the retailer.
2. Responsibilities are not defined clearly. This lack of responsibility frequently leads to things slipping through the cracks instead of being handled efficiently.
3. Frequently, the sales agents do not fill the returns reports and therefore returns may arrive to the returns warehouse without any additional information. As a result, the returns' department employees struggle to determine the problem and what exactly should be done with the returned items.
4. Many times, the distribution truck drivers do not verify that all the items listed in the returns form are present in the returns' pallet by the retailer. As a result, there is a mismatch between the listed inventory and the actual inventory that arrives to the returns warehouse.
5. The returns warehouse itself was unorganized and disheveled. Boxes continuously arrived and were piled in a very unorderly manner. Warehouse employees randomly opened boxes and started sorting its contents to determine what to do with each item. They then created new piles of items according the items' designation. Examples for these designations are discard, repackage, relabel, reprocess and "to be determined".

To improve the returns management, a "Returns Management" module was designed and added to the information system. In addition, the returns operations were reformulated to all the workers along the supply chain and a new physical layout of the warehouse was designed.

RETURNS WAREHOUSE DESIGN

As explained above, the current state of the warehouse is a great source of inefficiencies. For its redesign we first describe the mission and user profiles.

MISSION PROFILE

The mission is defined as: Treating returns beginning with their arrival at the plant, the determination of what actions need to be done and the execution of these actions.

Scope: From the moment the truck carrying the returns enters the plant's gates until the treatment of each of the items has been completed.

Mission activities:

1. Truck arrival and the unloading of the merchandise.

2. Verifying actual amounts match the amounts listed on the returns form.

3. Bringing the returns to the warehouse and classifying them as either for reuse or for disposal.

4. Handling any product as determined in the previous step.

Activities and expected results:

Each activity (and its corresponding expected result) is graded by a criticality index (CI), with CI=5 indicating very critical and CI=1 indicating least critical).

1. Activity 1: All the products that the retailer wants to return have indeed arrived at the plant. CI =5. Without the completion of this activity the other activities could not be executed.
2. Activity 2: The returns are unloaded off the truck into the warehouse. CI =5. Without the completion of this activity the other activities could not be executed.
3. Activity 3: The store's declaration of returns matches the actual returns. CI=3. It prevents fraud and losses but does not prevent other activities to be executed.

4. Activity 4: Each product fits into one of the classification categories. CI=4. Items that are unfit for consumption must not return to the marketing chain.
5. Activity 5: Each product was handled according to its category. CI=5. Saves money and prevents health hazards.

Possible failures:

1. Leaving the returns on the ramps instead of immediately bringing them into the warehouse.
2. Misclassification of the returns.
3. Products wait for too long until they are handled.

Health and safety:

1. Products left outside for too long may degrade (long-term effects).
2. Classification of unfit products as fit for consumption (immediate effect).
3. Health hazard for employees working in unfit conditions (sitting on the floor or on unstable boxes).

Activities' order:

The activities must be executed consecutively (from Activity 1 to 5). Each activity requires that the previous activity has been completed and therefore there is no flexibility in their order of execution.

Other consideration:

Weather: Rainy days in the winter and hot days in the summer are especially harmful to the returns.

Seasonality: Following the holidays there is a very large volume of returns that requires more than the usual operation hours.

USER PROFILE

Psychophysiological skills: Most of the activities do not require any special skills. Incoming packages may be heavy and surpass 30 kg. Fine motor skills are required for handling smaller items.

Mental skills: The activities do not require advanced memory ability or information processing. The main mental requirement is the ability to classify produce using one's own judgment.

Professionalism: The activities require professionalism. Errors in judgment or in execution can result with health hazards and losses.

Language skills: Most of the communication is between the employees of the return's room and with their supervisors. Most employees converse in Arabic whereas many of the managers in Hebrew. Therefore, basic knowledge of each of the languages in required.

Interpersonal skills: The return's warehouse employees stay together throughout the day and have workers come over from other departments to take produce. A calm and friendly atmosphere is needed for improving efficiency.

MODELLING THE RETURNS' ROOM

The analysis of the mission and user profiles reveals that the current state of the returns' room does not allow for an optimal treatment of returns. Ergonomically, it is ill designed and therefore does not permit reasonable execution of the required activities. In its current state, employees sit on the floor or on boxes with the merchandise accumulating into disorganized piles. The employees are working the merchandise on the floor without presorting of any kind. Figure 3 illustrates the current state of affairs in the room.

Figure 3: A schema of the returns' warehouse current state

For the redesign, we used the software Sketchup. It supports three-dimension design and is used in many design, architecture and engineering applications. We took the room's dimensions as given and used ergonomic theory to redesign the room to support a proper reception of returns, their sorting and their storage. It also considers human factors such as seating, lifting etc. In Figure 4 we plot the room's new design.

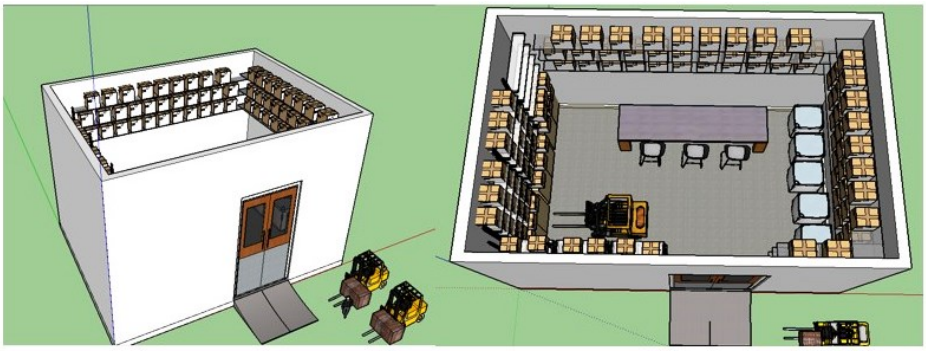

Figure 4: A schema of the returns' warehouse new design

Shelves were placed along the entire length of the room to contain the products that are to be re-packaged or resold. A table was brought into the room so that sorting or repackaging can be done while seated. Sufficient space was left to allow a forklift to enter the room and be able to maneuver in it safely. The boxes on the shelves are to be managed under a first-in-first-out (FIFO) policy. This will ensure that products are not overlooked. Large containers were placed in a row. These are to be filled according to the destination of the sorted products, disposal or factory departments (for re-packaging). These are to be emptied at the end of each workday, thus completing the treatment of the returns.

RESULTS AND CONCLUSIONS

This study improves the management of returns by developing a decision support information system and by ergonomic-based design of the facility that handles the returns. In the first part, an in-house sales information system was enhanced to support managers and sales agents in how they set prices. This information system uses sales data that was already available in the system and processes it to determine the optimal price to charge the retailers. As a byproduct of the maximization of profits, the result is that the retailers will purchase smaller quantities and therefore the returns are minimized as well. As a complement to the DSS, we improved the management and handling of the returns themselves. Whereas previously the reports were never verified, in the new setting returns are recorded and checked against the actual product arrival. Furthermore, the redesign of the warehouse increases operations' efficiency and reduces the risk that products that are unfit for consumption are resold.

The pricing model at the heart of the DSS assumes that the retailer and the supplier of the item are monopoles. This assumption is reasonable for only a subset of the retailer's products and for a subset of the retailers, those that do not face competition in their specific location from other large retailers. As a first step of testing the DSS, we selected somewhat less than a hundred (product, retailer) candidates for the experiment. Next, we assigned values to the cost variables. In most cases these data were readily available at the plant, in others we asked the operation's staff to provide us with their estimations. Historical sales data stored in the database was used to derive past demand for each of the products. Some of the products have less than three years of sales information and for these we used the marketing staff to estimate the demand's distribution.

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BIOGRAPHIES

Dr. Yahel Giat is a tenured faculty member in the Department of Industrial Engineering and Management in the Jerusalem College of Technology. He holds a Ph.D. and an MSc. in Industrial Engineering from the Georgia Institute of Technology, an MSc. in Economics, a B.Sc. in Electrical Engineering and B.A. in Computer Sciences from the Israel Institute of Technology.

Prof. Dan Bouhnik is the head of the Computer Science department in the Jerusalem College of Technology (JCT) in Israel. He is the author of several books used for teaching advanced computer sciences and his professional interests include virtual learning and its effect on the thinking process, information needs of special groups as well as the infusion of new technologies in the learning environment.

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Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

ENTROPY, GENERATIVITY, AND RUGGED FITNESS LANDSCAPES AS THE MEANS TO RATIONALIZE A PARADIGM SHIFT IN KNOWLEDGE MANAGEMENT

Ulrich Schmitt*	University of Stellenbosch, Business School, Bellville, South Africa	schmitt@knowcations.org
T. Grandon Gill	University of South Florida, Tampa, Florida, USA	grandon@usf.edu

* Corresponding author

ABSTRACT

Aim/Purpose	While traditional Knowledge Management (KM) continues to neglect the self-interests of knowledge workers as well as generative innovation potentials, it also seems unable to respond to rising complexities, opportunity divides, and entropies. This article follows up on a decentralized KM system-in-progress with a specific focus on how its alternative architecture seeks to address the shortcomings.
Background	It follows up on an informing perspective of client clusters and their target-fitness/ends-states by also taking account of contextual and means-related variances. The differing complexities of the resulting scenarios allow for making distinctions regarding the relationships and respective KM needs between mentees/informees and mentors/informants.
Methodology	The approach taken is conceptual analysis.
Contribution	The analysis advances the understanding of how the envisaged KM system would serve the informing scenarios better compared to the current status quo.
Findings	The novel system architecture serves the more constructive interconnection of individual and collaborative spaces by strengthening personal, institutional, and social digital curation and feedback across disciplinary and professional boundaries.

Accepted by executive review by Editor Michael Jones | Received: February 2, 2020 | Revised: February 26, 2020 | Accepted: May 12, 2020.

Cite as: U. Schmitt & T. G. Gill. (2020). Entropy, generativity, and rugged fitness landscapes as the means to rationalize a paradigm shift in knowledge management. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp. 61-78. Informing Science Institute.
https://doi.org/10.28945/4566

Future Research	The example provided could serve as a model and assessment tool for integrating design and informing science approaches in the study of IT/KM artefacts.
Keywords	knowledge management, personal knowledge management system, design science research, informing system, digital platform ecosystem, generativity, entropy

INTRODUCTION

A design science research (DSR) project-in-progress is aiming for a concept and prototype system supporting a decentralizing knowledge management (KM) approach to strengthen the faculty and autonomy of individuals and self-organized groups.

By mapping the complimentary dynamics of twelve traditional organizational KM models in a three-dimensional information space, a currently neglected area favoring personal KM (PKM) has been presented earlier (Schmitt, 2019a). The respective gaps have been elaborated on in related articles arguing that the organizational objectives have continuously taken precedence over the personal concerns and motivations of knowledge workers (Schmitt, 2018b), that the prioritized protection of intellectual capital benefitting institutions has also been pursued at the expense of innovativeness and generativity (Schmitt, 2019b), and that – having been introduced in a time of information scarcity – traditional models lack the muscle to tackle today's world of ever-growing dynamic complexity, information abundance, and entropy which are further amplifying structural holes, invisible work, fragmentation, attention poverty, and opportunity divides (Schmitt, 2020).

The intensifying role of entropy in the KM context has also been recognized by closely linking an entropic perspective to the probability distributions of personal knowledge among people in dynamic organizational settings, to the computability of knowledge entropy for respective organizational states, and to the interpretation of related KM interventions as organizational entropy management (OEM) (Bratianu & Bejinaru, 2019).

From an informing perspective, this latter novel notion sheds further light on particularly challenging situations where informing systems are expected to meet the needs of multiple clients, many of whom may have quite different objectives in being informed. The related informing activities have been pictured as transitions between peaks in a rugged fitness landscape (RFL) (Gill & Mullarkey, 2017; Murphy et al., 2015) and, subsequently, been addressed in the context of the PKM project (Schmitt & Gill, 2019).

This article aims, firstly, to establish the common ground between the OEM, RFL, and PKM approaches and argues for a further differentiation of the organizational entropy management perspective. It, secondly, re-applies the rugged fitness landscape to extend a prior analysis of how the envisaged PKM System would serve the RFL informing scenarios better than current practices and how it may further evolve. The RFL scenarios are then extended further to differentiate the roles of social curation and feedback in regard to the PKMS services to be afforded over time in a dynamic knowledge environment.

We begin by introducing the OEM perspective and by presenting the four RFL scenarios in light of entropy considerations. We then briefly recapitulate relevant prior work of why and how a decentralized PKMS-type-approach is supposed to perform better than current practices within these contexts and newly extend the RFL matrix to accommodate current deficiencies and potential affordances related to social curation and feedback. Finally, we summarize our findings in a concluding section.

THE ORGANIZATIONAL ENTROPY MANAGEMENT PERSPECTIVE

In keeping close to the thermodynamic origin of the entropic notion and its correlated concept of disorder within a system, Bratianu (2019) equates well-structured organizations with machines operating routinely, efficiently, reliably, and predictably with limited degrees of freedom at a low level of entropy. As, however, social rather than mechanical systems, organizations aiming for low entropy rely on their management to instill order through formal structures, regulations, traditions, organizational culture, and command-and-control based on labor division and decision power distribution for productivity and efficiency.

Flatter hierarchies and networked organization allow, by comparison, for more flexibility, creativity, competitiveness, and innovation but also demand an empowered workforce and collaborative leadership styles tolerating higher levels of organizational disorder and entropy, particularly, during organizational change and transformations (Bratianu, 2019).

Bratianu's (2019) perspective on entropy considers knowledge workers (gas molecules exhibiting diverse microstates in analogy to Boltzman's probabilistic approach) as elements of an organization (vessel containing all gas molecules as a macrostate determined by the distribution of all its microstates with their natural tendency to achieve a more probable stable macrostate). He reasons that - in case of well-structured organizations – the number of microstates defining a possible macrostate is significantly smaller compared to the more flexible settings yielding higher level of organizational entropy to promote creativity and innovation.

As knowledge creation, acquisition, sharing, and loss phenomena change the organizational probability distribution of knowledge over time, states of organizational knowledge entropy can be expressed "using the Boltzmann formula: $KE = - C \Sigma p_i \log p_i$", with KE the value of knowledge entropy, C a constant which is an arbitrary positive number chosen to adjust to a certain framework scale, and a probability distribution $p_1, p_2, p_3, \ldots, p_n$ where n is the total number of employees with p represented by normalized relative values. "This knowledge distribution can be considered related or not to a certain space or geographic framework of the organization", while its "value of knowledge entropy (KE) can be a very good indicator for the knowledge distribution of a certain level within the organization, at a given moment of time" (Bratianu, 2019, p. 361, 362).

The dynamic re-distribution of knowledge within the organization through sharing and intergenerational learning, accordingly, flattens the knowledge probability distribution and moves KE towards a more stable macrostate. KE increases by enhancing the innovation capacity via knowledge creation and acquisition (Bratianu, 2019). Since "any transformation of knowledge implies a change in the entropy of the universe considered (i.e., personal knowledge or organizational knowledge)", managerial interventions may increase "the probability of any employee to access needed knowledge, at a given time and in a given place" to raise the organizational entropy and positively influence innovation and firm performance (Bratianu & Bejinaru, 2019).

However, the starting points and objectives pursued by such informing and learning interventions matter in respect to the entropic considerations and are to be addressed in the next section.

KNOWLEDGE-BASED RUGGED FITNESS LANDSCAPE SCENARIOS

One approach to visualize the challenges potential managerial interventions are facing, particularly likely in dynamic environments, is the depicting of the respective informing scenarios as transitions between peaks in a rugged fitness landscape (Gill & Mullarkey, 2017; Murphy et al., 2015). Combining the states of (single and multiple) starting and possible ending peaks among (single or diverse) clients and targets/outcomes (Figure 1, left-and-right-hand side green rectangles) allows for the clustering of four distinct clusters C1 to C4 (represented by connecting lines) with distinct intervention scenarios (Schmitt & Gill, 2019):

- *C1 (green-bottom-left-to-bottom-right):* Need to determine a path that minimizes the duration and loss of fitness associated with the transition utilizing lectures, videos, or manuals by the informing agent.
- *C2 (green-bottom-left-to-top-right):* Moving clients 'set in their ways' to consider and/or pursue alternative peaks usually require assisting facilitators in order to shift paradigms and outside-the-box-thinking.
- *C3 (green-top-left-to-bottom-right):* Different paths to the distinct target may need to be established to accommodate the needs of different clients, self-paced learning with face-to-face tutorials as well as individual and/or group coaching approaches.
- *C4 (green-top-left-to-top-right):* This scenario is the most complex due to the inherent combinatorial explosion of potential informing paths to be considered. The way to address it (in the context of this article) is to create opportunities where clients take considerable responsibility for mapping out their own paths and are given the appropriate tools to do so.

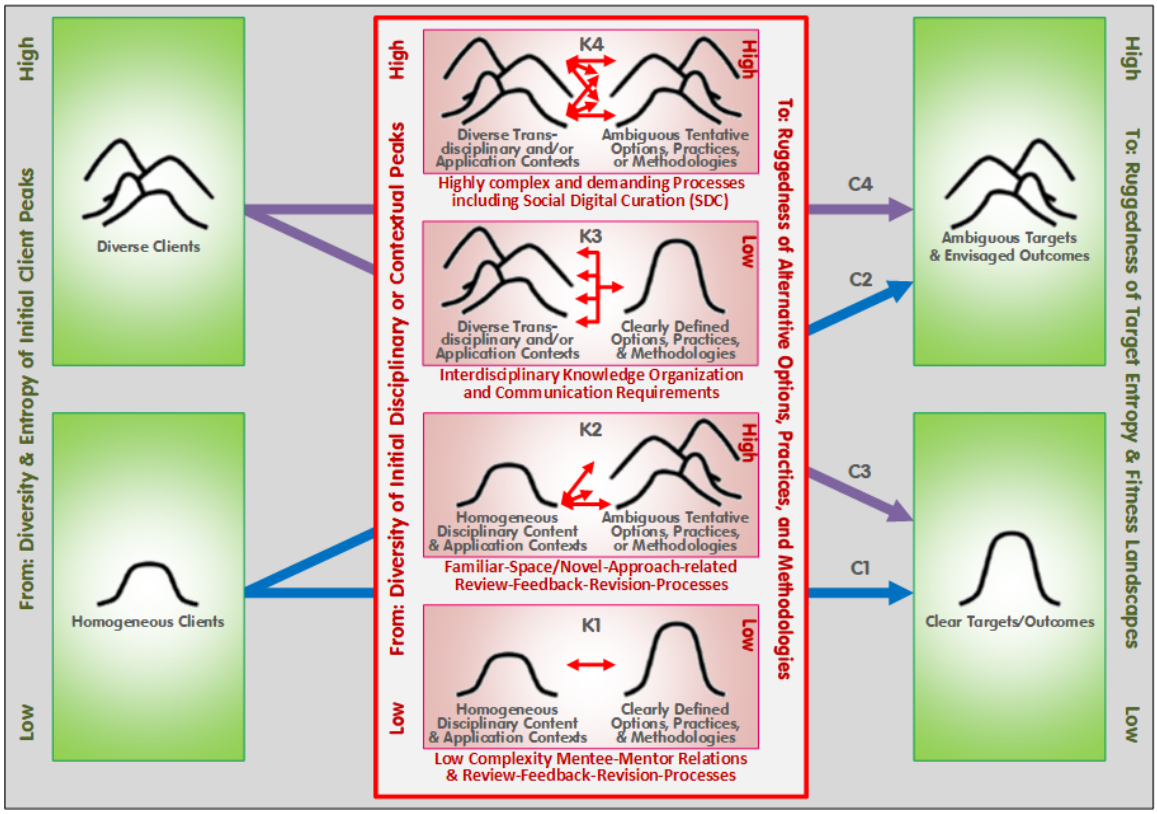

Figure 1 Clients, contexts, means, and ends of informing task scenarios from the informer perspective (outer green clients-ends-quadrants adopted from (Murphy et al., 2015)**)**

ENTROPY VERSUS RUGGED FITNESS LANDSCAPE SCENARIOS

While many of the scenarios are in need of following Braitianu's (2019) perspective and of raising organizational entropy for impacting positively on innovation and firm performance, the strengthening of success prospects may – at times – also require the exact opposite of lowering entropy, for example:

- *A C1 lowering-entropy scenario:* In May 2019, images taken by the Nepalese mountaineer Nirmal Purja (Cheung, 2019) attracted world-wide attention by picturing a long queue of

mountaineers waiting in line for their final short ascent to the Mount Everest. The context behind this image provides a good C1-case. In order to successfully climb Mount Everest (clear target), any participant of an expedition has to be already physically and mentally well prepared (homogenous client) in order to be acceptable for further training and guidance with a very narrow focus: firstly, to make it back alive and healthy, and, secondly, to – hopefully – make it to the top in the process. The objective is, hence, to minimize any differentials in the initial microstates of the mountaineers (compared to an ideal condition for survival and success), so the team is enabled to operate just as a well-structured organizational machine routinely, efficiently, reliably, and predictably with limited degrees of freedom at a low level of organizational entropy, especially in case of potential emergencies.

- *A C2 intervention strategy* may fit best with the entropy-raising approach described by Bratianu (2019) to transform structured organizations into more flexible network communities for meeting objectives of empowerment, innovativeness, and ambidextrous performance in pursuit of both exploitation as well as exploration.
- *C3-C4-related intervention* may try to raise entropy to further enrich the already existing diversities. They may, however, also adopt entropy-reducing strategies. During the initiation of an organizational change project, for example, the aim is to involve a diversity of organizational stakeholders and to set them on a path of fruitful collaboration. At this early stage, the priority is to bring everybody on-board and to establish a basis for a common mutual understanding without pushing (yet) any controversial topics which might trigger early conflicts and a premature failure of the undertaking.
- *Entropy-raising interventions in the most complex C4-scenarios* are also especially susceptible to the ever-growing dynamic complexity, information abundance, and entropy alluded to in the introduction (the next section addresses this - seemingly – entropic paradox).

It is foremost this problematic diverse-clients-ambiguous-targets (DCAT:C4) scenario (connecting the top-green rectangles in Figure 1) that the concept, design, development, and deployment of the decentralized PKMS intends to address. While a prior publication has already focused on the interdependencies between the RFL-DCAT and PKM approach in more detail (Schmitt & Gill, 2019), the following section summarizes these findings as a basis to integrate the OEM considerations as well as the subsequent social curation and feedback concerns.

THE ROLE OF DIGITAL PLATFORM ECOSYSTEMS (DPES)

The decentralized PKMS (Figure 2) is envisaged to being serviced by a central Digital Platform Ecosystem (DPE), generically defined as a meta-artefact which affords clients with highly diverse skills and ambitions to gainfully utilize its resources and generative potential in their personal and local contexts (Eck & Uebernickel, 2016).

The DPE's aim is not only to narrow widening opportunity divides (Giebel, 2013), but also to strengthen the quantity and quality of individuals' innumerable "nano-actions" which govern, if productively combined, any organizational (knowledge economy) and societal (knowledge society) performance, advancement, and viability (Wiig, 2011).

The proposed PKMS-DPE-solution "can be characterized as a social machine platform" that would offer its collective user community facilities for digitally capturing, creating, modifying, classifying, combining, and accessing atomic information structures (referred to as memes) and their relationships to be stored in personal and – if voluntarily shared - centralized repositories (Schmitt & Gill, 2019). Memes – originally introduced by Dawkins (1976) - may be comprised of content (e.g., parts of this paragraph, citations, or visuals), aboutness (e.g., article review, wordcount, or author's profile), structural connections (e.g., links between authors, papers, publishers, and references), intent (e.g., tasks to do), and monitoring (e.g., schedules, to-do-lists, or progress made) which may all be captured

based on the PKMS's standardized memetic format and associative indexing structures instead of following current document-centric storing practices.

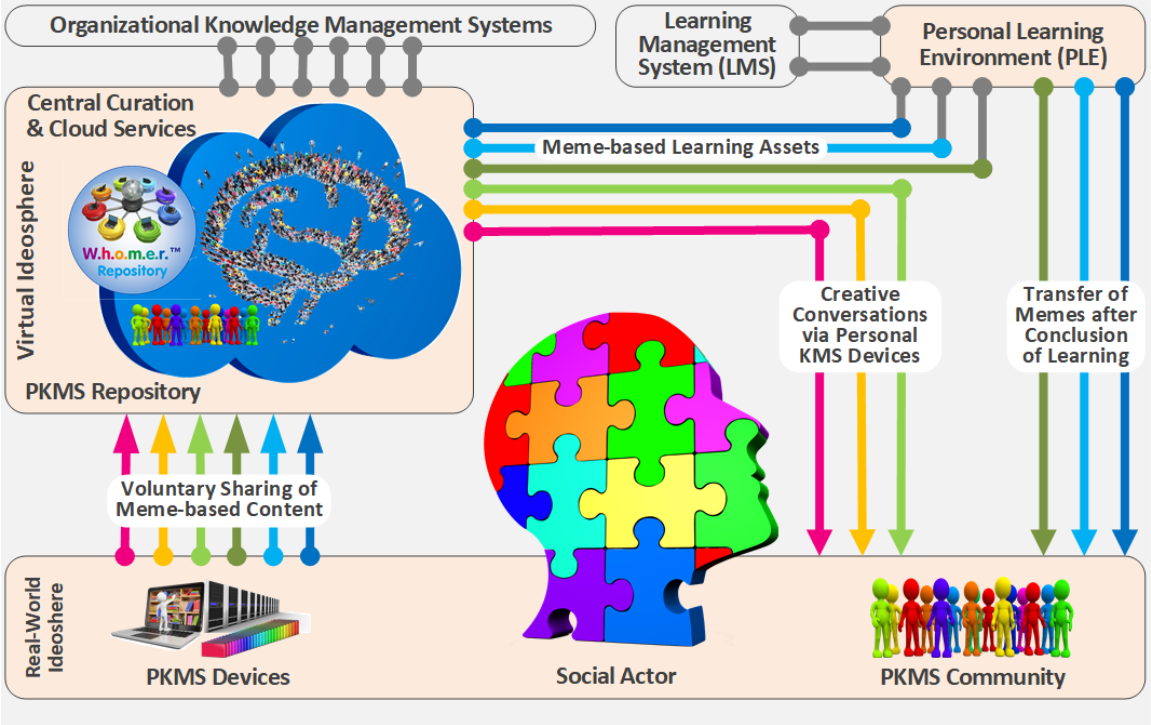

Figure 2 PKMS as a Digital Platform Ecosystem (DPE) (Schmitt & Gill, 2019)**.**

From a KM perspective, the ensuing centralized knowledge base (termed World Heritage of Memes Repository (WHOMER)) resembles a tangible accessible interrogatable instantiation of Popper's third world (Popper, 1978) where the meme-based knowledge and learning assets assembled by the user community are encapsulated – just like products in modern manufacturing systems – in as-built-genealogies.

As virtual memes are not expended when used or disbursed, their infinite usage potential via associative structural links allows for their transdisciplinary employment and the cutback of current unmaintainable levels of book-age-copy-and-paste-practices. The potential of reducing these attention-consuming redundancies in favor of attention-guiding traceability depends on the effective curation of the meme-pool (for accurate informing based on negentropic repositories) to be facilitated by community feedback and WHOMER services.

The seemingly entropic paradox between the positive OEM entropy and the negative PKM entropy is dissolved at this level of centralized curation (to be further detailed in later sections). The generally desired entropy of Bratianu's (2019) OEM perspective corresponds to the diverse and transdisciplinary related resources and their generative potential offered by the DPE to its PKMS community members to be utilized and further developed in their personal and local contexts. They may be linked to other, so far, unconnected (old or new) memes and subsequently shared within subsequent PKMS workflow cycles for continuous curation in line with the PKMSs' affordances, functionalities, and generative attributes (Schmitt, 2019a, 2019b).

The unwanted entropy referred to and sought to be eliminated or overcome by the curating services of the novel PKM approach (Schmitt, 2020) (partially also referred to as negative generativity, Schmitt, 2019b) prevent currently the productive utilization of the positive generativities or entropies; they are summarized with their negative effects (-) or potential positive advances in case of successful interventions (+) in Table 1.

Table 1: Causes and *Effects* of Undesired Entropy Clusters (Schmitt, 2020)**.**

	Public Knowledge-related Entropies	**Private Knowledge-related Entropies**
Discoverable Knowledge	Information Entropy *Information Overload (-)* *Attention Poverty, Mobility (-)*	Online and Publishing Realities *More rapid iterative Improvement (+)* *Innovation & Reputation Systems (+)*
Undiscoverable Knowledge	Structural Holes, Islands, Siloes Ineffective Utilization Deficient Awareness/Education *Innovation and Opportunity Divides (-)*	Invisible Work, Scaffolding Non-Linear Relationships *Unproductive Rework (-)* *Holistic Understanding (-)*

PROPOSING AN EXTENDED RUGGED FITNESS LANDSCAPE

Figure 1 (green quadrants and connections C1-C4) presents four scenarios suggesting distinct types of developmental paths to reach personal target fitness states. The middle section of Figure 1 also depicts four knowledge-related environments (red rectangles K1-K4) which substitutes the (homogeneous/diverse) client-axis with a contextual disciplinary/application-oriented perspective and the (clear/ambiguous) targets/outcomes-axis with a means-related options-practices-methodologies scale. The aim is to further extend and differentiate the personal states/paths (green clusters C1-C4 connecting clients to target fitness or ends) according to the range of potential contexts to be encountered and the means or tools at the clients' disposal. These further differentiated clusters are again employed to distill distinct *operation and intervention scenarios* from an informer's perspective (beneficial for educators, mentors, reviewers, and system designers) in order to guide clients' personal paths by considering matters of social curation and feedback. The aim is also to promote positive entropy (from now on referred to as generativity) and to avoid negative entropy (from now on just referred to as entropy):

- *K1 (red-middle-bottom) Low complexity review-feedback-revision-processes:* Need to determine a path within consistent disciplinary and application-oriented environments characterized by well-established means that minimizes the duration and loss of fitness. The support by traditional review-revise-engagements may be optimizable by better matching students/authors/mentees with supervisors/mentors as well as topics with reviewers by the informing agent/editor.
- *K2 (red-middle-2nd from bottom) Familiar-space/novel-approach-related review-feedback-revision-processes:* Adapting familiar homogeneous content and application contexts by employing alternative and/or novel means and approaches demands more intensive mentorship, especially in pursuit of alternative target and outcome fitness peaks.
- *K3 (red-middle-3rd from bottom) Interdisciplinary knowledge organization and communication requirements:* The need to tackle multi/inter/trans-disciplinary problem and/or divergent application spaces increases the complexity not only of tasks or paths but also of the respective knowledge organization and communication and, hence, the required mentorship which may has to be dispersed among several coordinating mentors. Employing well-established means or, at-least, approaches (e.g., design science research guidelines) and clear targets may ease the burdens in the mentees-mentors-relationships. Ambiguous targets (e.g., catering for multi-disciplinary audiences' consumption), on the other hand, may require bridging disciplinary divides in favor of collaborative spaces of common understanding. Informers are advised to decontextualize relevant content and methods (to create boundary objects, e.g., heuristics, frameworks, or templates) in favor of more viable generic approaches (1) to fit wider classes of tasks and problem spaces, (2) to accommodate diverse peers' interpretative as well as tailorable flexibility (Nick et al., 2007), and (3) to give clients the opportunity for repurposing and re-contextualization according to their personal and local circumstances.
- *K4 (red-middle-top) Highly complex and demanding review-feedback-revision-processes including Social Digital Curation (SDC):* The most challenging instances facing clients are referred to as 'wicked' problems defined as "open-ended in the sense that they are ill-defined and characterized by

> incomplete, contradictory, and changing requirements and complex interdependencies [and] that the information needed to understand the problem depends upon one's idea for solving it" (Rylander, 2009). The development of the PKMS concept, for example, fits this description.
>
> Due to the inherent combinatorial explosion of clients, contexts, means, and ends, a myriad of potential informing paths may need to be considered and reviewed. While the World Wide Web (of documents), the Semantic Web (of Data), or Social Media Platforms may be hailed to facilitate resolutions, they all are also affected by a range of inherent shortcomings and entropic concerns: replication, fragmentation, validity, integrity, granularity, traceability, indexing, accessibility, tailorability, editability, ease of mastery, ownership, transferability, generativity, openness, sustainability (Schmitt, 2017a, 2017b, 2019b). K4-scenarios are also hampered by current bibliographic classification systems and practices; instead of being grounded in the phenomena studied, they are "organized on a disciplinary basis [serving] interdisciplinary research and teaching poorly" (Szostak et al., 2016).
>
> The clients' conceptualizations and actions may well be highly contextualized as well as innovative and, hence, demand thorough understandings and responses from mentors and curators as well as sophisticated informing and feedback practices as, for example, 'Social Digital Curating' (SDC) defined as "a content creation process with unique cultural and social characteristics" to be utilized in collaborative and educational settings (Gadot & Levin, 2014) and in support of digital and media literacy as well as organizing knowledge flows from diverse sources to wherever and whenever it is needed (Cohen et al., 2013).

Although the PKMS-DPE is able to offer considerable support in the two K1 and K2 scenarios, today's key deficiencies primarily affect the K3 and K4 scenarios. Accordingly, it is here where the novel envisaged concept and system may contribute the most. It, for example, widens the accessibility and choice of transdisciplinary content via curated associations between cross-disciplinary themes and eases the repurposing of the granular (memetic) content components for new learning or knowledge asset creation. Captured boundary objects also offer guidance by affording authors a range of already decontextualized but interdisciplinary linked approaches and solutions tailorable to their local use and/or multi-disciplinary contexts (Star, 2010). The following two subsections are further focusing on curation at the individual, collaborative, and institutional level to provide a basis for detailing its envisaged PKMS-administered impact on the Cx-Ky-scenarios.

Curation and Informing to Support Personal Development

Curation traditionally "refers to the methods or systems that add value to and preserve resources" (Glushko, 2013) but has evolved together with the digital social, personal, educational, and commercial spaces "to encompass multitudinous and increasing forms of data-managing behavior" (Khan & Bhatt, 2019). However, while today's powerful technologies are able to locate ever-increasing amounts of digital information, they lack "effective tools for selecting, structuring, personalizing, [curating], and making sense of the digital resources available to us" (Kahle, 2008).

Individual self-reflection and self-curation

Accordingly, individuals are in need of "a 'place' or a 'space' in which to assemble and manipulate information resources for their own purposes, with flexible tools that they can adapt to their practices, skills, habits, and artistry" (Borgman, 2003) and that take advantage of today's generative opportunities where "the knowledge and skills of a knowledge worker are portable and mobile" (Rosenstein, 2009).

The PKMS-DPE-concept offers such a space by affording accumulating many individual unique memes over time for instant project benefit or potential future utility. While the magnitude of any one of the memes is small, continuous tailoring and cumulatively synthesizing them (via associative

structural links) facilitates classification and novel artefact creation (e.g., design ideas, learning or knowledge assets, or boundary objects).

Interludes for reflection and revisions are promoted by monitoring memes (e.g., schedules, to-do-lists, or progress made) and are further supported by dedicated frameworks published to support the concept's educational agenda (e.g., PKM for Empowerment (PKM4E), for Action (PKM4A), or for Development (PKM4D) (Schmitt, 2016a, 2018a, 2019a).

A decentralized networked PKMS-device, thus, enables "self-reflecting monologues of its user over life-long-learning periods of educational, professional, social and private activity and experience. In these conversations with self, the knowledge under review is biographically self-determined and presents itself as a former state of personal extelligence captured"; it affords the individual the means and autonomy to retain and build upon knowledge acquired, to develop his/her expertise for sustainable personal growth, and to collaborate "with fellow learners and/or professional acquaintances for mutual benefit" (Schmitt, 2014).

Collaborative informing, authoring, and curation

As these evolving grass-roots personal repositories sustainably preserve individual's creative energy and resources within agreeable levels of perceived inconvenience (time, effort, and self-discipline invested), synergies can obviously be realized by enabling "the same content to be used by multiple users for multiple purposes" and by making institutional and personal digital libraries "interoperable, such that individuals can download data for local manipulation, and can upload tagged data to share both content and metadata" (Borgman, 2003).

While rates of individuals' contributions to traditional institutional "document repositories remain low in most fields" (Borgman, 2010), the grass-roots collaborative bottom-up approach is expected to promote personal motivations and efforts resulting in improving the longevity and accessibility of content for further wider scrutiny, exploitation, and exploration.

Any meme-based (atomic or constructed) artefact shared may be subjected to Lane's (2011) "exaptive bootstrapping (EB)" dynamic by gearing it towards "cascades of changes in agent-artefact space" inextricably linked to innovations, organizational structures, processes, and functionalities. The five EB stages materialize in the PKMS-context as follows:

1. New artifact types [*memes and assets*] are designed [*authored*] to achieve some particular attribution of functionality [*backed by content and/or evidence to investigate, innovate, inform, or entertain*].
2. Organizational transformations are constructed [*utilizing existing structures, functions, and processes for diffusion (e.g., conferences, journals, books, web pages, self-publishing)*] to proliferate the use of tokens of the new type [*to ensure artefact's availability, diffusion, and understanding*].
3. Novel patterns of human interaction [*comprehension of content by audiences and ensuing discourses*] emerge [*modifying prior perceptions and/or triggering new insights*] around these artifacts in use [*by also promoting other referenced sources and related ideas*].
4. New attributions of functionality are generated [*by modifying the artifact's codification, container, and/or context and by reconfiguring it which may include new memes and relationships*] – by participants [*desk research*] or observers [*field research*] – to describe what the participants in these interactions are obtaining or might obtain from them [*newly devised content, blueprints, or physical models*].
5. New artifacts are conceived [*new memes or assets*] and designed [*virtual or physical embodiments*] to instantiate newly attributed functionalities [*informing*] which – by feeding back into step 1 – close the iterative bootstrapping cycle.

The speed and density of any iterative bootstrapping and curation cascade branching out depends, of course, on the content's popularity and pliability, but, as an essential pre-requisite, the respective

knowledge has at least been explicitly captured. Loads of today's generated knowledge, by comparison, is neither recorded nor shared resulting in "magnitudes of invisible work" (defined as the "gap between formal representations, including publications, and unreported 'back stage' work"; Star, 2010). Consequently, others are deprived from judging the merit of content without what has been referred to as its 'scaffolding' (Bush, 1945) and/or may have to re-spend the energy to investigate any absent subject matter on their own accord.

Instead, a PKMS-DPE-approach retains and synthesizes – once captured and voluntarily shared – the dynamically changed versions of content, aboutness, and annotations together with their structural connections, timelines, and user and usage profiles. Its generative potential and evolving novelty is, thus, grounded in an "exaptation" as asserted by tweaking (in line with []-insertions in steps 1 to 5 above) Lane's summary : "From the interactions between existing structures ([knowledge,] agents and artefacts), new [associations and] functionality emerge [which] may then become recognized by appropriately situated and motivated agents [(e.g., PKMS community members)], and (re)cognized as a [new insight] or new attribution of artefact functionality [(e.g., transdisciplinary applicability of boundary objects)]" (Lane, 2011).

Institutional informing and curation

Institutionally, initial KM and curation initiatives focused on viewing knowledge as a foremost strategic asset in need of being measured, captured, stored, and protected, followed by a more practice-based and community-centered approach leading to today's social media and cloud applications. To champion still neglected concerns, a future focus on iterative creative innovation processes is proposed which starts with the "reuse or new use of existing knowledge, adding an invention, and then creating a new product or service that exploits this invention" (Pasher & Ronen, 2011).

While the seven-traditional-schools-taxonomy (content-related: commercial, engineering, and system schools complemented by enterprise resource planning; collaboration-focused: cartographic, organizational, spatial, and strategic schools complemented by social media) has differentiated the scope of KM functionalities further (Earl, 2001; Schmitt, 2016b), these top-down centralized prohibitive institutional developments too often fail to gain acceptance from their workforce by ignoring most of their wider personal development aspirations. Social media providers are also doing considerable disservices to individuals by neglecting to confer vital affordances at the expense of their captured communities' attention, time, productivity, funds, and status (Cabitza et al., 2015; Mynatt et al., 1998; Schmitt, 2017a).

Bottom-up KM proposals favoring peer-to-peer content-sharing, expertise-finding, and connectivity (Pollard, 2008) and knowledge creation models able to tackle the accelerating information entropy and to seize generative potentials (Schmitt, 2019a, 2019b) have not yet materialized as institutional realities, and any knowledge worker is still denied even the most basic provisions that his/her personal digitized knowledge (1) always stays in his/her possession and at his/her disposal independent of changes in his/her social, educational, professional, or technological environment; (2) is based on standardized, consistent, transparent, flexible, secure, and non-redundant formats to safeguard its integrity and longevity; (3) may be shared to facilitate mutual beneficial collaborations within a community of diverse dedicated social actors and for a fruitful co-evolution with traditional KM Systems (KMS) and Learning Management Systems (LMS).

Interconnecting the individual, collaborative, and institutional spheres

These individual, collaborative, and institutional settings are affecting all Cx-Ky-scenarios including the more easily navigable unidisciplinary content areas (K1 & K2).

Crossan et al.'s (1999) 4I-Framework provides a psycho-social perspective to support organizational learning within these nested structures consisting of four dynamic feed-forward and feedback pro-

cesses (intuiting, interpreting, integrating, and institutionalizing). 'Intuition' takes place at the individual level by pre-consciously recognizing a pattern or opportunity. The resulting intuitive insights may be consciously shared, refined, and further developed within an interactive team setting marking the collaborative stage of 'Interpretation'. Transforming the potentially emerging shared coherent understanding into negotiated or mutually adjusted, wider coordinated actions characterizes the 'Integration' phase which may lead to embedded learning and organizational mechanisms and routines via formal rules, procedures, structures, systems, strategies, or safeguarded organizational memories and cultures at the stage of 'Institutionalization'.

By adding the fifth stage of 'Intertwining', Jones and Macpherson's (2006) 5I-Framework acknowledges and accommodates learning mechanisms outside an institution's internal boundaries with its external inter-organizational knowledge networks.

A further extension is to be suggested in a paper-in-progress with a complementing 6th I-level of 'Interfusing' to represent the societal level of the accumulated heritage of human knowledge as to be afforded by the PKMS's tangible, accessible, and interrogatable instantiation of Popper's (1978) third world.

CX-KY-SCENARIOS AFFECTED BY THE DIGITAL PLATFORM ECOSYSTEM

Before focusing further on the K3 and K4 contexts, the DPE's technological approach needs to be briefly reflected on in order to show how its underlying interactions and transitions embody the dual processes of sensemaking and sensegiving for balancing exploration and exploitation.

Figure 2's bird-eye-view depicts a social actor as a member of the PKMS user community (bottom-right) with his/her decentralized PKM device (bottom-left), the shared-content and centralized-curation WHOMER services (middle-left), and the Personal Learning Environments (PLE) with its e-learning functionalities (top-right). Adding to the broader DPE context are the interactions with the traditional Knowledge and Learning Management Systems (top). This concept aligns to the scenario of a decentralized KM revolution where creative conversations and curation cascade among empowered autonomous individuals and self-organized groups allow for emerging distributed processes of collective intelligence which in turn feeds back to their grass-roots personal and local settings (Levy, 2011; Schmitt & Gill, 2019).

Curating and interconnecting across disciplinary and professional boundaries

Accessing and making sense of the fragmented content and sources representing the analog and digital world record follows an increasingly complex and time-consuming trajectory. Transforming its dispersed ideas effectively into emergent concepts and innovations involves ever more cumbersome analytical and synthesizing processes. While an abundant digital capacity is available, traditional filters and authorities (e.g., peers, editors, publishers, and librarians) have lost their grip and a rising share of content is diffused before verified and free of theory, quoted sources, and cited evidence (Weinberger, 2011).

While computational filters and algorithms fill the curational gap to some extent, these 'services' may well be based on questionable intentions and flawed criteria resulting in subjective or false instead of objective and truthful content. "Without prudent filtering of information by its credibility, misinformation becomes infiltrated into curation work, thereby changing the meaning and knowledge that is produced. As misinformation becomes more pervasive, discernment and discrimination become increasingly difficult – and more necessary" (Khan & Bhatt, 2019).

Tackling this misinformation effectively is, however, hampered by current copy-and-paste-practices. Frequently, memes or content-snippets are continuously re-purposed but are neither linked nor versioned. They continue their lifecycles independently and, time and again, without verified traceable source, with erroneous modifications, in an obsolete state, or as misleading partial out-of-context

fragments. "Instead of digitally embedding and reusing parts of digital documents via structural references", copying and pasting also unnecessarily prolongs the book-age paradigm of over-simplistically modelling digital documents as monolithic blocks of linear content" (Signer, 2010).

The links currently being available are the world-wide-web's unstructured one-directional forwarding links (where the citing sources are hidden and only used as criteria in search engine results), the scholarly search applications' high-granularity document-to-document references (as cited in the reference sections of publications which may occasionally be complemented by page numbers), and the semantic web's low-granularity fact-and-data connections (to provide machine-processable accessibility to non-human agents via markup languages or RDF statements). While associative indexing (Bush, 1945) not only allows for bi-directionally traceable meme-to-meme links at an appropriate level of DPE's constructivist agenda, it would also serve the need to deal with today's proliferating "structural holes".

These structural holes (Burt, 2004) refer to unrecorded or not yet identified (but potentially beneficial) ties between knowledge clusters (e.g., memes, approaches, specializations, disciplines); the theories of organizational learning and knowledge creation, for example, "have been pursued as independent themes for almost two decades" (Brix, 2017). Their lack of connectivity contributes to undiscoverable public knowledge (islands and silos) (Szostak et al., 2016) and inhibits informing and methodological capabilities to better tackle complex transdisciplinary 'wicked' problem spaces. Associative indexing and its curated integrity bridge these divides, and while its enhanced traceabilities would foster more fruitful academic 'fishing' and writing expeditions, the more productive DPE output would also contribute to calls for a wider sharing and faster diffusion of ideas, sources, data, work-in-progress, and preprints for the benefit of more rapid iterative improvement (Nielsen, 2012).

Accordingly, curation within the EB-cascades alluded to needs to encompasses the "practices of harnessing preexisting content, transforming it through the application of criteria which assess and promote belief, and then directing the resultant packet of filtered information to a new audience [as] an act of knowledge creation" with "curators as potential agents of change" (Khan & Bhatt, 2019). These changes are administered through the DPE's affordances to support value-adding actions of selection (refining and reducing), arrangement (displaying, simplifying, contextualizing, presenting, and explaining), and preservation (Bhaskar, 2016) which also cut across professional and disciplinary boundaries. Being confronted with the interlinked and high-granularity rapid-re-bundling EB-cascades of meme-based content detailed earlier, the DPE further responds to the needs of advancing attention-conserving consumption and curation techniques to deal with the inherent information abundance perceived as overload.

Micro-macro-micro informing across the spheres of the 6I-Framework

Since DPE-actors are engaging individually and freely, their 'nano-actions' and 'micro-behaviors' may over time result in emerging 'micro-macro-effects' to affect their community in its entirety. Subsequent 'macro-micro-feedback' might, in turn, affect the actors' 'micro-states' to produce self-organization and synchronization (leading to the generative or (positive) entropic consequences alluded to by Bratianu, 2019). However, keeping abreast with and inspired by one's dynamically changing community can also be demanding and perplexing; individual actors may, hence, benefit from 'collective' micro-macro-micro informing or educational interventions (Mella, 2017). A Generative Collectives' Future Study (van Osch, 2012) confirms these needs by advocating "ambidextrous" open platforms capable to simultaneously evoke and enable operational efficiency (through structure for coordination and integration) and generative capacity (through tailorability for flexibility and fluidity).

Informing and guiding ambiguous tentative options, practices, methodologies

The role of boundary objects in providing less experienced users with direction to approach complex problem spaces has already been alluded to.

The same applies to the methodologies of cumulative synthesis and exaptive bootstrapping which form the very foundation of the PKMS approach to promote the innovativeness of researchers and entrepreneurs alike. Having accrued a critical set of memes (interlinked content including functionality attributions) may trigger the "perception" of a problem or opportunity as an unsatisfactory or "incomplete pattern" prompting the "setting" of an appropriate "stage" for further iterative cascading research, development, "acts of insight", until the "emergence of novelty" followed by "critical revision" and "mastery" (Usher, 1954). Not every meme captured or generated may be of immediate utility, but what might be considered to be irrelevant or misguided at a given time may turn out to be valuable later, and vice versa (Garud et al., 2016).

A further level of guidance is rooted in the PKMS's educational agenda which seeks to re-purpose accumulated meme-subsets to create learning assets for LMS execution (the development of a KM e-learning course based on the memes sets of the PKMS publications is currently under way; it further adds to the micro-macro-micro interventions mentioned). Unique affordances of this feature would include, for example, transferring essential memes of the learning assets to the learners' PKMSs for retention, repurposing, and tracing complementing memes in the DPE's repository as well as providing settings of non-linear learning paths to afford learners appropriate choices.

Further micro-macro-micro 'collectivity' informing is envisaged to include sophisticated research and reputation metrics (based on the DPE's advanced granularity, traceability, and generativity attributes) as well as promising leads and emerging trends (way before link-based search algorithms are able to fuel attention towards exciting new developments). Moreover, in utilizing the as-built-genealogies' traces, linked meme siblings (and, by extension, their authors) may be informed about state changes of their parent memes (e.g., update or expiry notifications, endorsements, retractions, withdrawals, or detected falsifications).

Other informing and counselling facets complementing the system's affordances would cover the support of affiliations between individual PKMS community members including, for example, student-supervisor, mentor-mentee, or author-reviewer/editor relations. These dialogues would have to be kept confidential just like the self-reflecting memes concerning personal tasks, diaries, plans, concerns, and evaluations and, hence, are opening up possibilities for future research projects.

DISCUSSION AND CONCLUSIONS

This article used the three notions of the rugged fitness landscape, harmful entropy (negative generativity), and generativity (positive entropy) to structure the differences between current traditional top-down KM models and systems and an envisaged novel decentralized bottom-up networked personal KM approach.

It argued that today's knowledge management is severely compromised by unsustainable rising entropy and an ineffective utilization of the explicit accumulated world record. While the former is "threatening the finite attention individuals' cognitive capabilities are able to master" (Schmitt, 2019c), both are suffering from a deficient awareness and education and the lack of adequate tools.

The explicit record has been termed 'extelligence' to position it as the externally stored counterpart to the intelligence of the human brain/mind tasked with understanding. Together they are driving each other in a complicit process of accelerating interactive co-evolution where curated extelligence archives of cultural experience and know-how "can be accessed by any individual who knows how, and can be augmented by any individual who knows how" (Stewart & Cohen, 1999).

This knowhow has to derive from the awareness, education, and suitable tools available, and the exemplifications in this and prior articles have demonstrated how a PKMS-DPE is envisaged to make novel inroads in this regard using generativity and entropy as guiding principles (Schmitt, 2019b, 2020).

Strangely, many of the last decades' influential KM-related books approaching curation issues do not even refer to 'entropy' (Arbesman, 2012; Bhaskar, 2016; Borgman, 2010; Glushko, 2013; Jenkins et al., 2018; Pauleen & Gorman, 2011; Rosenbaum, 2014; Sawyer, 2012; Wenger et al., 2009) although some address the abundance and overload effects caused by it. The reason may lie in the tenacity of traditional knowledge creation models, all introduced in a very recent, now antiquated past of information scarcity (Schmitt, 2019b) which discarded alternative ideas as exemplified by the 'Memex' (Bush, 1945), 'Xanadu' (Nelson, 1991), or attention management (Simon, 1971) because today's accelerating never-before experienced attention-consuming information abundance was beyond their maker's comprehension. Current technological development priorities (Big Data, Internet of Things) can be expected to add further unrestrained snowballing entropic consequences.

Redundancy increases the chances of matters to be found, but hampers – in today's information-rich world – the unearthing of further matters of interest. Available suites of tools allowing knowledge workers to become curators themselves (Bhaskar, 2016) share – in the authors' view – a common flaw: they all claim to solve the excessive-redundancy-problem by offering competing siloed repurposed-content which unleash even more disconnected replication where the truth is drowned in a sea of irrelevance (Huxley, 1932/2010) and where valuable curative 'nano'-contributions are unable to impact the totality of the related copies in circulation.

Moreover, these information-obese environments are boosting biased cognitive selection strategies which favor content "that is more likely to be searched for, attended to, comprehended, encoded, and reproduced" and tend to amplify polarized views (belief-consistency and confirmation bias), downside risks (negativity bias), herding undermining better judgement (social information bias), and spurious correlations impairing objective assessment (predictive information bias) (Hills, 2019).

However, the symptoms of information obesity are not primarily technology-driven but by the way knowledge production, curation, and consumption is designed and organized by us. Currently, individuals "are largely not free to make their own knowledge, to develop for themselves the filters through which they can individually establish information needs, find relevant information, evaluate it and apply it in their value system. Both their working lives and personal lives [are] subject to intense [environmental] pressures, through which minds and habits are shaped, [automated, and immunized against change.] And so, our minds grow fat and indolent" (Whitworth, 2009), and outdated paradigms prevail.

In contrast, the expansion of private meme stocks by associatively linking personally relevant input streams affords members of the PKMS-DPE community to curate and 'visibilize' their work by voluntarily shared output streams. The WHOMER central knowledge base at the receiving end of the decentralized local individual updates aggregates the content together with its own historical record and novel high-level 'micro-macro-micro' additions. As one of the steps, every meme and connection is vetted to (1) identify and eliminate duplicates (in such case, identical memes from different sources are merged while their relationships with diverse meme sets and usage histories are consolidated to keep all information), and to (2) keep a reference record of every meme shared, even if it might be blocked from dissemination due to, for example, legal, ethical, or falsification reasons (any identical meme uploaded in the future is, hence, identifiable to trigger appropriate actions). The consolidated and centrally curated multi-disciplinary content updates the single unified Popperian-Third-World-equivalent WHOMER repository alluded to which automatically enriches the contexts of the members' personal input streams and/or can be queried by the PKMS community.

These personalized processes are performed according to individual curators' understandings and subject perceptions with subsequent automated socialization practices to inform the PKMS community referred to already as 'Social Digital Curating' (SDC).

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BIOGRAPHIES

Ulrich Schmitt's professional background includes IT and management consultant positions (London, Basle), professor and vice president at two independent German universities, Vice Rector (Polytechnic of Namibia) and Dean of the Graduate School (University of Botswana). He studied Management and Industrial Engineering (TU Berlin, Cranfield University), completed his PhD (Basle University) and a Science & Research Management Program (Speyer University). Focussing on Knowledge Management, he is currently Professor at the University of Stellenbosch Business School.
http://www.researchgate.net/profile/Ulrich_Schmitt2

Grandon Gill is a professor in the Information Systems and Decision Sciences department of the University of South Florida. He is also the Academic Director of the Doctor of Business Administration program at the Muma College of Business. He is Editor-in-Chief of the Journal of IT Education: Discussion Cases, also serving as a Governor and Fellow of the Informing Science Institute. In 2014, he was the inaugural recipient of the Zbigniew Gackowski Award for contributions to informing science research.

Proceedings of the Informing Science + Information Technology Education Conference

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Online July 7-8, 2020

THE EMERGENCE OF MUSIC STREAMING APPLICATIONS AND ITS EFFECT ON CHANGES IN PERSONAL INFORMATION MANAGEMENT AND PRIVACY RELATED ISSUES [ABSTRACT]

Maor Weinberger* Bar-Ilan University, Ramat-Gan, Israel maor89@gmail.com

Dan Bouhnik Jerusalem College of Technology, Jerusalem, Israel bouhnik@jct.ac.il

ABSTRACT

Aim/Purpose: In this exploratory study we examine personal information management within music streaming applications. Also, we investigate the sense of ownership over songs being played on music streaming applications and whether the use of these services may be considered a social activity. In addition, we explore the extent of user privacy concern in using music streaming applications.

Background: This paper represents the second phase of the article titled *Usage Habits in Music Streaming Applications and their Influence on Privacy Related Issues [Research in Progress]* (Weinberger & Bouhnik, 2019).

Methodology: The research is conducted using a mixed methodology and consists of two phases: qualitative and quantitative. The qualitative stage is a pilot which includes semi-structured interviews with three music streaming application users in order to explore the possible change in personal information management, following the emergence of these applications (e.g., changes in classification and song retrieval methods). The quantitative phase includes the distribution of closed ended questionnaires among 192 users of music streaming applications (Male – 72.9%, Female – 27.1%; Age: 18-58), aiming to explore personal information management issues and privacy related issues that emerge while using these applications.

Contribution: As far as we know, this is the first academic research to investigate the issue of personal information management among music streaming applications and the

Accepted by Editor Michael Jones | Received: December 31, 2019 | Revised: January 22, 2020 | Accepted: January 27, 2020.

Cite as: Weinberger, M., & Bouhnik, D. (2020). The emergence of music streaming applications and its effect on changes in personal information management and privacy related issues [Abstract]. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp. 79-81. Informing Science Institute. https://doi.org/10.28945/4523

also the first to use a mixed methods approach to examine digital music consumption. In addition, it is the first study that takes into account privacy related issues among the users of music streaming applications.

Findings — We found major changes between personal musical information management in the past and in the present. As most of the participants (85.4%) prefer nowadays to sort musical items in playlists or not to sort them at all. Out of the participants who chose to sort in folders in the past, only 42.7% still do it at present and out of the participants who chose to sort by alphabetical order in the past, only 15.7% do it at present. Also, we found that the participants have medium sense of ownership over the songs being stored on their streaming applications (M=2.78, SD=1.46) and medium sense that those applications may be used as social activity (M=2.75, SD=1.25). Interestingly, the choice of "sophisticated" genres (e.g. Blues, Jazz or Classical) as favorite music genre predicts the perception of using music streaming applications as part of social activity (R^2=0.044, $p<0.05$). As for privacy concern, it was found that although the participants are moderately concerned about privacy within music streaming applications (M=2.67, SD=1.15), they are willing to pay for higher privacy protection services if they will be offered to them (r=0.49, $p<0.001$). In general, participants were found to be moderately willing to pay for premium services (M=2.44, SD=1.01), with ad-free service (M=3.07, SD=1.54) being the highest ranked premium service.

Impact on Society — The research may drive music streaming applications operators to offer premium services that provide various benefits, such as: ad-free usage, higher privacy protection or better social features, as participants are willing to pay for those features. They may also personalize their users by preferred music genres, to adapt the specific service being offered to them.

Keywords — music streaming applications, personal information management, privacy, music genre, social activity

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BIOGRAPHIES

Maor Weinberger is a doctoral student at the Information Science Department in Bar-Ilan University (BIU), Israel. His professional interests include online privacy and anonymity and information security.

Prof. Dan Bouhnik is currently Head of Computer Science Department in Jerusalem College of Technology (JCT) and a faculty member in the Information Science department in Bar Ilan University (BIU) in Israel. He taught Computer Science and Logic in High Schools both in Israel and the United States. Dan is the author of a number of books used for teaching Advanced Computer Sciences in High Schools and his professional interests include virtual learning and its effect on the thinking process.

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Online July 7-8, 2020

WHY WE PERCEIVE THINGS DIFFERENTLY: AN INFORMING SCIENCE PERSPECTIVE [ABSTRACT]

Eli Cohen — Informing Science Institute, Santa Rosa, CA, USA — EliCohen@InformingScience.org

ABSTRACT

Aim/Purpose	The paper introduces new concepts including the cognitive map, message atoms, and message resonance.
Background	Existing models of the informing process cannot explain how messages are created nor how people deal with multiple messages.
Methodology	Theory development.
Contribution	The theories presented offer new ways to conceptualize the informing process.
Findings	The often-unrecognized narrative has a far-reaching impact on message resonance.
Recommendations for Practitioners	The paper shows ways to creates messages that resonate.
Recommendations for Researchers	The theory of the narrative should expand the conceptualization of those exploring the informing process.
Future Research	This paper forms a building block in a full model of the informing process.
Keywords	cognitive map, informing science, message fragment, message resonance

OVERVIEW

Shannon and Weaver created a mathematical model to illustrate issues in the transference of a single electronic message to a single electronic device. Human communication is more complex than this. Messages act on us in individualistic ways. The informing science frameworks for communications up to this point are adaptations of the Shannon-Weaver model and suffer from its limitations.

This research examines these limitations with the aim to create in the end of this research stream a model that addresses them. Limitations found in current models of the informing process include the following. First, people are confronted not with just a single message, but with multiple and often

Accepted by executive review by Editor Michael Jones | Received: May 12, 2020 | Accepted: June 16, 2020.
Cite as: Cohen, E. (2020). Why we perceive things differently: An informing science perspective [Abstract]. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 83-84. Informing Science Institute. https://doi.org/10.28945/4578

competing messages. Second, different people respond differently to an identical message. Third, current models start with a message, but we also need to model how the message is created, assembled, and sequenced from message atoms. Fourth, in addition to the "sender" and the "receiver" found in these prior models, there is another actor, the media editor in the middle who further filters, sequences, and packages message elements into messages.

This research draws together relevant research developed from a variety of fields, including as communications, philosophy, brain science, linguistics, and psychology.

BIOGRAPHY

Eli Cohen founded and now serves as the Executive Director of the Informing Science Institute and as Editor-in-Chief of two of its journals, Informing Science: the international journal of an emerging transdiscipline, and the journal Issues in Informing Science and Information Technology. He has a background in multiple disciplines, including psychology, statistics, business, and cat tending. He retired from the Kozminski University in Warsaw.

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SEMANTICALLY ENRICHING THE KNOWLEDGE PAYLOAD OF KNOWLEDGE OBJECTS THROUGH THE UTILIZATION OF KNOWLEDGE OBJECT WRAPPERS

Albertus Buitendag*	Tshwane University of Technology, Pretoria, South Africa	buitendagaak@tut.ac.za
Frederik Hattingh	Tshwane University of Technology, Pretoria, South Africa	hattinghfg@tut.ac.za

* Corresponding author

ABSTRACT

Aim/Purpose	In this research the authors present the designs of three different knowledge object meta-data wrapper models as a supportive technology to assist the knowledge intensive operations of a network of knowledge, such as a living lab.
Background	Within any knowledge driven network environment there is a need to increase the corporate knowledge capacity of the network. The role of experts and knowledge brokers are emphasized, and the exchange of knowledge based on prior experiences informing corporate memories of the members, is the departure point of this research.
Methodology	The primary research method applied is that of the design science research methodology supported by experience and application research and the literature.
Contribution	Three different metadata models are presented that will when implemented support the informing process within the network of knowledge. The models are grounded on the utilization of metadata elements composing of various key descriptors as found in activity theory and normal means of heuristic enquiry which entail common questions. The elements are annotated and further enriched using standard JSON-LD IRI pairs. The presented models expand on the extant knowledge of the use of metadata annotations and present a novel way in encapsulating the corporate memories of knowledge workers in the form of knowledge object wrappers.
Findings	The results of the evaluation process of the design science research methodology applied, showed that there is a consensus that the use of knowledge object

Accepted by Editor Grandon Gill | Received: February 6, 2020 | Revised: June 2, 2020 | Accepted: June 23, 2020.

Cite as: Buitendag, A., & Hattingh, F. (2020). Semantically enriching the knowledge payload of knowledge objects through the utilization of knowledge object wrappers. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 85-116. Informing Science Institute. https://doi.org/10.28945/4590

wrappers as additional metadata, containers could enhance the knowledge capacity and efficiency of a LL and in particular the knowledge brokers.

Keywords JSON, JSON-LD, knowledge objects, network of knowledge, knowledge object wrappers

INTRODUCTION

The value and efforts of corporate memory retention through the application of innovative knowledge management practices within knowledge driven networked organizations, such as living labs (LLs) are recognized in the literature (Burch et al., 2018; Cooper & Gorman, 2018; Mercier-Laurent, 2016).

In essence, a living lab (LL) is a collaborative innovation eco-space that enables and supports information infrastructure development, refinement, and adoption (Lucassen et al., 2014). Information infrastructure development could entail the development and management of digital artefacts to support the entrepreneurial operations of the LL for different digital platforms and support services (Le Dinh et al., 2018).

The most basic definition of the concept 'corporate memory' describes corporate memory as "the body of information that an organization needs to keep for re-use" (Megill, 2005). It relates to the entire body of knowledge that the organization requires to deliver its strategic aims and objectives (Khilwani & Harding, 2016). According to Kühn and Abecker (1998), "A Corporate or Organizational Memory can be characterized as a comprehensive computer system which captures a company's accumulated know-how and other knowledge assets and makes them available to enhance the efficiency and effectiveness of knowledge-intensive work processes."

Knowledge objects (KOs) are used to describe knowledge assets (Kutsikos & Mentzas, 2012). KOs are most frequently used within an organizational environment (Grover & Davenport, 2001), that also comprises of users such as a LL. Becker et al., (2016) explain that the learning community and the users "have to externalize their tacit needs, requirements, assets, knowledge, information, and experiences into explicit digital content and knowledge objects."

In this paper the conceptual designs of different types of metadata wrappers (or knowledge object wrappers KOWs) are presented to be used in conjunction with KOs to assist with the knowledge intensive requirements of a network of knowledge (NoK) such as a LL.

Also discussed is how KOs and KOWs could be used as the raw or semi-raw 'material' in a NoK, for the 'capturing', informing, management, and transfer of the tacit knowledge and the corporate memories of the various LL members, through annotations and semantic integration.

RESEARCH AIMS

Knowledge is the 'fuel' on which LLs function and operate (Bergvall-Kareborn & Stahlbrost, 2009). Knowledge and knowledge generation in LL environments are the driving engine for innovation and value chain optimization (Dekkers, 2011). Within LL environments it is imperative to consider and harness all the corporate memories of the stakeholder. The process of generating knowledge in a LL environment may take on many forms, such as knowledge generation as part of a NoK. To attain a sufficient level of knowledge support, a common understanding of the knowledge seekers' information needs is required, leading to establishing relevant, effective, and appropriate tools with usable content. This requires the interrogation of various sources of information to facilitate learning and empowerment though the interaction of various stakeholders (Mngomezulu-Dube et al., 2018).

Learning objects and knowledge objects have been described as ideal mechanisms to support information dissemination and learning in a NoK (Sychov & Chirtsov, 2018).

Bearing the above in mind, this research aims to:

- present the conceptual designs for three knowledge object wrapper (KOW) meta-data models, which could be used to describe and annotate the various knowledge objects used within a NoK such as a LL; and
- describe how KOs and KOWs are used as the raw or semi-raw 'material' in a LL enabled NoK, for the 'capturing', management and transfer of the tacit knowledge and the corporate memories of the various LL members, through annotations and semantic integration.

LITERATURE REVIEW

In this section the contents of the core literature pertaining to the conceptual aspects that underpins this study is illuminated by means of a literature review. The literature review covers the concepts of a network of knowledge, knowledge objects and semantic annotation using JSON-LD.

NETWORK OF KNOWLEDGE AND COMMUNITY OF PRACTICE

Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do better, as they interact regularly with one another (Wenger, 2011). A community of practice (CoP) often contains an intrinsic network of knowledge (NoK) (Nousala & Hall, 2008) and a NoK requires an integrated and active CoP for support (Nesshöver et al., 2016). Expanding on the relationship and difference between a CoP and a NoK, Hustad and Bechina (2012) explain that a NoK is a more focused type of CoP, with a stronger focus on a proactive knowledge management strategy. A NoK could also be a smaller constituent of a CoP, where the NoK has the responsibility to foster knowledge sharing within the CoP by providing mechanisms and functions to better leverage information and knowledge support by optimizing existing knowledge management practices (Sedighi & Zand, 2012).

The concept of 'knowledge in action' CoPs was presented by Lesser and Prusak (1999) when they explained that the word 'practice' as part of a CoP entails knowledge in action, due to the knowledge and know-how that each individual uses in performing their respective duties. In addition, knowledge in action CoPs also support the consideration that the dynamic interaction amongst the members also impacts the overall larger value chain of which the community is part (Lowitt et al., 2015).

Knowledge systems could also comprise of networks of linked actors, organizations, and objects that perform several knowledge-related functions (McCullough & Matson, 2016). These authors further explain that the various functions enable the network to link knowledge and know-how with action (including research, innovation, development, demonstration, deployment and adoption).

Figure 1 presents the common layered composition of a LL NoK comprising of various users, such as knowledge workers and other experts provisioned with various LL cloud-based services and tools. Of importance to this study is the LL knowledge base that consists of various repositories such as a knowledge object repository (KOR) and the knowledge object wrapper repository (KOWR).

The KOR contains meta-data descriptions of KOs applicable to the current LL domain, whilst the domain ontology repository (DOR) provides links and references semantic knowledge from external domains. The authors propagate the notion that DKOs may take on different forms and that Web 2.0 sources, such as YouTube and Facebook postings, are ideally suited for the purpose of inherent knowledge sharing as well. This could be described in conjunction with the application of tools and services such as the Zotero API and the Facebook platform.

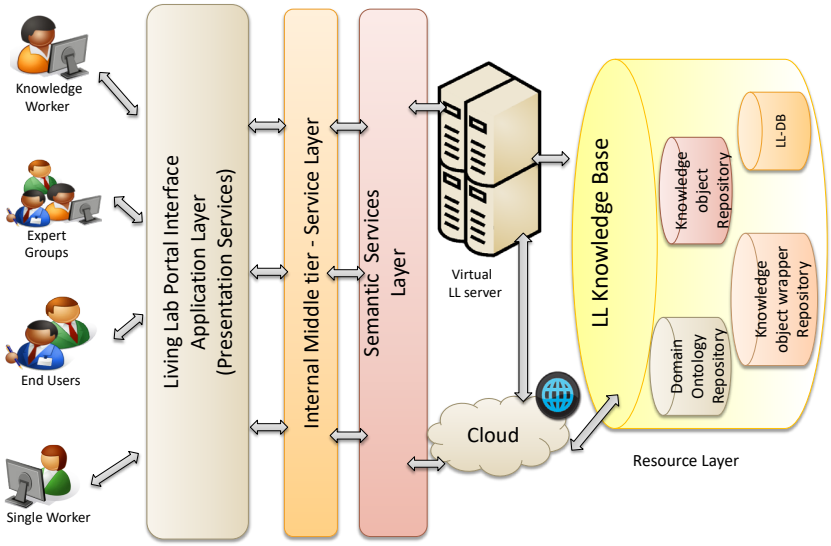


Figure 1. LL as a network of knowledge

From the above definitions and descriptions as depicted in Figure 1, it is evident that every participant of the NoK, portrays a role and that the individual actions of each participant could lead to knowledge sharing and learning within the community. Various tools and services (such as a question and answer service and a knowledge brokerage service) enable the knowledge driven operations of the LL including that of knowledge support.

KNOWLEDGE OBJECTS

The knowledge object (KO) concept is not new. KO is defined as being "a highly structured interrelated set of data, information, knowledge, and wisdom concerning some organizational, management or leadership situation, which provides a viable approach for dealing with the situation" (Bellinger, 2004). Some scholars regard a learning object (LO) which is defined by Wiley (2000), as "as any digital resource that can be reused to support learning which has been intentionally designed to support learning" and a knowledge object (KO) to be equivalent (Merrill, 1999; Paquette & Rosca, 2002). In contrasting various concepts relating to LO and KO, McGreal (2004) highlighted the fact that a KO is sometimes regarded as a component of a LO.

A knowledge object (KO) is described by a simple knowledge ontology, such as inner metadata tags or elements of the sharable content reference model (SCORM) which is written to the knowledge repository or knowledge base of the LL. The repository inter alia stores meta-data (using KOWs) of stored artefacts in an external knowledge base. In applicable instances meta-data are generated using the METS schema, which is a standard for encoding descriptive, administrative and structural metadata (*METS: An Overview & Tutorial*, 2013). Additional web sources are also gathered with semantic processes from the Web itself. This may include links to other Web 2.0 sites and the extraction of other possible and potential KO meta-data. The semantic extrapolation process generates tags which are compared with existing meta-data, using semantic pattern clustering in the semantic knowledge repository, which matches existing classes, relations, axioms, functions and instances of prior searches and results.

As far as knowledge objectives are concerned in this research, the focus is on digital knowledge objects semantically described by knowledge object wrappers. A digital knowledge object (DKO) is described as an instrument for the contextualization and re-contextualization of knowledge in order to facilitate the provision of advice and to aid in the learning processes of a computer or an individual (Flynn et al., 2016).

Figure 2 shows the authors' diagrammatic conceptualization of a most basic form of a DKO based on the work of Flynn et al. (2016). Throughout the rest of this paper, a DKO and a KO are considered as synonyms and the concepts are used interchangeably.

Figure 2 depicts the concept that a DKO contains at least one asset, referred to by Flynn et al. (2016) as the knowledge core or payload, which could take on different forms (such as digital content, notes, and other LO related artefacts) and an optional basic meta-data layer describing the object or knowledge asset. Some digital assets could include meta-data by default, such as YouTube videos (Rangaswamy et al., 2016) and pdf documents (Xu et al., 2016). It may also take on the form of a SCORM manifest file if the KO is in the form of a SCO where the manifest file is described by XML meta-data (*SCORM solved and explained*, 2018). In certain cases, the digital resource or asset could also have an existing Dublin Core (DC) meta-data record, either embedded within the digital asset itself or contained as a separate record entry stored elsewhere (DublinCore.org, 2012).

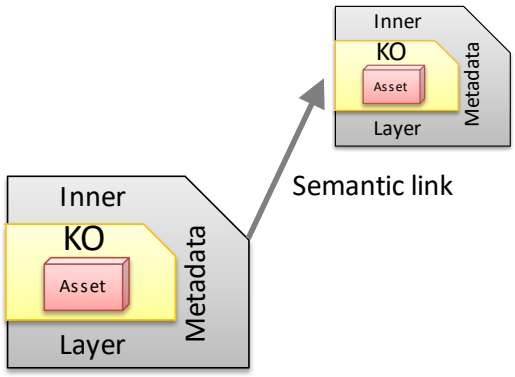


Figure 2. DKO in its most elementary form

In the context of this research, important considerations in the light of the above definition of a digital knowledge object (DKO) by Flynn et al. (2016) relate to the idea that the knowledge payload of the DKO could refer to any digital knowledge object, which is described in part by a meta-data wrapper. The main purpose of a KO is regarded as being to allow the holder of the KO to gain more knowledge or to be provided with new insights and to know better (Hsu et al., 2007). According to Bedford (2012), one of the most important KOs in any organization consists of the persons or people involved in the organization's business. This author stresses that people's 'personal knowledge' is the predominant asset for all organizations in the new millennium.

The notions of Woźniakowski et al. (2014) and of Flynn et al. (2016), that LOs or KOs could either be linked by a common relationship or by some kind of meta-data ontology scheme are also important for this study. Interlinking various KOs with one another and that to a user or case, would create the opportunity for discovering new patterns and trends.

JSON-LD

JSON (JavaScript Object Notation) is a lightweight data-interchange format which humans can read and write, and machines can easily parse and generate (*Introducing JSON*, n.d.). JSON is often used as a technology to describe digital content and knowledge such as metadata wrappers in knowledge intensive environments and systems (Lanthaler & Gütl, 2012; Sporny et al., 2014).

Linked Data (JSON-LD) is an initiative which utilizes JSON to provide linked data capabilities. JSON-LD is easy to interpret by both humans and machines and it provides a way to help JSON data interoperate at Web-scale (Sporny et al., 2014).

JSON-LD differs from JSON as JSON-LD also provides:

- a universal identifier mechanism for JSON objects via the use of IRIs;

- a way to disambiguate keys shared among different JSON documents by mapping them to IRIs via a context;
- a mechanism in which a value in a JSON object may refer to a JSON object on a different site on the Web;
- the ability to annotate strings with their language;
- a way to associate data types with values such as dates and times; and
- a facility to express one or more directed graphs, such as a social network, in a single document. (Sporny et al., 2014)

Currently, the JSON-LD 1.1 enhancements and specifications are being standardized and drafted, (see https://www.w3.org/TR/json-ld11/). In addition, JSON-LD is based on an entity-centric approach where traditional Semantic Technologies are based on a triple centric approach (Lanthaler & Gütl, 2012). According to Steiner and Mirea (2012) "JSON-LD is a format for expressing directed graphs, mixing both Linked Data and non-Linked Data in a single document. JSON-LD allows for adding meaning by simply including or referencing a so-called (data) context." It is added that JSON-LD objects can easily be encoded and transformed into RDF graphs, which in turn could be encoded as plain JavaScript objects with an additional nested object that contains the mapping from keys as well as values to RDF properties, URIs and literals (Garrote & García, 2011; Steiner & Mirea, 2012).

The utilization of the JSON-LD notation with standard nested references to vocabularies is suggested by the researchers in order to provide semantic concepts for standard items used as part of the knowledge object wrapper model as presented later.

As part of the example JSON-LD document, the keywords @context and @id provide the basic functionality of JSON-LD, where the @context is used to map terms to an internationalized resource identifier (IRI) and the @id is used to uniquely identify the node objects labeled in the document with IRIs (Sporny et al., 2014).

Various IRIs could be used, including the following:

- Dublin core meta-data initiative that represents a set of vocabulary terms which could be used to describe digital resources. (See http://purl.org/dc/terms/).
- Friend of a friend vocabulary for linking people and information. (See-http://xmlns.com/foaf/0.1/).
- GeoJSON, vocabulary set relating to geographical and spatial information. (See https://purl.org/geojson/vocab#).
- Provenance vocabulary set, that represents "information about entities, activities, and people involved in producing a piece of data or thing, which can be used to form assessments about its quality, reliability or trustworthiness" (https://www.w3.org/TR/2013/NOTE-prov-overview-20130430/). (See http://www.w3.org/ns/prov#).
- Very popular and widely used schema vocabulary (in the form of different schemas) for structured meta-data representation and encoding for various web-based sources. (See http://schema.org/).
- Simple Knowledge Organization System vocabulary and data model for sharing and linking knowledge organization systems (See http://www.w3.org/2004/02/skos/core#).
- XML schema vocabulary describing various XML schemas and their composition (See http://www.w3.org/2001/XMLSchema#).

Figure 3 provides an example of a listing of a JSON-LD document (rendered at http://json-ld.org/playground/) which could be used to represent a partial representation of the user entity as presented as part of the Knowledge Object class model.

```
{
  "@context": {
    "name": "http://xmlns.com/foaf/0.1/name",
    "homepage": {
      "@id": "http://xmlns.com/foaf/0.1/homepage",
      "@type": "@id"
    }
  },
  "@id": "http://www.facebook.com/EdwardBaloy",
  "@type": "http://xmlns.com/foaf/0.1/Person",
  "name": "Edward Baloy",
  "http://xmlns.com/foaf/0.1/title": [{
    "@language": "en",
    "@value": "Dipl.Agric-Sci."
  }, {
    "@language": "en",
    "@value": "BSc"
  }],
  "http://xmlns.com/foaf/0.1/workplaceHomepage": {
    "@id": "http://www.agrisa.co.za/"
  }
}
```

Figure 3. Example JSON-LD document describing a user

METHODOLOGY

The main research strategy followed in this study is that of design and creation research. A design and creation research strategy focuses on developing new IT related artefacts which could include models that "represent a situation and are used to aid problem understanding and solution development" (Oates, 2005, p. 108).

Figure 4 shows the design science research methodology (DSRM) process model as developed by Peffers et al. (2007) and used in this study. The process model comprises of a set of six distinct activities, which are represented as the rectangles in Figure 4. In the figure the entry point of this particular study is indicated, as well as the use of the experience and application research method (see ISTAG EAR report, 2004) deployed to assist in defining the objectives of the solution and as part of the design thereof. The applicable solution or artefact designed as part of this study is that of the different sets of KOWs used to semantically describe and enrich the direct and indirect knowledge payload of a KO. As shown in Figure 4, each of the activities presents a clear and concise set of guidelines and activities on which a DSR study could be based. Sandkuhl and Fellmann (2017) point out that as presented by Peffers et al. (2007), the model "provide[s] a procedural reference model to guide DSR research processes and a vocabulary to communicate the research entry point and phases."

With the first activity of the DSRM process model having been dealt with above, the focus now falls on applying activities two to five of the DSRM process model in this study, as illustrated in Figure 4. This discussion entails respectively defining the solution objectives; the design and development of the KOW metadata models; KOWs as a metadata illustration using JSON-LD; and an evaluation of the various KOW artefacts. This is followed by wrapping up and making a case for KOWs before dealing with its communication, the sixth activity of the DSRM process model.

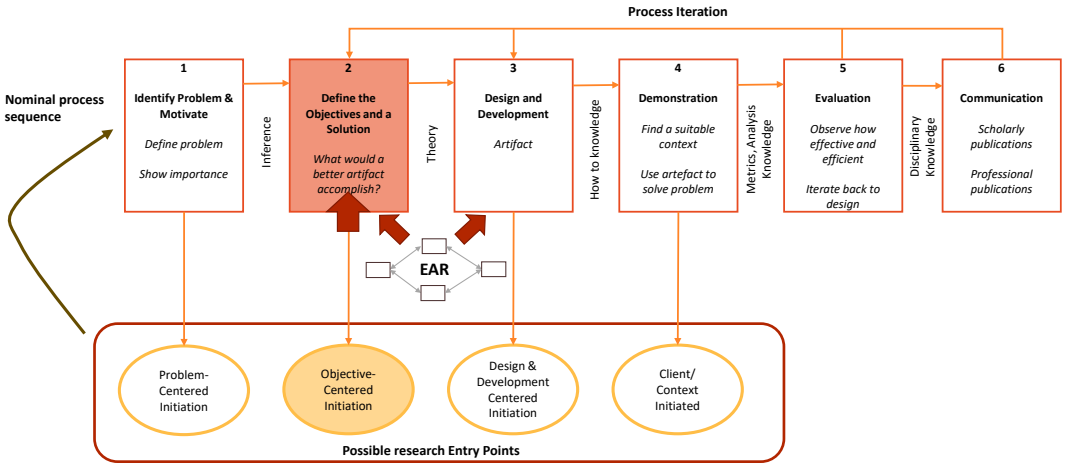


Figure 4. DSRM process model (Peffers et al., 2007)

Defining the Solution Objectives

As highlighted in Figure 4, the entry point of this research is dealing with an objective-centered solution (activity 2). As noted in the introduction the main objectives of this research are as follows:

- To present a conceptual design for a knowledge object wrapper (KOW) meta-data model which could be used to describe and annotate the various knowledge objects used within the LL environment.
- To describe how KOs and KOWs are used as the raw or semi-raw 'material' within a LL (as a NoK supported by various tools and services), for the 'capturing', management and transfer of the tacit knowledge and the corporate memories of the various LL members, through JSON-LD annotations and semantic integration.

The attainment of the objectives allows answering the following research question:

> *How can a KOW be modeled to incorporate the use of metadata tags annotated with JSON-LD to assist the knowledge workers with their knowledge support and knowledge related operations?*

The main proposition in this research is that question-and-answer pairs could be used as metadata elements constituting the design and composition of a KOW.

None of the scholars whose research was studied propagate or suggest the implicit use of questions as part of the meta-data schema from which the KOW could be constructed (Alshawi et al., 2006; Bannan-Ritland et al., 2002; Flynn et al., 2016; Seo et al., 2001). The use of questions and the linking of answers to extension source documents are suggested by Sanga, et al. (2016), but no details are given of how these questions are linked to the knowledge sources.

For the researchers, the idea to use questions as meta-data tags held a promise to address the question of how the tacit knowledge of a knowledge worker could be to some degree encapsulated. The use of questions has a two-folded impact: firstly for the reader of the questions and the subsequent answers linked to it, as well as for the knowledge worker who has to present some form of interpretation through internalization (or as part of the process for capturing of the relevant descriptions based on questions). KOs as accelerated epistemic objects (Zwick & Dholakia, 2006) have the potential to raise particular questions by embedding or describing knowledge therein, for which answers could be found and knowledge be generated (Ewenstein & Whyte, 2009). In other words, the knowledge worker needs to apply his or her cognitive ability in the creation (completion of the annotation) of the KOW entry, and as part of interpreting a KOW of an existing digital asset or KO. The application of the cognitive ability in thinking about how a particular KO is used and how it materialized in the experiences of its user and creator, relates to the concept of 'agential realism', where

knowledge is regarded as someone's view and experiences (Barad, 1996). Agential realism has the potential to address and limit the tacit knowledge gap in traditional knowledge systems. Holford and Hadaya (2017) explain that agential realism could be accomplished, "by creating an opportunity for individuals (or groups) who possess and act out embodied tacit knowledge to continue to do so in the presence of communication and information technology, which in turn, act as enhancers of tacit knowledge creation and sharing within the groups or individuals in question."

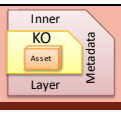
Design and Development of the KOW Metadata Models

The design and development of the KOW metadata models (as the artefacts) of this research (activity 3 in Figure 4) entailed two different sub activities. In the first sub activity the design requirements of the KOW are given attention which is followed by the second sub activity, the actual designs of the proposed models.

Presenting the design requirements of a KOW

The design requirements for a KOW to be used within a LL environment as part of the knowledge service provisions and tools are set out in the Table 1. One of the main objectives of a KOW is to allow for the encapsulation of knowledge related meta-data that will assist the knowledge workers and services, with processes to identify appropriate knowledge sources and to establish possible knowledge and other resource linkages.

Table 1. Design requirements of a KOW

KOW design requirement Code and description 	Explanation / Clarification
KOWDR1 KO should reference an asset	A KO should reference at least one KO, LO or sharable content object (SCO).
KOWDR2 A KOW should allow one KO to link or reference 0 to M other KOs	Multiple KOWs should be able to link to other KOWs.
KOWDR3 Single KO would have multiple KOW from single or multiple users	A KO could have more than one associated KOW annotated by one or more users.
KOWDR4 The included meta-data should reference existing schemas and vocabularies	For semantic interoperability and discovery, a KOW should comprise of meta-data data elements that also reference existing semantic vocabularies and schemas such as resource description frameworks (RDF)s.
KOWDR5 KOW should reference case, use and experience related meta-data	The case and associated question and other experience related metadata, such as the value and the applicability of the KO towards the solving of the problem or towards the provisioning of an answer, should be stored. Experience meta-data in the form of ratings/endorsements and the applicability of the KO should also be stored.
KOWDR6 KOW should encapsulate existing knowledge taxonomies tied to questions	Meta-data to tie and connect data elements to existing ontologies and schemas should also be included. This for example, includes meta-data in relation to the persons, products, events, things and other schema objects.
KOWDR7 Data interchange should be presented in JSON and/or JSON-LD format	In order to submit structured KOW meta-data between various services, JSON or JSON-LD should be supported.
KOWDR8 KOW should be managed separately from the KO and referenced data sources	KOW wrapper meta-data should be managed separately to avoid duplication of SCO and other KO resources and ease retrieval and the management thereof.
KOWDR9 KOWs should be stored in their own LL Knowledge base (repository)	The descriptions and relational meta-data of the various KOWs should be stored and managed in a separate knowledge base.

The designs of the KOW meta-data models or layers

Attaining the first research objective is the focus of this subsection, namely, "To present a conceptual design for a knowledge object wrapper (KOW) meta-data model which could be used to describe

and annotate the various knowledge objects used within the LL environment". This is discussed under the headings relating to three concepts and design propositions, namely the -

- knowledge case meta-data layer;
- question and answer view meta-data layers; and
- KCML-KOW Domain class diagram and code illustration.

With reference to Figure 2, a DKO is depicted in its most elementary form. The next two subsections suggest the inclusion and design of two additional layers of meta-data elements annotated and presented in the form of KOWs. The first suggested layer is discussed next, followed by another set of meta-data layers (referred to as the question and answer view meta-data layers) where the knowledge worker has the option to use either one, both, or none of the second layer alternatives. Each of the layers described below could be regarded as optional additional meta-data wrappers tightly coupled to a KO reference or instance. These discussions are followed by discussions regarding the KCML domain class and an illustration of how KOWs could be semantically described and enriched using JSON-LD.

The knowledge case meta-data layer

One way in which the use of an existing KO or group of related KOs could be significantly enhanced is through the inclusion of meta-data relating to the case (that is the 'use' case) to which and for which the KO is tied and or associated. The following basic class diagram (Figure 5) depicts the researchers' conceptual suggestion for a meta-data layer (in the form of a wrapper) that, from a knowledge worker activity perspective, contains some descriptive meta-data.

As illustrated in Figure 5, the meta-data are related to some of the main applicable classes and the basic association between one another. The *Subject* (for example the knowledge worker) is assigned to a particular *Case* for the provisioning of one or another knowledge support *Service*. Service provision is based on a *Request* and a request is grounded in a *Question*. The *Subject* (that is the knowledge worker interacts with the *Object* (namely the knowledge seeker).

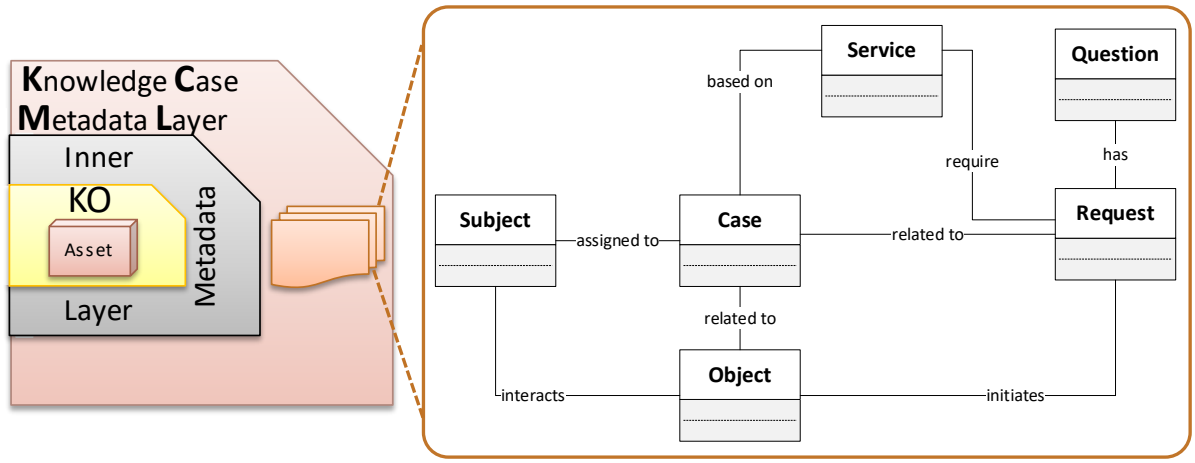


Figure 5. Elements of the KCML-KOW

The concept of a KO which could provide a linked answer to a single question, or a multiple of questions and combination of KOs to a single question, is also possible (as depicted in Figures 6 and 7). The KCML-KOW is linked to a KO and one KO could be described by various KCML-KOWs. As depicted the KCML-KOW also contains a pointer to a question embedded as part of the KOW and the answer to the question contained within the original KO. The answer to the question is contained within the KO and the KCML-KOW describes both the question and the answer in the form of meta-data descriptions.

The *Object* is related to a particular *Case* and is primarily responsible for the initiation of the *Request*, which is related to some, or other question or knowledge request. The following two additional viewpoints also need to be clarified:

- A singular KO (which might also be a SCO or SKO) aggregated and described with an inner meta-data layer (IML) could be annotated with more than one KCML-KOW. Each KCML-KOW could have the same or different authors (namely the *Subject*) based on the contextual use of the KO as represented in Figure 5.
- A KOW could also include a set of questions relating to each KO with the aim of encapsulating the externalization and internalization processes of the individual knowledge worker.

Figure 6 illustrates the researchers' notion, in line with the conceptual presentation of Woźniakowski, et al., (2014), about the different connection paths possible between various DKOs (also compare Figure 2) where one single KO (which could also be a SCO or a SKO) could be described by one or a multiple set of KCML-KOWs, where each KOW relates to a question for which there is an answer. As shown in Figure 6, it is suggested that a KO with a base inner meta-data layer (IML) could have one or more related KCML-KOW, each of which could be related to its own case, with one or more creators. The typical creators of the KCML would be the applicable knowledge workers within the LL. Therefore, if different knowledge workers are assigned to a particular case, different KOs could be utilized and annotated for the purpose, as each knowledge worker could have his or her own perspectives and insights about the case. It could also be that different KOs could have the correct possible and alternate sources of information for the solution that is the answer to the intrinsic main question of the case. One other possible scenario could be that there are related cases from a previous request or case, which could be utilized and analyzed for use with the new or arising case.

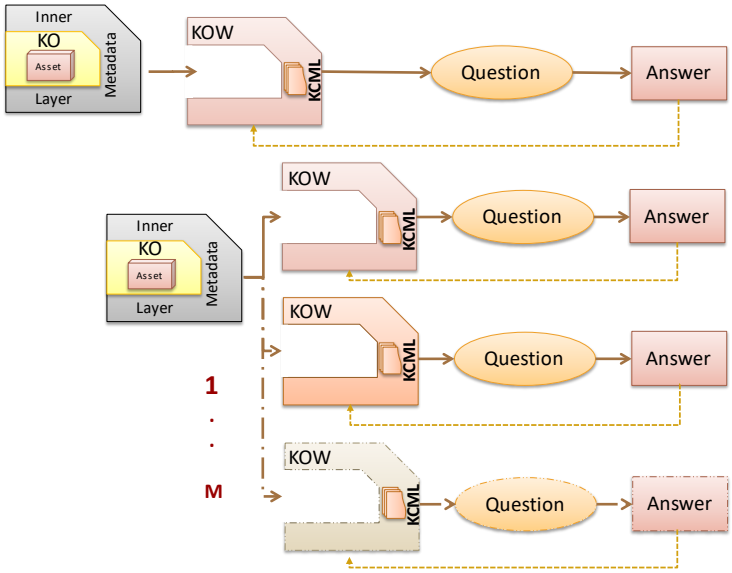


Figure 6. KOW as a meta-data envelope linked to a question

The question and answer view meta-data layers

In order to provide an even richer related meta-data set to each KO primarily described by an IML-KOW, two additional optional interchangeable meta-data layers are suggested as motivated and explained next.

Answering a set of questions relating to a KO, could further describe the current KO in terms of its purpose, meaning and use. Presenting this type of additional meta-data (in the form of answers to a set of questions) to the user of the KO and storing it for the user, could further enhance the learning, understanding and knowledge transfer processes as part of the knowledge support activity. This

should not be mistaken for the main question related to the case, as they are questions from which the answers are further descriptors to the case and the usefulness applicability and application of the KO. This ultimately leads to improving the KM practices of the LL. In some essence it aims to capture some of the tacit knowledge of the knowledge worker in relation to the KO and the knowledge requirements at hand.

Figure 7 presents the suggestion that two additional alternate meta-data layers could be included for each KO. In essence a KO could have one or either of the two layers as meta-data descriptions and each KO could also have zero or more of each meta-data description.

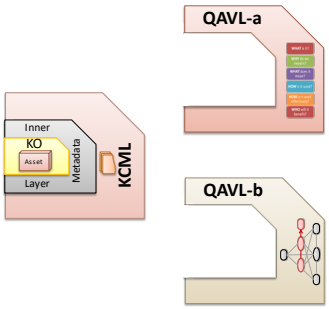


Figure 7. Additional meta-data layers based on questions

In Figure 7, a wrapper indicated as 'Question and Answer View Layer' (a QAVL–a), lists questions in relation to the instance of the KO. The second layer, QAVL–b lists questions in relation to the use of the KO as a tool for the knowledge extension activity, based on the common questions and elements in relation to those of activity theory (compare Engeström, 1999).

Figure 8 proffers an example of a set of questions with their corresponding suggested answers, that when included as part of a KO, would present an additional layer of meaning to the KO.

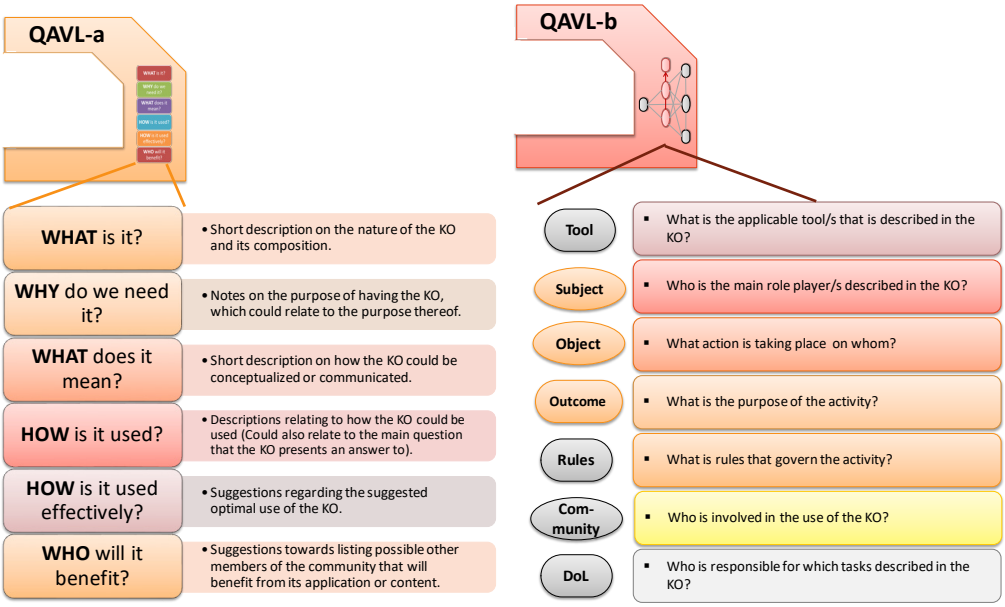


Figure 8. Question and answer view - meta-data layer A and B

It should be noted that the questions and the set of answers are not the only meta-data stored as part of the KO. Other types of meta-data are also stored, such as the question itself and the case to which the KO is linked. This is described in the next sections as part of the suggestion and development phases.

To illustrate the practical use of the questions as meta-data elements and stimulate the internalization process of the individual knowledge worker, the concept of a KOW based on the questions is presented. Table 2 gives a description of a KOW using the set of questions offered in Figure 8, as an example to illustrate the concept 'typical meta-data answers' as answered by the researcher (who take on the role of knowledge workers) and where applicable substantiated by the literature.

Table 2. Typical meta-data annotations relating to the different QAVL layers

QAVL-a (Based on common questions)		QAVL-b (Based on the elements of Activity Theory)	
Meta-data question element	Descriptive illustrative answer	Meta-data question element	Descriptive illustrative answer
WHAT is it?	A KOW is a meta-data structure which stores data relating to a KO in a relational DB as part of the applicable company (such as a LL) knowledge base. The meta-data could easily be transformed to JSON-LD documents for interoperability and exchange between various knowledge-based services. Data relating to the KO and other entities involved (such as the users, the case for which the KO are required and the link to where the KO could be found, which is the URL) are stored and captured for future use and inferences.	**Tool**	Any applicable service that utilises KOs. For example, QAS, Knowledge interchange service or the EKB service.
WHY do we need it?	There is a need to be able to capture the essence of know-how and innovation embedded within a single or various knowledge sources (Frappaolo & Capshaw, 1999; Joshi et al., 2007; Meihami & Meihami, 2014), such as a KO or the know-how of a knowledge worker. Storing various meta-data descriptions as well as related questions, presents the LL with a source of data which could be linked to other ontologies for semantic interoperability (da Silva et al., 2014), improved levels of integration and better exploitation of inherent knowledge and synergies (Wruck et al., 2014).	**Subject**	The knowledge worker that utilises a service to better understand and interpret available knowledge for dissemination purposes.
WHAT does it mean?	It means that better mechanisms for provisioning knowledge support in a knowledge driven environment could be created as part of the operations of various services and tools. The thought processes of the individual knowledge worker are also captured when various patterns between the data and KO sources overlap (Smith, 2001). The data stored will be available for later referral and inferences and for analysis with a view to the discovery of possible trends and patterns (Nayak, 2002). It also provides the opportunity to discover and create connections or patterns between various KOs (Hodgins, 2002) and KOWs in relation to the different questions and meta-data relating to the questions that it encapsulates. It furthermore means that having such data available in conjunction with the utilisation of KOs in the organisation, should provide a competitive advantage to the members (Jing Cao et al., 2016; Mentzas, 2004; Pires & Cota, 2016) and the respective knowledge workers as part of the network of knowledge. It would also improve the knowledge workers' capacity to gain access to knowledge, solve problems and provide answers to questions (Al-Omari et al., 2016). This implies that the application of KOWs would also require the active participation of the knowledge workers to be more involved and apply various thinking processes both in the capturing of the meta-data and its interpretation.	**Object**	The knowledge seeker that has a knowledge request. Existing KOWs are analysed and evaluated to assist the knowledge worker to best help with the knowledge seekers' request for information.

HOW is it used?	The use of KOWs (which includes capturing the required meta-data) is related to the use and knowledge management processes (KM) of KOs (see Ale, Toledo, Chiotti & Galli (2014)) as part of the network of knowledge (NoK). As each KO is described and annotated by knowledge workers and stored as part of a repository, more data could be available for future inferences and knowledge retrieval (Ale et al., 2014). KOWs could carry a rating load in relation to the KO and the question that the KO aims to address.	**Outcome**	How did the KOW address the problem or information request of the knowledge seeker? Were the KOWs analysed adequate and did the knowledge support rendered, have the desired effect in terms of learning and knowledge dissemination?
HOW is it used effectively?	The effective use of the KO is dependent on the constant creation, and maintenance thereof as well as the KOW that annotates it. The effective use of the KOW will also be dependent on the tools and services that are provided for the management and use of KOs in the NoK (such as the LL) for the various knowledge workers, and in the case of this research for the individual or groups of extension officers.	**Rules**	Relates to the procedures and policies regarding the creation, maintenance and annotation of the KOWs.
WHO will it benefit?	The application of KOWs to annotate KOs as part of the knowledge support service provisions of the LL, would benefit the various knowledge workers, the community that the knowledge workers serve and the larger value chain.	**Community**	Relates to the community and entities that are intrinsically referenced within the applicable KOW references as well as the community for which the KOs and KOWs are used as knowledge support.
		DoL	Relates to the work that the knowledge workers are required to do with regard to the annotation of KOWs based on knowledge requests as well as the use of existing KF and KS services as part of the knowledge factory portal interface.

Table 2 illuminates the suggestion of how various questions and QAVL elements could be used as practical meta-data descriptions. The following additional elements for suggesting how various questions and QAVL elements could be used as practical meta-data descriptions, could be added, and annotated as part to the KOW included meta-data:

- Presenting the main question to be addressed as part of the knowledge support request, by the knowledge seeker.
- Suggestions relating to the case, problem, community, or the project that the extension officer (as the knowledge broker) is assigned to (Hlatshwayo & Worth, 2016).
- Suggestions about the skills set, technical knowledge and expertise of the extension officer (David & Samuel, 2014; Suvedi & Kaplowitz, 2016).
- Descriptions relating to the composition of the applicable KO (as a specialized LO) that the KOW describes. Such descriptions could include the title, details, segment and topics, perceived difficulty and level and the content link (Davies & Newell, 2015; Sabitha et al., 2016) of the KO or LO (which could be aggregated as a set of digital assets (Yaghmaie & Bahreininejad, 2011; Zouaq et al., 2007).
- Suggestions about the linked answer and other knowledge resources supplied to the knowledge seeker (in relation to the knowledge request) and the position and composition thereof as part of the KO. (It is promulgated by this research that the applicable KO contains the answer to the question at hand).

In essence, the proposition of the use of KOWs relays to the enhancement of the knowledge support activities of the LL through the creation of provisions in the form of services, which are enriched through the application of meta-data. The meta-data are captured as part of a KOW, where the meta-data include some of the knowledge workers' thought processes and other semantic descriptors such as to why the KO is useful, how it was used to address a problem, and to whom the KO could be

recommended for future use. In other words, stating for whom and in which cases the KO could be used in the future to partially or completely (where a rework of the KO would be required) provide an answer to a knowledge support request.

KCML-KOW domain class diagram

The previous two subsections presented descriptions relating to the awareness and suggestions about the design of a KOW. In this subsection the development stage of the design and creation methodology is addressed in the design of a domain class diagram for the storage of the applicable meta-data that a KCML-KOW would comprise of.

JSON-LD is a semantically enriched and fully compatible extension of JSON which allows developers to present meta-data and other entries linked to common vocabularies (Lanthaler, 2013). Many popular web-based software services and tools such as LinkedIn, Twitter, Meetup and Zotero (for research purposes) utilize JSON as an interchange format that could easily be transformed to meaningful JSON-LD documents (Young, 2016). This is particularly appealing to this research, since JSON-LD could be used as a data format for the description of a knowledge object wrapper (KOW). For the purposes of this research, a KOW is regarded as being able to provide an 'additional layer' to current meta-data models, with the specific objective to include questions, as well as unique cases as part of the meta-data. For the researchers, the main idea behind the implementation of the KOW is not to substitute or replace existing meta-data models, but to extend the models with new functionality, by adding a new dimension with additional semantic content, besides that of tags in the form of questions.

Referring to the conceptual class model as part of Figure 5, the extended domain class model that follows (Figure 9) is presented. This extended version includes an indication of various subclasses and an indication of the specialization relationships for each of the classes. Figure 9 represents the domain class diagram with various domain classes that also relate to various vocabularies as part of the schema.org domain. The main notion is the idea that a case refers to a KO and that a KO contains a creative work reference. The other classes relate to the knowledge case instance.

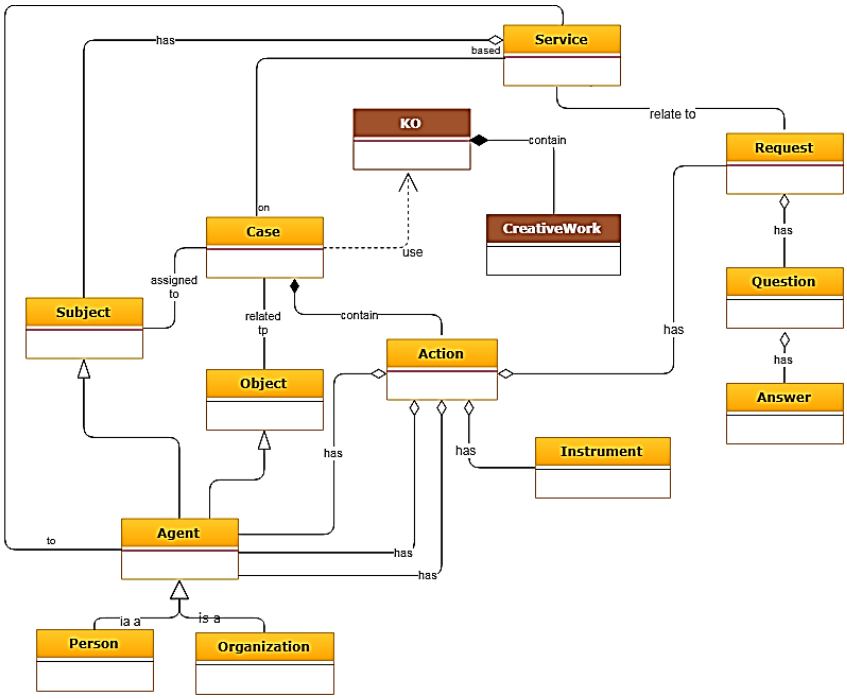


Figure 9. KCML-KOW domain class diagram

Table 3 describes all the domain classes presented in Figure 9 with a short description of their relationships and association with one another and possible IRIs.

Table 3. KCML-KOW domain class description and related IRIs

Domain class	Description and relation	Possible IRIs
Case	The *case* class represents the applicable case that is opened and instantiated by the subject in relation to a knowledge request. The case object relates to the particular agent that is assigned to the case'. A case is dependent on a knowledge object. A case also comprises of an action.	http://dbpedia.org/ontology/Case
Subject	The *subject* class represents the base class for an agent object which could be either a person or an organisation. The subject triggers the instantiation of a case.	http://schema.org/Person https://schema.org/Organization
Object	The *object* class represents the base class for an agent that is responsible for managing the applicable case. The object responsible for a case could either be a person or an organisation. The agent in this regard could perform the role of a broker.	http://schema.org/Person https://schema.org/Organization
Agent	The *agent* represents the base (superclass) of the person or organisation that is involved in an act. Both the subject and object are super classes for the agent object.	http://dbpedia.org/ontology/Agent http://xmlns.com/foaf/spec/#term_Agent
Person	The *person* class represents a human being. In this research the person could either be a knowledge seeker, knowledge agent, or any person that is involved in the LL processes.	http://schema.org/Person
Organization	The *organisation* class represents an entity such as a business, school, higher educational institution, bank, or government department.	https://schema.org/Organization
Action	The *action* class relates to an action performed by an agent on an object. The object here is not an object class instance, but rather a thing or artefact.	https://schema.org/Action
Instrument	An *instrument* is the tool used as part of an action. It relates to the object that the agent used to perform the action.	https://schema.org/instrument
Service	A *service* is provided by an organisation (which is an agent). A case is based on a services request. A service relates to a request.	http://schema.org/Service
Request	An action relates to a *request*, and a request is part of a service.	https://schema.org/InteractAction
Question	A request has an intrinsic *question* and a question has a potential answer. A question also has an aggregated list property to an item list. This item list could be a list of applicable KOs.	https://schema.org/Question
Answer	This refers to the *answer* or set of possible answers to a question. The answer in itself could refer to a list of possible answers, which could be contained within a question object.	https://schema.org/Answer
KO	A *KO* relates to a case. The KCML-KOW refers to a particular KO and is dependent on it.	https://schema.org/Thing
CreativeWork	A KO contains a *creative work*. This relates to any type of artefact created by a person, such as a book, article, tool or video.	https://schema.org/CreativeWork

KOWs - A META-DATA ILLUSTRATION USING JSON-LD

This section about KOWs as a meta-data illustration using JSON-LD, entails a simple demonstration of the practical application of KOWs (action 3 shown in Figure 4). In order to explain how a typical set of KOWs could be rendered in JSON-LD, the researchers constructed three illustrative examples respectively in the form of an:

- inner meta-data KO layer example (compare Figure 6);
- example of how a KCML-KOW dataset could look like, based on a knowledge case (KCML-KOW); and
- example of an QAVL-a meta-data layer.

The examples that follow are based on the following realistic scenario of an emergent farmer (knowledge seeker) seeking advice from an extension officer (knowledge broker):

Andries Nkadimeng is an emergent beef farmer in Vissershoek. He wants to know "*Which cattle breed is best for beef in South Africa*?". In order to obtain assistance with his query, he sought advice from the National Emergent Red Meat Producers' Organisation (NERPO). A chief breed advisor named Jackson Baloyi which deals with extension requests was assigned to help Andries. Jackson opened a case to assist him with the action of dealing with Andries' question. When the case was opened, unique identifying keys were created for the case and the associated action. Being part of a larger LL and having access to the various KF services and tools, Jackson used the question and answer service tool to search for possible corresponding cases and similar questions stored in the LL KB. Some answers and matches were returned, but Jackson also decided to do a normal Google search. This search resulted in him finding an article online as part of the Farmers Weekly website (Coleman, 2017). Jackson decided that the article is very suitable to assist Andries and extracted the article's meta-data with the knowledge object wrapper management service (a tool that is part of the service layer of the LL, compare Figure 1). The newly created knowledge object wrapper was also allocated a unique key which was assigned to the case.

Figure 10 consists of a basic 'use case' diagram of an extension officer initiating an extension request. The use case diagram presents the two main cases and their applicable related cases. As depicted in Figure 10, the applicable knowledge worker creates a case entry. This action includes assigning an object in relation to the case that refers to the subject which is the knowledge seeker. An applicable agent is also assigned. It may be the knowledge worker him or herself, or it may be a search based on previous cases and expertise (this is not included in the use case diagram).

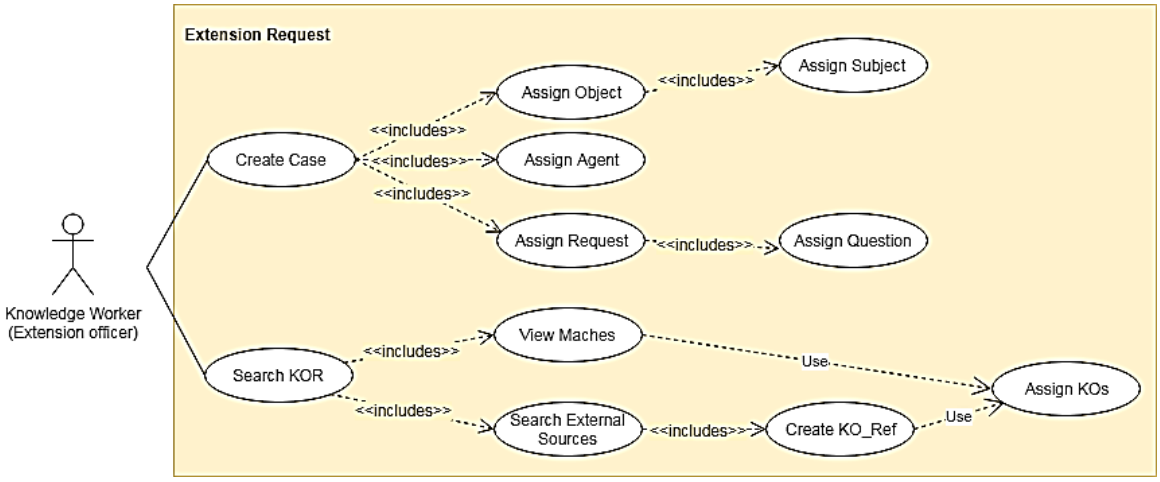


Figure 10. Extension request use case

A knowledge request in the form of a question is also assigned. The knowledge worker may in addition search the KOR and view record matches regarding previous cases and KOs utilized, or if no satisfactory KO is found, an external search is performed. Existing KOs would have KO-References (outer meta-data layers). For new knowledge objects a KO-Reference needs to be created.

The initiation of an extension request could entail the creation of an inner meta-data wrapper (in case a KO is sourced from an external source) and must entail the creation of a KCML wrapper. Each of these wrappers is elaborated on as follows in the discussion on the inner meta-data layer; knowledge case meta-data layer (KCML); QAVL-a and QAVL-b; optional meta-data wrappers; and Motivating questions as meta-data tags.

The inner meta-data layer

The inner meta-data layer as portrayed in Figure 5, is basically a digital knowledge source (DKO) tied to an asset. The asset in relation to the scenario refers to the online Farmer's Weekly article referred to in the example above (Coleman, 2017), available at:

https://www.farmersweekly.co.za/animals/cattle/select-top-performing-beef-cow/

Using existing API tools and parsers such as (https://www.npmjs.com/package/schema-org-parser-json-ld), encapsulated JSON-LD meta-data embedded in the applicable Farmer's Weekly article HTML page (Coleman, 2017) could be extracted.

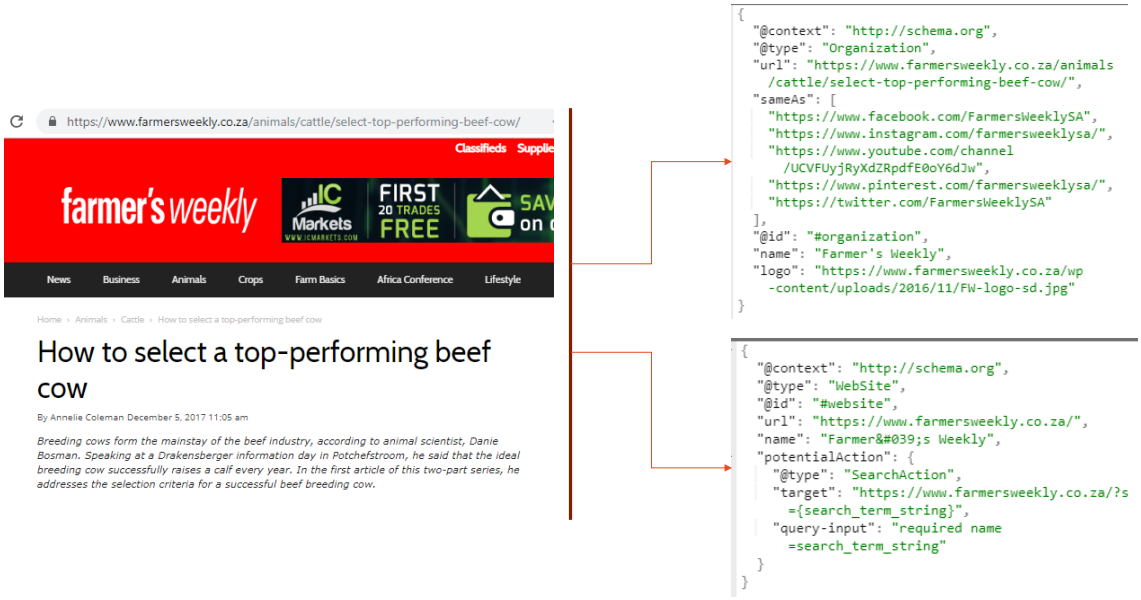


Figure 11. JSON-LD meta-data extracted from the Farmer's Weekly (Coleman, 2017)

Figure 11 shows two JSON-LD meta-data fragments extracted from the Farmer's Weekly page using the schema.org vocabulary (Coleman, 2017). The upper JSON-LD fragment would typically constitute the inner meta-data layer. As part of the LL service layer (compare Figure 1), a KOW management service (KOW-MS) would provide functionality to extract entity (object) data (in this case that of the organization) into the applicable tables as part of the KOWR in the LL KB (compare Figure 1).

The snippet of JSON mark-up could also be stored as a complete large blob field within the table, or as a separate text file reference. For this instance (the record instance), a unique KO key is also created and stored. For illustrative purposes it is assumed that the KO key for the article associated with the IRI (URL) (Coleman, 2017) is *C000000034*. Table 5 represents the most basic record entry created as a KO reference named KO 34 with a key value of *C000000034*.

Table 5. Conversion of a JSON-LD document to a relational table defined in SQL

JSON-LD meta-data of a KO_Ref entry	Corresponding SQL table create and insert
{ "@context": "http://schema.org", "@type": "Thing", "name": "KO 34", "id": "C000000034", "mainEntityOfPage ": { "@type": " WebPage", "url": "https://www.farmersweekly.co.za/animals/cattle/select-top-performing-beef-cow/", "name": "Farmer's Weekly" } }	CREATE TABLE IF NOT EXISTS KO_RefTable (context VARCHAR(17) NULL, type VARCHAR(5) NULL, id VARCHAR(10) NULL, entity_of_page_type VARCHAR(7) NULL, entity_of_page_name VARCHAR(15) NULL, entity_of_page_url VARCHAR(78) NULL, name VARCHAR(5) NULL); INSERT INTO KO_RefTable VALUES ("http://schema.org","Thing", "C000000034"," WebPage", "Farmer's Weekly", "https://www.farmersweekly.co.za/animals/cattle/select-top-performing-beef-cow/", "KO 34");

The knowledge case meta-data layer

As shown in Figure 5, the knowledge case meta-data layer (KCML) contains meta-data regarding the case that is opened. The opened case refers to the query (namely the extension request), lodged by the knowledge seeker (also compare Figure 10). In this process, a unique key is created for the particular request in the form of a case number, which is stored as part of the case entity (compare Figures 5 and 9 and Table 5).

Figure 12 portrays the JSON-LD mark-up representing a KCML-KOW based on the scenario. The data which include, both the mark-up and the values, could be extracted from applicable tables as part of the KOWR. The JSON-LD document as presented in Figure 12 was created by the researchers to demonstrate the concept. The mark-up presented in Figure 12, was validated by using the structured data testing tool of Google, which supports schema.org vocabularies (see https://search.google.com/structured-data/testing-tool/u/0/).

JSON-LD

```
{
  "@context": [
    "http://schema.org/",
    {
      "case": http://dbpedia.org/ontology/Case     }
  ],
  "@type": "Thing",
  "identifier": "C000000741",
  "name": "Case 741",
  "potentialAction": {
    "identifier": "CR00022541",
    "@type": "AskAction",
    "object": {
      "@type": "Person",
      "address": {
        "@type": "PostalAddress",
        "addressLocality": "Gauteng",
        "postalCode": "0251",
        "streetAddress": "R513 Plot 88A Vissershoek"
      },
      "email": "mailto:AndriesNkadimen@gmail.com",
      "image": "Andries.jpg",
      "jobTitle": "Farmer",
      "name": "Andries Nkadimeng",
      "telephone": "(083) 123-4567",
      "url": "https://www.facebook.com/AndriesNkadimeng"
    },
    "agent": {
      "@type": "Organisation",
      "name": "NERPO",
      "url": "http://nerpo.org.za/",
      "telephone": "(012) 492 1383",
      "employee": {
        "@type": "Person",
```

```
        "address": {
          "@type": "PostalAddress",
          "addressLocality": "Gauteng",
          "postalCode": "0081",
          "streetAddress": "160 Garstfontein Rd"
        },
        "email": "mailto:Jackson@Nerpo.org",
        "image": ".jpg",
        "jobTitle": "Chief Breed Advisor",
        "name": "Jackson Baloyi",
        "telephone": "(081) 671 5501",
        "url": https://nerpo.org.za/BaloyiJ }
    },
    "question": {
      "@type": "Question",
      "name": "Red meat cattle breed",
      "upvoteCount": "10",
      "text": "Which cattle breed is best for beef in South Africa?",
      "dateCreated": "2017-11-10",
      "author": {
        "@type": "Person",
        "name": "Andries Nkadimeng",
        "sameAs": "https://www.facebook.com/AndriesNkadimeng"
      },
      "answerCount": "1",
      "suggestedAnswer": {
        "@type": "Answer",
        "upvoteCount": "1337",
        "dateCreated": "2017-12-07",
        "isBasedOn": {
          "@type": "Answer",
          "identifier": "C000000034",
          "url": "https://www.farmersweekly.co.za/animals/cattle/select-top-performing-beef-
                cow/"
        },
        "author": {
          "@id": "https://www.farmersweekly.co.za/AnnelieColeman",
          "@type": "Person",
          "name": "Annelie Coleman"}
      }
    }
  }
}
```

Figure 12. Possible JSON-LD mark-up representing a KCML-KOW

In broad terms the document could be used to semantically describe the following scenario applicable to a case:

> Case 741 relates to an action that involves an emergent farmer asking a question to an advisory employee from Nerpo. The question asked entailed the object, namely the farmer posing a question to an agent. The question reads "Which cattle breed is best for beef in South Africa?" A suggested answer was found in knowledge object C000000034 in an article written in Farmer's Weekly by Annelie Coleman (2017).

The real value of utilizing KCML-KOWs as one of the products of the KF becomes evident. Within the KF one of the main tasks of the knowledge workers as presented and suggested by this research, relates to the creation, management and maintenance of KOs and the applicable meta data wrappers. These could be -

- inner layer meta-data wrappers;
- KCML-KOW (as described in this section); and
- QAVL-a and QAVL-b meta-data layers (discussed next).

QAVL-a and QAVL-b: optional meta-data wrappers – An illustration

In a previous section two additional optional meta-data wrappers are suggested. These meta-data wrappers are created by a knowledge worker that deems an applicable KO as being of high value. It may also relate to a knowledge worker that wants to add additional semantic connotations to

applicable aspects of the KO. Each of these types of wrappers contains a particular question that is assigned to an answer (compare Figures 6 and 8 and Table 2).

The meta-data elements contained in the two suggested wrappers, could easily be converted into standard record entries by incorporating a bridging entity. The records relating to each wrapper entity could easily be represented by using JSON-LD, as well tying and associating the questions to standard schema.org elements.

Figure 13 depicts a domain class diagram representing the associated classes and attributes that constitute a QAVL instance. Not indicated in the diagram, is the concept that both the QAVL_a and QAVL_b classes are base classes of a QAVL superclass. In essence the mapping and associations between a QAVL_a and QAVL_b instance is the same. A QAVL_a instance references a KO_Ref object, which in turn contains and refers to applicable knowledge objects. Both the KO_Ref and the KO classes represent an inner meta-data wrapper. A QAVL_a contains a reference to a KO_Ref instance and a set (or list) of questions. Each of the questions contains at least one accepted answer and a list of other possible suggested answers. An answer contains the answer to the question and an applicable IRI.

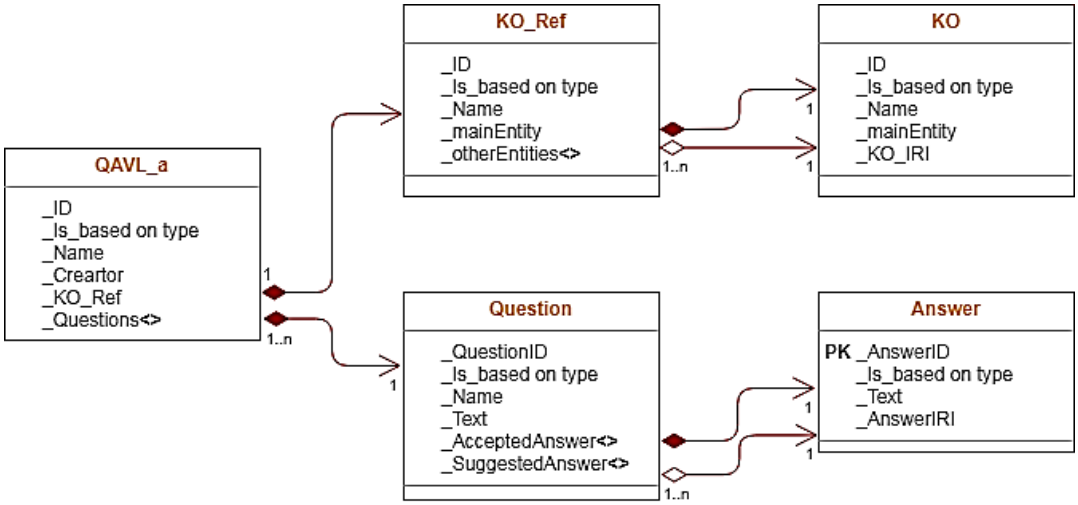


Figure 13. QAVL_a domain class diagram

Figure 14 illustrates the JSON-LD mark-up, representing a QAVL_a-KOW based on the farming scenario as described. The data in the form of both the mark-up and the values, could be extracted from applicable tables as part of the KOWR. The JSON-LD document as presented in Figure 14, was created by the researcher to demonstrate the concept of how a QAVL_a-KOW could be populated, grounded on the data from the tables which the knowledge worker created based on the article. The typical questions as indicated in Figure 8 and described in Table 2 were answered by the researcher for illustration.

JSON-LD

```
{
  "@context": "http://schema.org/",
  "@type": "CreativeWork",
  "identifier": "QAVLa_0001981",
  "creator": {
    "@type": "Person",
    "name": "Jackson Baloyi",
    "url": "https://nerpo.org.za/BaloyiJ"
  },
  "isBasedOn": {
    "@type": "CreativeWork",
    "mainEntity": [
      {
        "identifier": "C000000034",
```

```
        "url": ""
      },
      {
        "identifier": "",
        "url": "https://www.farmersweekly.co.za/animals/cattle/select-top-performing-beef-
cow/"
      }
    ]
  },
  "dateCreated": "2017-12-10",
  "hasPart": {
    "@graph": [
      {
        "@type": "Question",
        "name": "Q1",
        "text": "What is the KO?",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Article relating to the factors to consider when selecting a top
                performing beef cow"
        }
      },
      {
        "@type": "Question",
        "name": "Q2",
        "text": "Why do we need it?",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Provides valuable advice on aspects and advice such as: Calving percent
                        ages, and maternal ability"
        }
      },
      {
        "@type": "Question",
        "name": "Q3",
        "text": "What does it mean?",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Resource in relation to cattle breeds and profitability aspects"
        }
      },
      {
        "@type": "Question",
        "name": "Q4",
        "text": "How is it used?",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Reading article with references"
        }
      },
      {
        "@type": "Question",
        "name": "Q5",
        "text": "How is it used effectively",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Read in conjunction with an advisor for clarity of terms which could be
                        unknown"
        }
      },
      {
        "@type": "Question",
        "name": "Q6",
        "text": "Who will it benefit?",
        "acceptedAnswer": {
          "@type": "Answer",
          "text": "Any farmer and advisor requiring information on the aspects to consider
                        when selecting a cow type for beef production"
        }
      }
    ]
  }
}
```


Figure 14. Possible JSON-LD mark-up representing a QAVL_a KOW

From the above discussion it transpires that the QAVL_a-KOW attempts to encapsulate some of the tacit knowledge of the knowledge worker. This wrapper is related to a specific KO_Ref object. It would be possible to add an additional IRI element to each of the answers as well, as shown in the domain class diagram (see Figure 13). The composition of a QAVL_b-KOW would closely resemble that of the example given, but with questions and answers relating to the AT elements of the applicable KO when used as a tool for informing.

Motivating questions as meta-data tags

The role and predominant use of questions as meta-data tags are strongly supported by the researchers and forms one of the pillars on which this research is based. This is evident in the examples as portrayed in Figures 6, 8, 9 and 12 to 14, as well as in the discussions regarding the use and importance of questions for knowledge transfer and informing, such as:

- where the concept of a NoK and the role that asking questions plays in the knowledge dissemination process;
- where partaking in living labbing operations entails knowledge operations and seeking answers to questions;
- about the activity of knowledge creation and the knowledge worker operations;
- about the intrinsic processes of externalization and internalization through dialogue supported by questions; and
- where the initial concept of a question tied to a KO and the use of questions as meta-data tags are presented.

In the researchers' experience, including questions as meta-data-tags adds a new dimension to the process of knowledge comprehension and understanding. Such questions to be asked by the user could relate to:

- better understanding of the nature of the knowledge source presented as an answer to a problem;
- evaluating the result-set of a question posed in a browser or search engine, with prior stored questions (the subsequent evaluation of the question to the result set, could have the knowledge seeker either modifying the existing question stored as a meta-data tag, or adding an additional question as reference to the resultant knowledge source);
- presenting additional context to the KO relating to the scope and content of the KO;
- better analyzing and contextualizing the existing tags; and
- tying-in additional semantic constructs in the form of linguistics.

EVALUATION OF THE VARIOUS KOW ARTEFACTS

The fifth stage of the DSRM of Peffers et al. (2007) evaluation of the various KOW artefacts (activity 5 in Figure 4), is the focus of attention in this section. The evaluation process involved the use of a simple questionnaire which was supplied to five experts (coded as ER-E1 to ER-E5) respectively in the fields of knowledge management, web-based support services and tools, ontologies, living labs and networks of knowledge. As part of the evaluation process of the research, the designs and motivations presented in the first sections of this report which entailed the designs, composition, and illustration of the use of the various KOWs, were supplied to them for review. An overview of these experts' evaluation of the various KOW meta artefacts is presented in Table 4.

Table 4. Evaluation of the various KOW meta artefacts

Criterion	Evaluation result
1 - The utilisation of KOs would increase the knowledge capacity of the LL.	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: 20% | Agree: 60% | Strongly Agree: 20% Motivation Yes, this is value adding to the service (ER-E5).
2 - The discussions pertaining to the design of the KCML are clear.	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: 20% | Agree: 60% | Strongly Agree: 20% Motivation
3 - The inclusion of the metadata classes and subsequent elements as portrayed in Figure 5, as an additional wrapper would allow for the partial capturing of tacit knowledge	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: 20% | Agree: 40% | Strongly Agree: 40% Motivation Each of the classes as presented in Figure 5, relates to that of an activity system. Capturing and managing data about the use of a KO as a tool in the knowledge transfer process, encapsulates some of the thought processes and reasons, as well as the application thereof, which to an extent presents some of the tacit knowledge of the subject and the object with regard to a knowledge system (ER-E1). Yes, this could definitely enhance tacit knowledge and contribute to the long-term memory of the LL (ER-E5).
4 - The idea that a single KO could be linked to several different KOWs as depicted in Figure 6, would allow the encapsulation of the externalisation and internalisation knowledge processes of the individual knowledge worker.	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: 20% | Agree: 60% | Strongly Agree: 20% Motivations The idea that the research aims to present here, is based on having a knowledge worker complete a group of datasets regarding the knowledge requests that are presented as a case. In doing so, the knowledge worker must internalise the request and the use of the knowledge object. This process in itself attempts to capture the tacit and implicit knowledge of the worker to a certain extent (ER-E1). Yes, the "linking" of such KO's could be of great value to all roll players and as such contribute to all levels of knowledge (ER-E5).
5 -The notion that different knowledge workers could be assigned to the same case, each creating their own KOW based on the KCML metadata wrapper would create a rich knowledge set and for current and future references.	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: — | Agree: 60% | Strongly Agree: 40% Motivations I fully understand this and from practical experience, having a rich dataset on any item would surely assist not only in future decision making but also for future analysis purposes. It would also be possible to discover trends and patterns (ER-E1). Yes, this kind of approach will be enriching and if knowledge workers get the opportunity to share their experiences with one another in terms of the kinds of services they provided, it could be of great value to the LL (ER-E1).
6 - The exposition, design and presentation of the KCML_KOW domain class diagram in Figure 9 and Table 3, are clear and understandable.	Strongly disagree: — | Disagree: — | Slightly disagree: — | Slightly agree: — | Agree: 60% | Strongly Agree: 40% Motivation

7 - The proposition and design of the two question and answer view metadata layers as discussed, are clear and purposeful	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					80%	20%
	Motivation					
8 - The argumentation pertaining to the various elements of the different wrapper compositions (QAVL-a and QAVL-b) (see Table 2) in relation to their use and implementation, would add value to the fundamental knowledge load of a KO when applied.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					80%	20%
	Motivation As elaborated upon in 2.5.3, having a rich set of data would surely increase the knowledge source and trustworthiness of the related knowledge object. It indeed makes sense In a practical manner, the more experts review for example a tool, the more reliable the data become (ER-E1).					
9 - The argumentation pertaining to the various elements of the KCML knowledge object wrapper elements (see Table 3) in relation to its use and implementation, would add value to the fundamental knowledge load of a KO when applied.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					100%	
	Motivation					
10 - The illustration regarding the use of the KOWs composed as JSON-LD documents is clear and concise	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
				20%	40%	40%
	Motivation Yes, it is a standard depiction and implementation of JSON-LD scripts and mark-up (ER-E1).					
11 - The use of JSON-LD as a technology is suitable to describe, annotate and encapsulate the various elements in the form of JSON-LD documents.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
				20%	60%	20%
	Motivation					
12 - The use of JSON-LD documents would contribute to the interoperability of various knowledge services of the LL and facilitate the exchange of data.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					60%	40%
	Motivation					
13 - The motivations for the use of questions as metadata tags add an additional dimension to the way in which tacit and explicit knowledge could be stored and shared.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					20%	80%
	Motivation Yes, I think that makes the process more advanced and as such helps to provide an improved service to the users (ER-E5).					
14 - The discussions and motivations in relation to the case for KOWs are valid.	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
					100%	
	Motivation					

15 - The discussions and motivations in relation to the use of the various KOW metadata models are novel and unique. (In other words, the way in which the use of KOWs is suggested in this section presents a knowledge contribution.)	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
				20%	60%	20%
	Motivation I have not come across the use of knowledge objects and in particular the notion of different sets of knowledge object wrappers. In the best of my judgement the approach is unique (ER-E1).					

As is evident from the results presented in Table 4, there is a consensus among the experts that the use and implementation of KOWs in the design of knowledge intensive services and tools could lead to the better functioning of a NoK. The additional benefits and case for the application of KOW are presented in the next section.

WRAPPING UP –THE CASE FOR KOWS

The voluminous information obtained from the numerous sources consulted and encapsulated within the sample KCML-KOW and sample QAVL_a-KOW, was immense. Applying the process of utilizing KOW in conjunction with KOs as part of a knowledge support service, will present the knowledge worker with a rich set of knowledge that would otherwise not have been available if for example, the knowledge worker only referred to the applicable Farmer's Weekly article (Coleman, 2017).

From the dataset (compare Figure12) various sets of information could be inferred, such as the following:

- Who the farmer (that is the object/ knowledge seeker) is in relation to the case.
- Who the agent is that assisted the farmer with his or her query.
- To which organization the agent belongs.
- What the question is that the farmer posted.
- The suitable answer provided in relation to the question.
- Who the person (author) is that created the knowledge object and for which organization he or she works.

In relation to the knowledge taxonomy presented by Lundvall and Johnson (1994) it is possible to present an answer from the KCML-KOW about the nature of each of the four knowledge classifications, namely:

- **Know-what** –the facts encapsulated in the Farmer's Weekly (Coleman, 2017) article part of KO identified as C000000034;
- **Know-why** –encapsulated in the knowledge of the applicable agent from NERPO, as well as the expert opinion of the author of the article (Coleman, 2017);
- **Know-how** –the knowledge of knowing which cattle breed to select; and
- **Know-who** –realized in the notion that 'who knows what', as the agent knows about the case and question; and 'who knows how to do what' that relates to the agent knowing how to refer the applicable question to the correct knowledge source. The agent now also has knowledge about the 'who', in the form of who is the farmer (the knowledge seeker) and who is the carrier of the knowledge (the author). This could also be interpreted from the viewpoint of the knowledge seeker, as the knowledge seeker now knows who to contact with additional problems and questions regarding cattle breeds.

In the 'case', a similar type of question could be posted in future (by another knowledge seeker). The existing KCML-KOW could be returned as a dataset, and by using just this dataset the new

knowledge seeker could then be linked to the applicable agent, the applicable farmer as well as the author of the KO. This only from one KCML-KOW. In practice it is envisaged that the knowledge workers of the LL would create a KCML-KOW entry for each of the extension requests that they are assigned to.

Having an ever rich and expanding repository or knowledge base containing different tables from which the data encapsulated as part of the KCML-KOW, could be rendered (based on simple queries), would present the LL knowledge workers with an in invaluable knowledge resource. Three of the most obvious advantages of this are -

- being able to obtain a list of similar KOs and references (know-what, know-why);
- harnessing knowledge based on previous experiences; and
- knowing which extension workers and knowledge agents were assigned or managed similar cases previously (know-how, know who).

Within the LL environment typical services and tools will be predominantly tasked with the management of KOWs, but each KO as well as derived KOWs as part of the KB, play an important role in the overall functioning of the LL to ultimately provide holistic linkages between the correct knowledge seekers and knowledge holders, and between different entities. This concept has to do with research objective seven, with the aim to describe how KOs and KOWs are used as the raw or semi-raw 'material' in the LL NoK for the 'capturing', management and transfer of the tacit knowledge and the corporate memories of the various LL members, through annotations and semantic integration in relation to research objective four, are also partially attained.

A corporate memory could be regarded as knowledge captured in one or another format, that could be fully interpreted by the document holder. Having a rich set of KOWs in different formats as suggested above, will also assist in building a KB that encapsulates a rich set of experiences based on usable knowledge. The knowledge encapsulated within the KOWs is both readable in a human form and could also be interpretable applications, tools and software that could query the data. The querying of the data is achieved through the implementation of a relational DB structure. The design and discussion of the relational schema for the standard operational KOWs that could be created from standard queries and tables stored in the LL-DB and KOR as part of the KB (see Figure 1), are illuminated. The KO table in this schema represents any entity with an IRI, which could include any person, organization or artefact.

One of the requirements stipulated by one of the expert reviewers in the review of the design requirements of the KOW, is that the KOs which are semantically enriched should be sharable amongst different systems. Utilizing JSON_LD (as does JSON) allows interoperability and the sharing of data between different systems.

COMMUNICATION

The final stage of the DSRM (depicted in Figure 4, as activity six in the DSRM process model) involves the communication of the results and the findings. This article attempts to fulfil that requirement.

CONCLUSION

In this article the researchers attempted to demonstrate the notion that the application of KOWs in a networked knowledge intensive environment such as a LL, could better and expand on the corporate knowledge attainment of its members.

These artefacts present the technology that will enable the knowledge operations of the LL. The description and application of reusable KOs annotated and defined with a suggested design and description of various metadata models in the form of KOWs in the JSON-LD format as part of a living lab, are presented to facilitate and provide expanded possibilities for knowledge management

which include the practice of knowledge support and other LL operations, like information transfer, for solution development.

Two different metadata models are presented, namely question and answer view layer a (QAVL-a) and question and answer view layer b (QAVL-b). Each of these models is annotated by using different metadata elements that could be stored and rendered in various formats such as JSON-LD. These metadata wrappers are added to existing knowledge objects and attempt to facilitate the capturing of corporate knowledge and memories within the LL and the NoK. Various KOs could be annotated with different and a combination of different types of QAVL wrappers, resulting in a rich descriptive set of elements to describe a KO. The QAVL-a metadata model utilizes standard questions as metadata tags, whereas the QAVL-b model is based on the typical elements of activity theory.

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BIOGRAPHIES

Bertie Buitendag is a lecturer at the Tshwane University of Technology in Pretoria, South Africa. His core research area includes ICT Knowledge support for emergent farmers and Living Labs, SMART LL operations and knowledge management. Other areas of interest include the: Semantic Web, (WEB 3.0) and WEB 2.0, and ICT's for community upliftment.

Fredre Hattingh is a lecturer at Tshwane University of Technology. His research interests include Living Labs, Virtualization and Plagiarism detection. Other areas of interests include Open Source Software and emerging technologies.

Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

ASSESSING THE ASSOCIATION BETWEEN AGILE MATURITY MODEL LEVELS AND PERCEIVED PROJECT SUCCESS

Vaughan Henriques	University of Cape Town, Cape Town, South Africa	HNRVAU001@myuct.ac.za
Maureen Tanner*	University of Cape Town, Cape Town, South Africa	mc.tanner@uct.ac.za

* Corresponding author

ABSTRACT

Background	The underlying philosophy of the agile manifesto is embodied in principle one which promotes the continuous delivery of software that is deemed valuable by the customer, while principle twelve encourages continual improvement of the delivery process. This constant improvement, or maturity, is not a concept unique to agile methods and is commonly referred to as a maturity model. The most common of maturity model is the Capability Maturity Model Integrated (CMMI). However, research consensus indicates CMMI might not fully be compatible with agile implementation, specifically at higher levels of maturity without sacrificing agility. Agile maturity models (AMM), which are aligned to agile principles encourage continuous improvement while maintaining agility.
Aim/Purpose	Given the underlying philosophy of the agile manifesto, this study investigates whether an increase in agile maturity is associated with improved perceived project success.
Methodology	The study employs a conceptual model based on an existing agile maturity model that is related to perceived project success. Using an objectivist perspective, a quantitative method was employed to analyze the results of an online survey of agile practitioners.
Contribution	The significant contribution from this research is the validation of the conceptual model relating the activities and maturity levels of the AMM as the independent variables to the dependent variable of perceived project success.

Accepted by executive review by Editor Michael Jones | Received: November 19, 2020 | Revised: January 22, February 3, 2020 | Accepted: February 5, 2020.
Cite as: Henriques. V., & Tanner, M. (2020). Assessing the association between agile maturity model levels and perceived project success. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 117-156. Informing Science Institute. https://doi.org/10.28945/4519

Findings	The data analysis found that a significant positive correlation exists between maturity levels and perceived project success. The strongest correlation was found at the highest maturity level, with relatively weaker correlation at the lower levels of maturity. It can thus be concluded that a higher level of maturity in the AMM is positively associated with perceived project success.
Recommendations for Practitioners	The study has practical implications in highlighting that performance management, requirements management, regular delivery and customer availability are key areas to focus on to establish and continually improve the success of agile implementations. This study further assists practitioners in systematically identifying the critical agile activities, such as the use of story cards, continuous delivery and the presence of a knowledgeable customer.
Recommendations for Researchers	The contributions of this study for academics is the confirmation of the maturity model developed by Patel and Ramachandran (2009a). This study also shows the association between the individual activities within the maturity levels as well as the maturity levels and the perceived project success, addressing a gap in literature relating these concepts.
Future Research	It would be useful to replicate this study whilst following a qualitative approach. The study could also be replicated with a sample consisting of agile project customers.
Keywords	Agile, Scrum, XP, Maturity Model, Agile Maturity Model, Agile Process Improvement, Project Success, Agile Success

INTRODUCTION

As a result of the ever-changing business environment and the need to produce quality software more rapidly (Silva et al., 2015), the agile manifesto was created in 2001. The agile manifesto contains a set of four value statements and twelve principles for agile methodologies (Fowler & Highsmith, 2001). Principle twelve of the agile manifesto encourages teams to strive to improve the process of software delivery continually. In an effort to attain this constant improvement, organizations typically utilize maturity models such as Software Process Improvement (SPI) frameworks. A maturity model is a predefined process improvement model for improving the desired outcome (Fontana et al., 2015).

Nowadays, organizations are increasingly interested in combining maturity and agility within software development projects (Silva et al., 2015). To that effect, this study has explored the concept of an agile principle-based maturity model. Patel and Ramachandran (2009a) propose an Agile Maturity Model (AMM), which is based on agile principles. The AMM proposes a five-level model of increasing maturity, with key agile process focus areas at each level. Each maturity level fulfils at least one of the agile principles and corresponds to a more mature agile implementation. In general, the intent of a maturity model is the continual improvement of a desired outcome (Fontana et al., 2015). Since the underlying agile philosophy is the delivery of quality software, it can be logically concluded that an increase in agile maturity should relate to an increase in the perceived success of a project.

However, a review of the current literature highlights a lack of research relating to improved maturity in an agile maturity model to project success. While studies exist which relate the maturity levels of Capability Maturity Model Integrated (CMMI) to improved project success, Gren et al. (2015) conclude it would be useful to perform such a study in the context of an agile maturity model. Without an empirically validated agile maturity model (Gren et al., 2015), there is limited guidance for practitioners to reference which agile processes in the AMM will increase the project success rate. Though Patel and Ramachandran (2009a) propose an agile principle-based maturity model, research has not

yet been conducted to investigate whether higher AMM maturity relates to improved perceived project success.

Addressing the stated research problem, the purpose of this research is to ascertain whether improving (maturing) in agile discipline is associated with improved perceived project success. The research is intended to provide empirical evidence independent of the agile method, industry, or organization in which it is being applied.

The purpose of this research is to ascertain whether improving (maturing) in agile discipline is associated with improved perceived project success by providing empirical evidence, independent of the agile method, industry, or organization in which it is being applied. The specific research question is "How are the different maturity levels of the Agile Maturity Model (AMM) as proposed by Patel and Ramachandran (2009a) associated with perceived project success?" The related sub-question is "How are the specific process areas of the different maturity levels in the AMM associated with perceived project success?"

LITERATURE REVIEW

THE AGILE MANIFESTO

The agile manifesto is intended as a guide for software development projects to be more responsive to changing business requirements whilst continuously delivering quality software rapidly (Silva et al., 2015). This is underpinned by principle one, *"Our highest priority is to satisfy the customer through early and continuous delivery of valuable software"* (Fowler & Highsmith, 2001, p. 30), which can be viewed as the driving philosophy for agile methodologies. The agile manifesto does not prescribe a specific methodology but instead provides a set of guiding values and principles.

Though the conceptualization of the agile manifesto is considered the birth of modern agile methodologies, it served as a consolidation of the principles and values being applied in major iterative development methodologies. The origin of agile methods stems back to Iterative and Incremental Design and Development (IIDD) dating to as early as the mid-nineteen fifties (Glazer et al., 2008). IIDD implemented a continuous process improvement approach in which feedback and collaboration were continuously sought in developing software (or a product) to ensure customer satisfaction and improvement (Johnson, 2002).

AGILE TEAMS INCLUDING BUSINESS REPRESENTATIVE

The agile principles strongly support and promote the concept of a cross-functional, self-organized team (Fowler & Highsmith, 2001). Typically, agile teams consist of five to nine people, having all the roles required to deliver the software (Papadopoulos, 2015), allowing the team to be self-sufficient, which leads to improved project success (Stettina & Hörz, 2015). This is consistent with the 'whole team' concept from Extreme Programming (XP) in which *"people with all the skills and perspectives necessary for the project to succeed"* (Beck & Andres, 2004, p. 38) are included.

Besides the presence of technical competencies such as architecture, design, development, testing, database administration, and project management, agile teams include roles for business representation (Beck & Andres, 2004). The consensus in research has shown that the role of business representation as part of the team is critical to the success of an agile project (Tanner & von Willingh, 2014) and forms the vital link between the business, customer and end-user and the development team (Ambler, 2012).

AGILE TEAMS AND BUSINESS FEEDBACK

The agile manifesto repeatedly reinforces the concept of feedback and collaboration in both the value statements and principles, stressing the primary measure of success being the delivery of software.

Principles two *"Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage"* and four *"Business people and developers must work together daily throughout the project"* (Fowler & Highsmith, 2001, p. 35) encourages daily feedback from the customer while functionality is being developed, ensuring the delivery of business value. Studies have found a lack of customer feedback can cause a financial loss to business (Hoda et al., 2011). Besides this continuous customer feedback during the development iteration, principle twelve of the agile manifesto "*At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*" (Fowler & Highsmith, 2001, p. 35), encourages scheduled feedback sessions with the broader business.

PERCEIVED PROJECT SUCCESS

Thomas and Fernández (2008) equate the notion of project success to the capturing of Proteus, the mythical sea god of the elusive sea change. The popularity of this topic in academic literature is evidence of the protean nature of project success. Jugdev and Müller (2005) look at the evolution of the concept and the associated changes in beliefs on how this is to be measured over a forty-year period. Customary measures are based on the 'Iron-Triangle' of project management (see Figure 1), the dimensions being scope, resources, and schedule. Whilst these dimensions are the fundamentals upon which projects are executed and reported (McLeod et al., 2012), there is an agreement of an important distinction to be made between project management success and project success (McLeod et al., 2012).

The former refers to proper management of the three dimensions of the iron-triangle, whilst the latter is a more fluid, perceived, and subjective concept. An often-quoted example depicting this is the Sydney Opera House, which cost fourteen times the original budget and took fifteen years to complete (Jugdev & Müller, 2005). Assessing only the time and budget aspects, this would be considered a failure in the project management sense, yet it is considered a landmark achievement in architectural terms, a project success. This non-interrelation of the two measures is further supported by research work conducted by Joosten, Basten, and Mellis (2011), who conclude, though projects continue to be reported on using the iron-triangle measures, project decision-makers continue to use context-specific subjective measures to determine the success of a project.

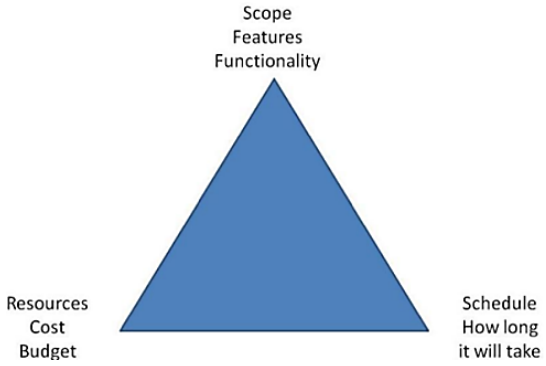

Figure 1: The traditional "Iron-Triangle" of project management (Highsmith, 2004)

A study by Thomas and Fernández (2008) focusing on subjective (perceived) project success was not able to distil a single definition of the concept. This view is further supported by McLeod et al. (2012), who further highlight that stakeholders within a project could evaluate the success of the project differently based on their perspectives, perceptions, and context for the evaluation. This is consistent with Jugdev and Müller (2005), who highlight that different line managers involved in the same project could perceive success to a greater or lesser extent based on its contribution towards achieving an overall business goal. Simplistically reproduced here, Figure 2 depicts how stakeholder

perceptions influence the evaluation of the success of a project, i.e. the perceived success of a project is dependent on the evaluator, and their perception of the value contributed.

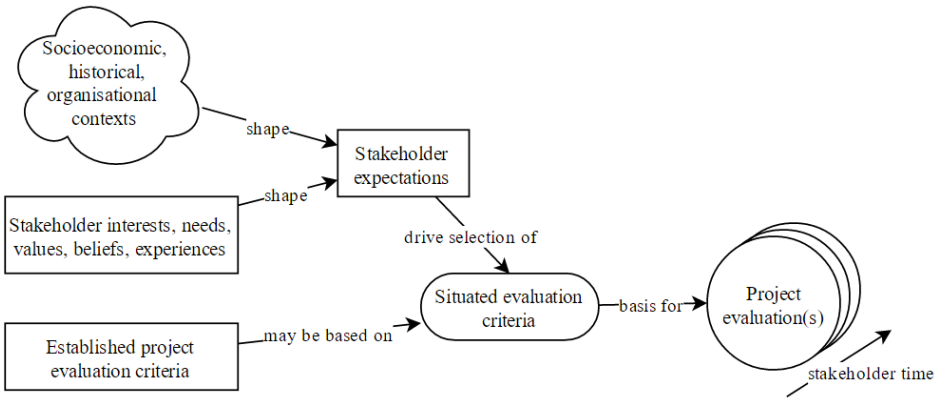

Figure 2: Stakeholder perspective can influence project success evaluation over time (McLeod et al., 2012)

Highsmith (2004) proposes the iron-triangle in the agile project world (see Figure 3). Whilst the traditional 'iron-triangle' remains, it serves only as a constraint in the agile-iron-triangle, with the latter focusing on value and quality delivery. Both the value and quality form part of the subjective measures, with quality being *"the most subject to variation in perception by multiple project stakeholders"* (Prabhakar, 2008, p. 7). Agile methods have altered the traditional view on project success, with the focus shifting more towards stakeholder satisfaction (Leppänen, 2013).

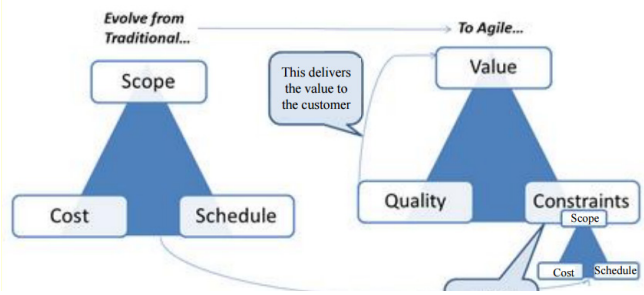

Figure 3: Agile Iron-triangle (Highsmith, 2004)

In a study researching the relation between agile planning efforts and project success, Serrador and Pinto (2015) divide the *"Overall Project Success"* between the traditional iron-triangle *"Project Efficiency"* measures and the perceived *"Stakeholder Success"* (Serrador & Pinto, 2015, p. 1043) aspects. The stakeholder success aspect relates to the value and quality dimensions of the agile iron-triangle, i.e. the subjective perceived project success. Serrador and Pinto (2015) concluded that the questions relating to stakeholder success are a better indicator of perceived project success. The questions utilized for measuring perceived project success was a combination of three dimensions being the perception of the project teams' satisfaction with the deliverables, the teams' perception of the clients' satisfaction with the deliverables and the teams' perceptions of the end-users' satisfaction with the deliverables (Serrador & Pinto, 2015).

Given the context and perspective sensitivity of project success, current literature and research in this field shows it is based on perception and is thus, a subjective measure. In the context of this study,

the working definition for perceived project success will be as defined by the definition of stakeholder satisfaction (Serrador & Pinto, 2015), as shown in Figure 4.

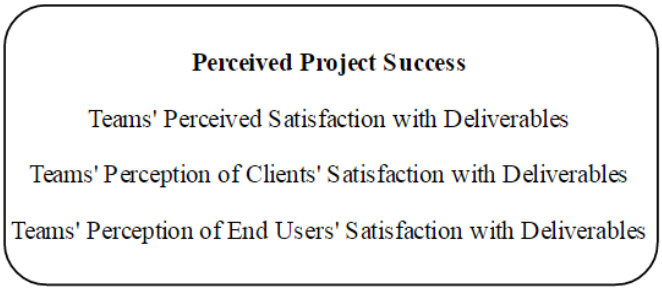

Figure 4: Perceived project success construct – defined as stakeholder satisfaction (Serrador & Pinto, 2015)

MATURITY MODELS

Maturity is in reference to the software development process. Specifically, *"maturity is the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective"* (Paulk et al., 1993, p. 20). A maturity model describes how a process can evolve (mature) over time. Each phase of evolution (maturity level) is a progressive step along an improvement path, improving the desired outcome (Fontana et al., 2015). With the first phase being the least mature and the last phase equating to optimal maturity, each maturity level defines the focus areas required and success criteria to be assessed to provide evidence of the maturity level being achieved (Leppänen, 2013). When fully matured, the process operates optimally (Leppänen, 2013) and is executed consistently, producing steady, predictable outcomes (Paulk et al., 1993).

In the mid-1980s, the Department of Defense (DOD) in the USA commissioned an investigation into the recurrent poor performance in life-critical software projects. The projects were fulfilled by third-party contractors in an inherently low trust environment (Glazer et al., 2008). In response, the Software Engineering Institute (SEI) of Carnegie Mellon University published the first version of the Capability Maturity Model (CMM) in 1991. CMM provided the DOD with a mechanism for assessing the software development process maturity of third-party vendors, providing some reassurance for quality software being delivered on the basis that managing the process would improve the outcome (Glazer et al., 2008).

Once publicly available, practitioners produced a number of variants that were initially consolidated by SEI into version one of the CMM Integrated (CMMI) in 2000. Subsequent updates occurred with version 1.2 and version 1.3 being released in 2006 and 2010, respectively. The 2006 CMMI version 1.2 update saw the introduction of maturity models focusing on three different disciplines, termed constellations in CMMI parlance. The first of these constellations were specifically focused on software development and officially named CMMI-Dev (Kitson et al., 2009). Amongst other changes, the 2010 CMMI version 1.3 release included changes addressing implementation in agile environments (SEI, 2010).

CMMI defines five levels of increasing maturity with the focus area showing the key improvement to be achieved at that level. The five maturity levels consist of twenty-two process areas. To attain a given level of maturity, all the corresponding process areas need to be addressed, including the process areas of the lower levels (SEI, 2010).

As can be seen in Table 1, CMMI level one (initial) is solely reliant on competent individuals with no defined process in place (SEI, 2010). As such, it can be considered as a starting point for the maturity model, indicating a lack of any formal maturity being in place.

Table 1: CMMI maturity levels, focus, and process areas (The Process Group, 2015)

Level	Focus	Process Area
5 - Optimizing	Continuous Process Improvement	Causal Analysis and Resolution Organizational Performance Management
4 - Quantitatively Managed	Quantitative Management	Organizational Process Performance Quantitative Project Management
3 - Defined	Process Standardization	Decision Analysis and Resolution Integrated Project Management Organizational Process Definition Organizational Process Focus Organizational Training Product Integration Requirements Development Risk Management Technical Solution Validation Verification
2 - Managed	Basic Project Management	Configuration Management Measurement and Analysis Project Monitoring and Control Project Planning Process and Product Quality Assurance Requirements Management Supplier Agreement Management
1 - Initial	Competent People and Heroics	

CMMI level two (managed) is solely concerned at a project level. Activities take guidance from the governing policies and procedures of the organization and focus on defining and documenting the various activities (SEI, 2010). CMMI level three (defined) focusses on standardizing the various processes across the organization and adhering to these standards (SEI, 2010). CMMI level four (quantitative management) focuses on project management activities based solely on the quantitative measures established in lower levels of maturity, e.g. project monitoring and control in level two (SEI, 2010). The focus can be at a project, process, or organizational level (SEI, 2010). CMMI level five (optimizing) shifts the focus to continuous improvement at an organizational level using Organizational Process Management (OPM) and Causal Analysis and Resolution (CAR). With both OPM and CAR concerned with organizational improvement, the key distinction at this level of maturity is the focus being solely on the organization as a whole (SEI, 2010).

It is evident from the focus and process areas that, besides level two activities that focus on the project delivery, the CMMI is aimed at achieving organizational maturity (Fritzsche & Keil, 2007).

Compatibility of CMMI and agile methods

A significant research effort has been invested in attempting to find a level of compatibility between CMMI and agile methods. Consensus exists in literature that the co-existence of the higher levels (four and five) of CMMI maturity and agile is difficult to achieve without sacrificing the agility (Fritzsche & Keil, 2007; Łukasiewicz & Miler, 2012; Marçal et al., 2008; Potter & Sakry, 2009).

Boehm and Turner (2005) highlighted the potential problem that the introduction of agile methods in mature organizations could affect the maturity ratings. Fritzsche and Keil (2007) and Łukasiewicz and Miler (2012) attribute this challenge to the nature of the two disciplines with CMMI focusing on the organizational level while agile focuses on the successful delivery of a project. This is consistent with research finding a decline in project success rates (Dingsøyr & Moe, 2014) when organizational elements such as corporate governance are considered (Laanti, 2014).

Nevertheless, research indicates a high degree of compatibility between agile methods and CMMI at maturity levels two and three. Łukasiewicz and Miler (2012) found a seventy percent exact or partial match between agile methods and CMMI levels two and three. In a similar study, Fritzsche and Keil (2007) extend the mapping between the agile methods of Scrum and XP and CMMI levels two through three, finding no evidence of support at levels four and five in agile practices.

Marçal et al. (2008) focus their research on mapping Scrum to the project management activities of CMMI levels two, three, and four finding sixty-five percent, forty-three percent, and zero percent compatibility, respectively. Mapping Scrum to the requirements management, project planning, and process monitoring and control activities of CMMI levels two and three, Potter and Sakry (2009) find satisfactory compatibility, although acknowledging complete absence in other more organizationally focused process areas.

Research by Sutherland, Jakobsen, and Johnson (2008) found the introduction of the Scrum methodology in a CMMI level five compliant organization had the effect of successfully decreasing the amount of rework required. Whilst at first, this might seem contradictory to literature, it is notable that the introduction of agile methods was after the organization had attained the level five rating (Sutherland et al., 2008). Thus, agile was not implemented in isolation to achieve the maturity rating.

Current research indicates using an agile method in isolation to achieve maturity "levels higher than the third require some far-reaching compromises that significantly affect the benefits of agile methodologies" (Łukasiewicz & Miler, 2012, p. 417). When using CMMI to mature an agile method, *"the best improvement approach in an agile environment is to stop at CMMI level 3"* (Fritzsche & Keil, 2007, p. 24).

Maturity models for agile environments

The application of agile principle twelve encourages the continuous improvement of the software delivery process, which aligns with the intent of a maturity model. Whilst the CMMI focuses on process maturity; given the people-centric and collaborative nature of agile environments, there is an agreement that a CMMI equivalent agile maturity model should align to agile principles and practices (Fontana, Fontana, et al., 2014; Gren et al., 2015).

A systematic literature review by Henriques and Tanner (2017), focusing on research themes conducted with agile maturity models as the independent variable, found two major themes emerging. The two major themes being, "Agile/CMMI" focusing on "adapting agile practices and principles to fit current software maturity models" (Fontana et al., 2015, p. 89) and "Agile Maturity", which focus on maturity models based on agile principles, as shown in Figure 5. As depicted, the majority of the articles (59%) focus on the "Agile/CMMI" topic due to the existing investment organizations have in CMMI (Leppänen, 2013).

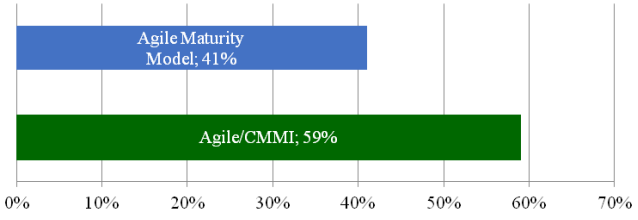

Figure 5: Agile maturity models - research theme distribution (Henriques & Tanner, 2017)

The remaining 41% of the articles represent the major theme of Agile Maturity, with subthemes addressing agile process improvement, agile mature model assessment, proposing an agile maturity model, comparison between agile maturity models, and agile adoption frameworks. The majority of these articles focus on proposing an agile maturity model (Henriques & Tanner, 2017).

Analysis of proposed agile maturity models

Fontana et al. (2015) attribute the first agile maturity model to Nawrocki, Walter, and Wojciechowski (2001). A number of agile maturity models currently exist either explicitly by name, i.e. "Maturity Model" or provide a maturity assessment and adoption framework. Examples of explicit maturity models are proposed by Ambler (2010), Nawrocki et al. (2001), Patel and Ramachandran (2009a), and Yin et al. (2011).

Though each of the models provides between three and six maturity levels, there are shortcomings (Fontana et al., 2015; Leppänen, 2013) when viewed relative to the characteristics mentioned in the section on the maturity models or in the scope to which they can be applied, summarized in Table 2.

The maturity models proposed by Benefield (2010), Lui and Chan (2005), Nawrocki et al. (2001) and Yin et al. (2011) are limited to either a Scrum or XP agile methodology. However, agile methods are broader than these methodologies, and an agile maturity model would need to cater to all agile methods by being based on agile principles and not solely on the practices of a specific methodology.

The models proposed by Ambler (2010), Fontana, Reinehr, and Malucelli (2014), and Qumer and Henderson-Sellers (2008) provide no focus areas or associated success criteria (Fontana et al., 2015; Leppänen, 2013) which are intrinsic characteristics of a maturity model (Leppänen, 2013).

Table 2: Summary of agile maturity models relative to maturity model characteristics and scope (Fontana et al., 2015; Leppänen, 2013)

Maturity Model	Criticism
Ambler (2010)	Agile adoption framework No assessment criteria No success criteria
Benefield (2010)	Limited to XP Limited to British Telecom
Fontana, Reinehr, and Malucelli (2014)	No success criteria defined No ability to assess
Lui and Chan (2005)	Limited to XP No success criteria defined No ability to assess
Nawrocki, Walter, and Wojciechowski (2001)	Limited to XP No success criteria
Qumer and Henderson-Sellers (2008)	No success criteria defined No ability to assess
Yin, da Silva, and Figueiredo (2011)	Limited to Scrum Limited ability to assess

In the analysis of the five-level Agile Maturity Model (AMM) by Patel and Ramachandran (2009a) the conclusion is it "exemplifies how to perform the assessment" (Fontana et al., 2015, p. 91). Thus applying the characteristics of maturity models previously mentioned the requirement to be applicable across any agile method and providing assessment criteria, the working definition of an Agile Maturity Model as proposed by Patel and Ramachandran (2009a) is adopted for this research. Furthermore, it is based on agile practices and principles, and provides predefined focus areas for each maturity level, refer to Figure 6. Each AMM level and focus area are further discussed in the following subsections.

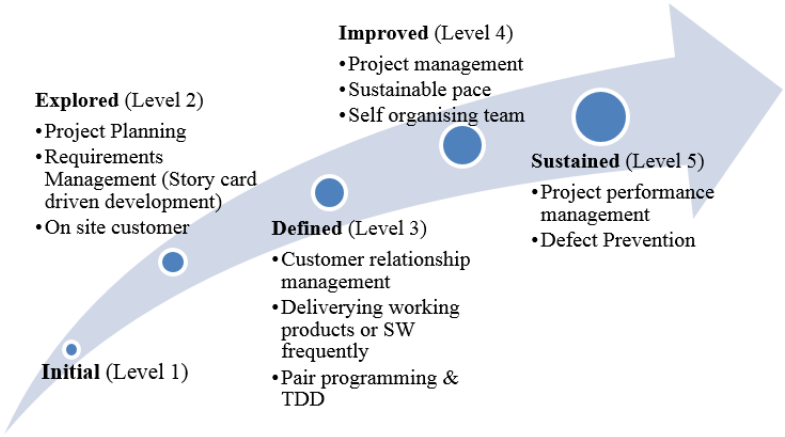

Figure 6: Level AMM for Agile SPI (Patel & Ramachandran, 2009a)

AMM levels and focus areas

Level One: Initial. Level one of the AMM (Initial) is characterized by being dependent on heroic efforts with no specifically defined process in place (Tarnowski, 2014). Outcomes are not repeatable, and there is no alignment to agile principles. This level is equivalent to level one of the CMMI.

Level Two: Explored. Level two of the AMM (Explored) activities covers the initial set of focus areas that organizations implement to establish agile practices (Patel & Ramachandran, 2009a). The focus is on planning based on developer estimates and requirements management in the form of story cards for the current iteration. The customer is present onsite but not necessarily always available for the project team (Patel & Ramachandran, 2009a). This level shows strong alignment with agile principles two, four, six, and ten.

The AMM requires the presence of the customer to be available daily to the agile team in a decision-making capacity to direct development efforts (Patel & Ramachandran, 2009a), which aligns with principle four of the agile manifesto (Fowler & Highsmith, 2001). Tanner and von Willingh (2014) confirm previous research on knowledgeable and empowered customer presence being a success factor for agile implementations, which should include the tracking of the development progress (Patel & Ramachandran, 2009a). Lack of proper customer presence and collaboration has been shown to affect prioritization, clarity of requirements, loss of productivity, and "in extreme cases, Business Loss" (Hoda et al., 2011, p. 527). The presence of the customer is vital in the prioritization of requirements (Sverrisdottir et al., 2014), allowing the developer to focus only on functionality important to business, aligned with agile principle ten (Fowler & Highsmith, 2001).

The requirements are explained to the development team by the customer at the onset of an iteration (Patel & Ramachandran, 2009a), aligning to agile principle six (Fowler & Highsmith, 2001) and captured by the customer, in a properly structured and standardized story card representation (Patel & Ramachandran, 2009b). At this level of maturity, the story card needs to be explanatory enough to derive the acceptance criteria for the desired functionality. The story card is used only as a guideline and is allowed to change within the iteration (Sverrisdottir et al., 2014), aligned with agile principle two (Fowler & Highsmith, 2001). Sufficiently detailed story cards allow the proper detail breakdown of the tasks required to implement the requirement (Vlaanderen et al., 2011), which allows for more accurate developer-based estimates and thus improved project or iteration planning. This form of agile requirement management has been shown to be a critical success factor for agile implementations (Chow & Cao, 2008).

Estimation in an agile environment takes the form of planning poker, which is a consensus-based technique similar to using wide-band Delphi estimation (Gandomani et al., 2014). Though relying on a mix of expertise, the tendency is for less optimistic, i.e. more realistic outcomes (Mahnič & Hovelja,

2012), which is vital for establishing a proper implementation plan and tracking the development velocity of the team.

Level Three: Defined Having established the agile practices in level two, level three (Defined) shifts the focus to better defining the specific agile implementation (Patel & Ramachandran, 2009a), focusing on the use of technical and technological aspects of the implementation. This level is characterized by increased customer relationship management through increased customer presence and customer satisfaction, through constant feedback, aligning with principles four and six. Using more collaborative development practices such as pair programming and test-driven development ensures more frequent and regular delivery of working software (Patel & Ramachandran, 2009a), aligning with principles one, three through seven, and nine. The AMM at this level of maturity requires "frequent releases which will create a feedback loop" (Patel & Ramachandran, 2009a, p. 10), generally taking the form of a demonstration of the functionality developed during an iteration to the customer. These demonstrations are vital for the customer to provide necessary feedback to the development team and allow the surfacing of any incorrect assumptions made during development, which assist in improving future iterations (Hoda et al., 2011) and rely heavily on the collaborative relation built in the previous maturity level.

This collaboration extends to the development practices employed, with the AMM expecting pair programming, code peer reviews, and collective code ownership (Patel & Ramachandran, 2009a). Interestingly these aspects are not explicitly listed in critical success factor research by Chow and Cao (2008) nor explicitly mentioned in the agile manifesto. Unsurprisingly, it remains a contentious issue both in practice and academic research, with findings ranging from showing improved code quality and increased business knowledge to it having limited success, working only for new and complex problems when the proper mix of skills, personality, and expertise are involved (Bipp et al., 2008; Hannay et al., 2009; Lui & Chan, 2006). Lui and Chan (2006) specifically highlight the limitation of these techniques when either experienced developers are paired or the problem domain is well understood.

A further practice assisting the quality of software being delivered is the use of proper agile practices and techniques (Chow & Cao, 2008). Practices such as Test-Driven Development (TDD) in which unit tests are coded before any functionality is developed have been shown to improve the software quality (Sanchez et al., 2007). Building on the previous maturity level, the unit tests are derived from the user story.

Level Four: Improved. The foundation having been established in prior maturity levels, level four of the AMM (Improved), focuses on non-technical aspects such as project, team, and people management. It is characterized by a shift toward project management and tracking based on successful delivery (principle seven). Teams are allowed to organize their own development efforts (principle five and eleven; working hours are limited to ensure a sustainable pace (principle eight), and opportunities for improvement are constantly identified (principle twelve) (Patel & Ramachandran, 2009a).

Listed as a critical success factor, proper agile project management techniques (Chow & Cao, 2008) are related to the proper planning, work allocation, and progress tracking. Properly prioritized work lists, known as product backlogs, is the responsibility of the customer to ensure the team works on relatively important work items. A properly prioritized backlog relates to the success of a project (Stettina & Hörz, 2015). In conjunction with the developer estimates for each of the user stories in the previous maturity level, a project plan is compiled.

Having a complete prioritized list of the functionality required allows the selection (pull) of the next piece of functionality to be built by the development team. This pull mechanism of work allocation, based on discussion and collaboration with the customer (Stettina & Hörz, 2015), has been shown to a success factor for agile projects ensuring the most important business functionality is delivered first (Chow & Cao, 2008). This form of work allocation is characteristic of a self-organizing team leading to an environment where the development team is trusted to get the work done (Stettina & Hörz,

2015). This form of work allocation is a "classic craftsman environment" (Boehm & Turner, 2003, p. 7).

Progress tracking for the AMM is performed relative to stories completed (Patel & Ramachandran, 2009a). The AMM suggests the use of agile measures such as burn-down charts to measure overall progress (Papadopoulos, 2015), with story completion rates being used to measure continuous value delivery and risk reduction (Verheyen, 2014).

Principle eight of the agile manifesto introduces the concept of being able to sustain a "constant pace indefinitely" (Fowler & Highsmith, 2001, p. 31), which is confirmed by critical success factor research, showing adhering to a regular work schedule to be a vital component for success. To achieve a sustainable pace, one of the practices of extreme programming calls for a limit of forty hours (Sauter, 2006).

Level Five: Sustained. The previous maturity levels create an environment in which agile practice and implementation is properly established. Level five of the AMM (Sustained) switches the focus to project performance management with the team focusing on eliminating the root cause of defects and ensuring quality delivery, which meets customer satisfaction (principle one) (Patel & Ramachandran, 2009a), thus maintaining an increased delivery velocity.

In the context of the AMM, project performance management relates to similar focus areas introduced at the lower maturity levels, but the expectation at this level is increased. An example of this is, whilst at the lower levels, customer presence is required for planning and daily feedback level five requires the customer to be present with and available to the team daily for a minimum of two hours (Patel & Ramachandran, 2009a). Research has shown that in mature agile environments, the availability and commitment of customers can be more influential for success than satisfaction and collaboration (Misra et al., 2009). Furthermore, story cards produced at this maturity level insist on the inclusion of acceptance criteria provided by the customer to determine if functionality has been successfully delivered (Patel & Ramachandran, 2009b). Amongst other disciplines, the AMM requires all code to have unit tests coded prior to the development of the functional code and the release to production only taking place once all unit tests have passed (Patel & Ramachandran, 2009a).

The discipline of testing and quality assurance extends into defect prevention where bugs found in released code are addressed in favor of future functionality (by agreement with the customer) (Patel & Ramachandran, 2009b). Root cause analysis is applied to the defect, the cause is addressed, tests are developed to identify the defect and ensure non-recurrence, an approach which has shown to increase both quality and the overall sustainable velocity of delivery (Nagappan et al., 2008).

CONCEPTUAL MODEL, CONSTRUCTS AND HYPOTHESES

CONCEPTUAL MODEL

The research questions presented in this study combine concepts from agile principles and practices, maturity models, and perceived projects. Combining these concepts results in the high-level conceptual model shown in Figure 7, which shows the hypothesized relationship between the constructs. The conceptual model for this research relates the levels of the AMM as the independent variable to the dependent variable of perceived project success.

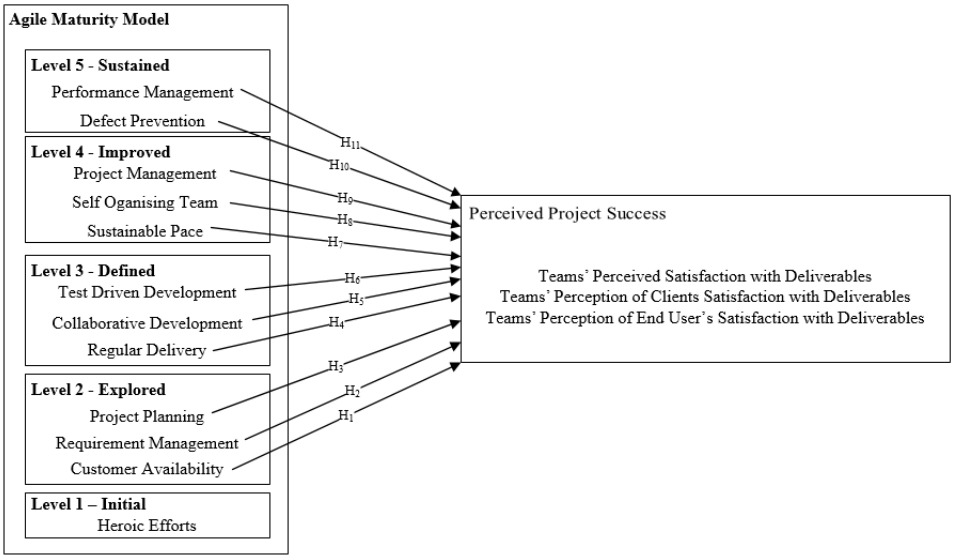

Figure 7: Conceptual model for evaluating the association of focus areas of the AMM (Patel & Ramachandran, 2009a) and perceived project success (Serrador & Pinto, 2015)

The dependent variable for this research will adopt the definition of perceived project success as being stakeholder satisfaction as defined by Serrador and Pinto (2015) and discussed in the section on Perceived Project Success in the literature review.

The AMM, as proposed by Patel and Ramachandran (2009a), forms the basis for the conceptual model presented in Figure 7. More specifically, to answer the sub-question posed in this research, the conceptual model needs to associate each of the focus areas at each maturity level to the perceived project success.

HYPOTHESES

Using the conceptual model gives rise to eleven hypotheses and their corresponding null hypotheses for this study (see Table 3). Evidence from literature in support of the hypotheses is available in section 2.5. Note that the initial level of the AMM is characterized by being dependent on heroic efforts with no specifically defined process in place (Tarnowski, 2014). Outcomes are not repeatable, and there is no alignment to agile principles and is thus excluded from this research.

Table 3: Summary of Hypotheses

AMM Level	Hypotheses	Evidence from literature
Level 1: Initial	N/A	N/A
Level 2: Explored	H_1: *Customer availability* in an agile team environment is positively associated with the teams' perceived project success. $H_{0\text{-}1}$: Customer availability in an agile team environment is not positively associated with the teams' perceived project success.	(Patel & Ramachandran, 2009a) (Tanner & von Willingh, 2014) (Hoda et al., 2011)
	H_2: *Requirement management* implemented through the use of story cards which are allowed to change is positively associated with the teams' perceived project success.	(Patel & Ramachandran, 2009a)

AMM Level	Hypotheses	Evidence from literature
	H_{0-2}: Requirement management implemented through the use of story cards that are allowed to change is not positively associated with the teams' perceived project success	(Sverrisdottir et al., 2014)
	H_3: *Project planning* activities based on estimates by the implementation team are positively associated with the teams' perceived project success. H_{0-3}: Project planning activities based on estimates by the implementation team are not positively associated with the teams' perceived project success.	(Gandomani et al., 2014) (Mahnič & Hovelja, 2012)
Level 3: Defined	H_4: *Regular delivery* of software to the customer is positively associated with the teams' perceived project success H_{0-4}: Regular delivery of software to the customer is not positively associated with the teams' perceived project success	(Patel & Ramachandran, 2009a) (Hoda et al. 2011)
	H_5: Using *collaborative development* techniques such as pair programming, peer reviews, and collective code ownership is positively associated with the teams' perceived project success. H_{0-5}: Using collaborative development techniques such as pair programming, peer reviews, and collective code ownership is not positively associated with the teams' perceived project success.	(Patel & Ramachandran, 2009a)
	H_6: Using *test-driven development* practices is positively associated with the teams' perceived project success. H_{0-6}: Using test-driven development practices is not positively associated with the teams' perceived project success.	(Crispin, 2006) (Sanchez et al., 2007)
Level 4: Improved	H_7: Implementing *sustainable pace practices* by limiting working hours to forty hours a week is positively associated with the teams' perceived project success. H_{0-7}: Implementing sustainable pace practices by limiting working hours to forty hours a week is not positively associated with the teams' perceived project success .	(Patel & Ramachandran, 2009a)

AMM Level	Hypotheses	Evidence from literature
	H_8: *Self-organizing teams* that are allowed to select the work items and organize themselves to deliver the functionality is positively associated with the teams' perceived project success. $H_{0\text{-}8}$: Self-organizing teams that are allowed to select the work items and organize themselves to deliver the functionality is not positively associated with the teams' perceived project success.	(Stettina & Hörz, 2015) (Boehm & Turner, 2003)
	H_9: *Agile project management activities* using customer prioritized backlogs and tracking mechanisms based on value delivery are positively associated with the teams' perceived project success. $H_{0\text{-}9}$: Agile project management activities using customer prioritized backlogs and tracking mechanisms based on value delivery are not positively associated with the teams' perceived project success.	(Chow & Cao, 2008) (Stettina & Hörz, 2015)
Level 5: Sustained	H_{10}: Implementing *defect prevention* and root cause analysis in favor of future functionality is positively associated with the teams' perceived project success. $H_{0\text{-}10}$: Implementing defect prevention and root cause analysis in favor of future functionality is not positively associated with the teams' perceived project success.	(Patel & Ramachandran, 2009a) (Patel & Ramachandran, 2009b) (Nagappan et al., 2008).
	H_{11}: *Project performance management* activities focusing on customer involvement and satisfaction are positively associated with the teams' perceived project success. $H_{0\text{-}11}$: Project performance management activities focusing on customer involvement and satisfaction are not positively associated with the teams' perceived project success.	(Patel & Ramachandran, 2009b)

RESEARCH METHODOLOGY

The objective of this study was to analyze the association between the independent variables represented in the levels of the AMM and the perceived project success, independent of external factors. Thus, an objectivist ontological stance using a positivist view was adopted for the research. Using a deductive approach to prove or disprove the hypotheses, the goal of this research relates to theory type IV of the taxonomy mentioned by Gregor (2006) and is both explanatory and predictive. Saunders et al. (2009) note a key constraint of a deductive approach to ensure rigor is *"that the researcher should be independent of what is being observed."* (Saunders et al., 2009, p. 125). Thus, to maintain rigor and remove the researcher from the agile environments being researched, a quantitative approach was used. To further maintain the independence between the researcher and the participants, a question-

naire was employed as the inquiry strategy, using an online survey for ease of distribution and the ability to reach a wider audience.

RESEARCH INSTRUMENT

The research instrument contained three sub-sections namely information and consent, demographic information, and survey information. The information and consent provided some background to the research being conducted and include an opportunity for the participant to indicate consent to participate in the research. The demographic information prompted for information to categorize the respondent without identifying the individual or the organization, consistent with the objectivist ontology.

The survey section focused on the conceptual model being researched. The questions used in the research instrument was a combination of the AMM questions used by Patel and Ramachandran (2009a) for assessing the presence of the specific focus area characteristics for a given level of agile maturity and by Serrador and Pinto (2015) in determining stakeholder success factors for the perceived project success and will take the form of a five-point Likert scale. A Likert scale has been shown to be useful when measuring opinions and attitudes in social sciences (Croasmun & Ostrom, 2011). The five-point scale was used specifically since Cummins and Gullone (2000) advise that a broader selection of options allows respondents the opportunity to provide a useful response, yet a balance needs to be attained in scale length to reduce to the survey response time (Cummins & Gullone, 2000). Furthermore, a scale with an odd number of options was used to allow a neutral response option. The absence of a neutral response option could influence the results obtained since respondents would be forced to adopt a stance (Croasmun & Ostrom, 2011). The forced response would tend to more socially acceptable answers, thus skewing the results (Garland, 1991).

The wording of the survey questions was in the form of a statement to which the respondent can indicate agreement on a Likert scale selecting from strongly disagree, disagree, neutral, agree, or strongly agree. Podsakoff, MacKenzie, Lee, and Podsakoff (2003) highlight the importance of phrasing statements negatively, to act as *"cognitive 'speed bumps'"* and to avoid *"automatic, cognitive processing"* (Podsakoff et al., 2003, p. 884). Thus, where possible, each construct will include a negatively worded statement.

As previously mentioned, the constructs representing agile maturity levels were adopted from the AMM based on the model by Patel and Ramachandran (2009a), which includes qualitative assessment criteria for each process area. Since the study was quantitative, statements developed adapted the assessment criteria from the AMM to be more suitable to a quantitative study and a Likert scale. Various statements, in line with constructs of the framework, were formulated accordingly. The questionnaire is included in the Appendix.

TARGET POPULATION & SAMPLE

The objective and questions posed in this study are independent of any specific agile methodology. The AMM utilized as the independent construct in the conceptual model is consistent with the non-dependence of a specific agile methodology. Literature indicates agile team members are not bound by job titles, with Ambler (2012) highlighting the difference between roles and job titles in agile teams. Given the conceptual model for this research, the population for the study includes respondents practicing any agile methodology and cannot be limited to any specific job title.

With the focus on maturity levels, organizations representing the five levels of maturity needed to be included in the survey. With the novelty of the agile maturity research area, there is no empirical data indicating the agile maturity level of an organization. Based on CMMI, Shrum and Phillips (2004) provide guidance suggesting organizations can take up to seven years to obtain a higher level of maturity, which was used as guidance in terms of the population being approached.

Given no comprehensive database exists which defines the sample frame of agile practitioners, a combination of non-probabilistic sampling approaches was used (Saunders et al., 2009). Purposive sampling was initially utilized, including contacts within the industry, agile communities and practitioners. Purposive sampling is a technique used to select respondents who will best answer the research question being posed (Saunders et al., 2009) based on their knowledge and expertise in the field being researched (Tongco, 2007) and best match the population defined for the study. Though a non-random technique, it has been shown to *"be just as effective as, and even more efficient than, random sampling"* (Tongco, 2007, p. 155). Thereafter a snowball sampling technique was employed, which is characteristic of research involved in a non-deterministic sample frame (Saunders et al., 2009).

Non-probabilistic sampling suffers from common limitations. Most notably, these include bias and self-selection; potentially leading to a homogenous sample (Saunders et al., 2009). However, given the objective is to obtain responses from agile practitioners, the initial use of purposive sampling should mitigate this limitation.

RESULTS

The responses to the survey were exported from Qualtrics into Microsoft Excel (version 2007) to perform the initial data cleansing and analysis. The total number of respondents to the survey was ninety-six. Two of the respondents opted not to partake in the survey by answering "No" to the initial consent question. Of the remaining ninety-four, twenty-five of the surveys did not have all the answers completed and were deemed to have been abandoned. This resulted in a working response set of sixty-nine ($R_n = 69$) total completed responses. Though a sample of sixty-nine seems low, this does not invalidate the study, as Stutely (2003) advises as a rule of thumb, a minimum number of 30 is required for statistical analysis. Furthermore, *"Statisticians have also shown that a sample size of 30 or more will usually result in a sampling distribution for the mean that is very close to a normal distribution"* (Saunders et al., 2009, p. 218). The completed responses were then imported into SPSS for further statistical analysis.

DESCRIPTIVE ANALYSIS

This section describes the background of the respondents in line with the questions asked in the questionnaire, i.e. industry, the agile methodology being used, the agile experience of the respondent, length of time the project was using an agile methodology, the job title, and role of the respondent.

For the categorical variables industry, agile methodology, job title, and agile role, a non-probabilistic one-sample chi-square test with a null hypothesis that each category occurs with equal probability at a significance level of $p \leq 0.05$ was performed to determine whether the responses were occurring with equal probability.

Tests for normal distribution of the ordinal variables indicating the number of years the project had been using an agile method, coded as "ProjectAgileYears" and the number of years of personal agile experience of the respondent, coded as "AgileExperience" were conducted. The normality test used the Shapiro-Wilk (SW) test with a null hypothesis that the sample is normally distributed. A $p - value < 0.05$ indicates the variable is not normally distributed.

Responses by industry

With 47 responses, representing 68.12% of Rn, the majority of the responses were obtained from the financial services sector. These 47 responses were composed of 10 (14%) from Banking, 30 (43%) from Insurance and 7 from "Other" types of financial services (see Table 4). The response distribution achieved is consistent with annual international surveys where financial services and insurance comprise approximately 20% of responses (VersionOne, 2016). The chi-squared result $X^2(2) = 0.000,\ p \leq 0.05$ indicates the difference in the responses obtained by industry is statistically signifi-

cant, with a bias towards the financial services industry. Given the non-probabilistic sampling technique utilized, this outcome is expected.

Table 4: Response Distribution by Industry

Industry	Number of Respondents	Percentage of Total Completed Responses
Academic/Education	1	1%
Entertainment	3	4%
Financial Services - Banking	10	14%
Financial Services - Insurance	30	43%
Financial Services - Other	7	10%
Medical/Health Services	3	4%
Retail	10	14%
Transportation	1	1%
Other	4	6%
Total	69	100%

Responses by Agile methodology

Consistent with findings from international surveys (VersionOne, 2016), the findings from this study indicate Scrum to be in use in the majority (75%), 52 responses (see Table 5). Interestingly none of the respondents indicated using XP. This is expected as the current trend in the use of agile methods internationally shows that XP is consistently on the decline (VersionOne, 2016). The chi-squared result $X^2(2) = 0.000,\ p \leq 0.05$ indicates the difference in the responses obtained by agile methodology is statistically significant, with a bias towards the scrum methodology. However, given the alignment to international trends and findings (VersionOne, 2016), the response to this survey is consistent with other observations and thus properly representative of the agile population.

Table 5: Response distribution by agile methodology implemented

Agile Methodology	Number of Respondents	Percentage of Total Completed Responses
Scrum	52	75%
Kanban	4	6%
Scrumban	2	3%
Scrum/XP Hybrid	2	3%
Custom Hybrid	6	9%
Other	3	4%
Total	69	100%

Responses by job title and agile role of respondents

The majority of responses, 29% (20 respondents) were from "developers". The remaining responses were evenly distributed, with the only other notable exception being that of "solution architect" at 10% (7 respondents) (see Table 6). The prevalence of developers as well as solution architects is unsurprising as Ambler (2012) mentions the predominance of both the developers and architects in agile teams, particularly in large corporate environments. The chi-squared result $X^2(2) = 0.000,\ p \leq 0.05$ indicates the difference in the responses obtained by job title is statistically significant, with a bias towards respondents having a job title of "developer".

In contrast, the distribution of respondents by the agile role being fulfilled confirms the difference between roles and job titles in agile teams (Ambler, 2012), with the developer role being the most common amongst respondents. Notably, a number of respondents perform multiple roles. The chi-squared result $X^2(2) = 0.849,\ p \leq 0.05$ indicates the difference in the responses obtained by agile role is not statistically significant and thus no bias towards any specific agile role is present.

Table 6: Response distribution of job title and agile role responses

Job Title	Number of Respondents	Percentage of Total Completed Responses
Business Analyst	3	4%
CTO	2	3%
Data Analyst	1	1%
Data architect	2	3%
Developer	20	29%
Development Manager	2	3%
DevOps specialist	1	1%
Director of Technology	1	1%
Head of Process Engineering	1	1%
IT Team Manager	1	1%
Lean Agile Coach	1	1%
Line Manager / Scrum Master	1	1%
PMO Manager	1	1%
Practice Head: Software Quality Engineering	1	1%
Product Owner	2	3%
Programme Manager	1	1%
Project manager	3	4%
QA engineer	1	1%
Quality Assurance & Test Manager	1	1%
Scrum Master	4	6%
Scrum Master/ Project Manager	1	1%
Senior Business Analyst	1	1%
Senior Manager Custom Application Development	1	1%
Senior Staff Engineer	1	1%
Software Practise Engineering - Practise Manager R&D	1	1%
Solution Architect	7	10%
Systems Analyst	2	3%
Tech lead	1	1%
Test Analyst	1	1%
VP of Technology	1	1%
Team leader	1	1%
Agile coach	1	1%
Total	69	100%

Responses by years Agile in use for project

The responses of the number of years projects have been using agile methodologies are evenly distributed across the available year ranges. The majority of respondents, 50 responses (72%) indicate using agile methodologies for three years or less (see Table 7). The normal distribution and descriptive statistics results indicate the responses are not normally distributed, with a SW result of 0.905 and $p - value < 0.001$. The skewness value of 0.512 indicates the distribution is moderately and slightly positively skewed.

Table 7: Distribution of responses by number of year's project has been using agile

Number of Years Project Using Agile Methodologies	Number of Respondents	Percentage of Total Completed Responses
Less than 1 year	14	20%
Between 1 and 2 years	16	23%
Between 2 and 3 years	20	29%
Between 3 and 4 years	7	10%
Between 4 and 5 years	11	16%
Between 5 and 6 years	0	0%
More than 6 years	1	1%
Total	69	100%

Responses by Agile experience of respondents

Given the publication of the agile manifesto in 2001 (Fowler & Highsmith, 2001) being over fifteen years ago it is unsurprising the majority of the respondents, 43 responses equating to 62%, report to have more than four years of agile experience, comprised of 16 responses between 4 and 5 years, 4 responses between 5 and 6 years and 23 responses with more than 6 years' experience (see Table 8). The normal distribution tests conducted for agile experience indicate the variable is not normally distributed, with an SW measure of 0.869 and a $p - value < 0.001$. The skewness value of -0.410 indicates the distribution is fairly symmetrical and slightly negatively skewed. The responses obtained are consistent with findings from international studies (VersionOne, 2016), which show the majority of respondents having more than four years of agile experience (VersionOne, 2017).

Table 8: Response distribution by agile experience of respondents

Experience with Agile Methodologies	Number of Respondents	Percentage of Total Completed Responses
Less than 1 year	6	9%
Between 1 and 2 years	5	7%
Between 2 and 3 years	12	17%
Between 3 and 4 years	3	4%
Between 4 and 5 years	16	23%
Between 5 and 6 years	4	6%
More than 6 years	23	33%
Total	69	100%

Item Consistency and Reliability Tests

For each of the constructs, the internal consistency of responses was determined using the Cronbach alpha (α) test. A Cronbach $\alpha = 0.7$ is deemed to show the combination of questions posed for a construct is reliable (Nunnally, 1978). Although an α as low as 0.6 is acceptable for exploratory re-

search (Fornell & Larcker, 1981), where a construct was found to have $\alpha < 0.6$, the test was extended to determine the effect of the elimination of a question would have on the reliability measure. Since Cronbach α depicts the lower bound reliability measure (Hair & Hult, 2016), it is suggested further reliability tests be conducted for low α results (Sijtsma, 2009). For these cases, the Spearman correlation (rho) was calculated to determine whether there was a statistically significant correlation between the responses. A statistically significant correlation measure and $\alpha \geq 0.6$ ensures the questions used in the analysis of the construct are aligned to the intent of the construct.

The questions related to a construct were coded as a concatenation of the construct abbreviation, e.g. CA (Customer Availability) and the question number in the survey. The constructs Customer Availability, Requirements Management, Self-Organizing Teams, Agile Project Management and Performance Management have a Cronbach $\alpha = 0.7$, Project Planning, Regular Delivery, Test Driven Development and Sustainable Pace have a Cronbach $\alpha = 0.8$ and Perceived Project Success with a Cronbach $\alpha = 0.9$ showing high internal consistency. Collaborative Development ($\alpha = 0.5$) and Defect Prevention ($\alpha = 0.4$) show low internal consistency, and further analysis is applied as further detailed in the following subsections.

Collaborative development

A Cronbach of $\alpha = 0.5$ was obtained for the Collaborative Development construct. The exclusion of any of the questions does not improve the reliability measure of the construct (refer to Table 10). Table 9 shows the results of the rho correlation tests for the collaborative development construct. The results show a statistically significant correlation between CD17 and CD18 at a 0.01 (99%) confidence level. However, CD19 shows a statistically insignificant correlation with these questions. CD19 is thus excluded from further analysis and the construct is represented by CD17 and CD18.

Table 9: Internal consistency Spearman (rho) correlation for Collaborative Development Construct

Variable	CD17	CD18	CD19
CD17	1.000		
CD18	0.349**	1.000	
CD19	0.099	0.178	1.000
** Correlation is significant at the 0.01 level (2-tailed)			

Table 10: Effect on Cronbach alpha measure when deleting questions

Variable	Cronbach's Alpha if Item Deleted
CD17	0.335
CD18	0.225
CD19	0.498

Defect prevention

A Cronbach of $\alpha = 0.4$ was obtained for the Defect Prevention construct; however as shown in Table 12, the exclusion of any of the questions does not improve the reliability of the construct. Table 11 shows the results of the rho correlation tests for the defect prevention construct. The results show a statistically significant correlation between DP33 and DP34 at a 0.01 (99%) confidence level. However, DP35 shows a statistically insignificant correlation with these questions and a possible explanation is the negative phrasing of the question. Roszkowski and Soven (2010) show that negatively phrased questions could adversely affect the response correlation. DP35 is thus excluded from further analysis and the construct was represented by DP33 and DP34.

Table 11: Internal consistency Spearman (rho) correlation for Defect Prevention Construct

	DP33	DP34	DP35
DP33	1.000		
DP34	0.418**	1.000	
DP35	0.113	0.070	1.000
** Correlation is significant at the 0.01 level (2-tailed)			

Table 12: Effect on Cronbach alpha measure when deleting questions

Variable	Cronbach's Alpha if Item Deleted
DP33	0.115
DP34	0.246
DP35	0.547

CONSTRUCT NORMALITY AND DISTRIBUTION

Each construct was tested for normality using the Shapiro-Wilk (SW) test for normality to determine the statistical approach to be applied. With $p - value < 0.001$, the constructs of CA, RM, RD, and PPS are non-normally distributed. The constructs PP, SOT, and DP were found to have $p - value = 0.001$, and thus also have a non-normal distribution. The remaining constructs of CD, $p - value < 0.005$, TDD, $p - value < 0.007$, SP, $p - value < 0.026$, APM, $p - value < 0.002$ and PM, $p - value < 0.141$ were all found to have a $p - value > 0.001$ and thus the responses were normally distributed. Since there is a mixture of normally and non-normally distributed responses, non-parametric statistical methods were used for further analysis (Saunders et al., 2009).

HYPOTHESES TESTS

Correlation analysis was used because the objective of the research is the investigation of the association between the two constructs and the data collected is discrete numeric data (Saunders et al., 2009). Since the conceptual model being investigated in this research and the corresponding hypotheses are unidirectional, a one-tailed correlation was employed. Spearman's non-parametric correlation (r_s) was used to determine the strength and direction of the correlation since it does not assume normality in the underlying data. Significance testing was conducted for each hypothesized correlation to test the probability of the correlation occurring by chance. For resulting $p - value < 0.05$ the correlation was deemed to be statistically significant, allowing the relevant null hypotheses to be rejected (Saunders et al., 2009).

Table 13 shows the summary of the Spearman rho correlation for each of the independent constructs against the dependent construct of perceived project success. As is evidenced, all the constructs show statistically significant correlation at either the 0.01 (99%) or 0.05 (95%) confidence interval. The strongest correlation of 0.626 is observed for PerfMng while the weakest correlation of 0.270 is observed for CD.

Table 14 shows the summary of the Spearman rho correlation for each of the maturity level constructs against the dependent construct of perceived project success. As is evidenced, all the constructs show a statistically significant correlation at the 0.01 (99%) confidence interval. The strongest

correlation of 0.626 is observed at maturity level five (L5), while the weakest correlation of 0.482 is observed at maturity level three (L3).

Table 13: Summary of Spearman rho Correlation of independent constructs to the dependent construct of Perceived Project Success

Construct	Correlation
Performance Management	0.626**
Requirement Management	0.559**
Self-Organizing Team	0.540**
Test-Driven Development	0.496**
Regular Delivery	0.491**
Defect Prevention	0.473**
Project Management	0.473**
Customer Availability	0.401**
Project Planning	0.347**
Sustainable Pace	0.340**
Collaborative Development	0.270*
** Correlation is significant at the 0.01 level (1-tailed). * Correlation is significant at the 0.05 level (1-tailed).	

Table 14: Summary of Spearman rho Correlation of independent constructs to the dependent construct of Perceived Project Success

Construct	PPS
Level 2 – Explored (L2)	0.507**
Level 3 – Defined (L3)	0.482**
Level 4 – Improved (L4)	0.575**
Level 5 – Sustained (L5)	0.616**
** Correlation is significant at the 0.01 level (1-tailed).	

FINDINGS AND DISCUSSION

HYPOTHESES ANALYSIS

Hypothesis 1: Customer availability

The Customer Availability construct shows a statistically significant correlation of 0.401 at a confidence level of 0.01 (99%). Thus, the null hypothesis $H_{0\text{-}1}$ is rejected in favor of H_1. The responses to this survey indicate that customer availability is positively associated with the teams' perceived project success.

This finding is consistent with previous research on customer availability being a critical success factor for agile environments (Chow & Cao, 2008; Tanner & von Willingh, 2014) and further supports principle four of the agile manifesto (Fowler & Highsmith, 2001). Critically at level two maturity of the AMM, a knowledgeable customer should be present at the start of an iteration to ensure requirements are properly understood, explained and clarified (Patel & Ramachandran, 2009a). Furthermore, findings from this study confirm previous work in which the daily availability and inclusion of the customer in decisions related to the development of the software are positively associated with project success (Abelein & Paech, 2015).

Hypothesis 2: Requirements management

Responses to this survey show a statistically significant correlation of 0.559 at 0.01 (99%) confidence level between the requirements management and perceived project success construct. The null hypothesis $H_{0\text{-}2}$ is rejected in favor of H_2 and the finding from this research is that requirement management is positively associated with the teams' perceived project success.

Consistent with findings by Patel and Ramachandran (2009b), this research indicates that the management of requirements represented in story cards is positively associated with perceived project success. Furthermore, the findings from this research are consistent with principle two of the agile manifesto (Fowler & Highsmith, 2001) with Ambler (2014), and Sverrisdottir et al. (2014) highlighting the positive influence changing requirements can have on perceived project success.

Hypothesis 3: Project planning

The responses for this survey show a statistically significant correlation of 0.347 at 0.01 (99%) confidence level between project planning and perceived project success. Thus, the null hypothesis $H_{0\text{-}3}$ is rejected in favor of H_3.

The results confirm that the use of agile estimation techniques allows for more accurate and reliable estimation (Surowiecki, 2004), which in the context of this study, is found to have a positive association with the teams' perceived project success. Using the teams' input into the iteration plan and the presence of the customer during the initial estimation allows for transparency, clarification, and expectation management, resulting in a more realistic and achievable plan (Patel & Ramachandran, 2009b). This confirms previous findings that input from the development team in project planning, based on the granular decomposition of the work required, allows for more accurate, reliable and realistic estimates (Turner, 2014) and thus improved project success.

Hypothesis 4: Regular Delivery

The regular delivery construct shows a statistically significant correlation of 0.491 at a 0.01 (99%) confidence level with the perceived project success construct. Thus, the null hypothesis $H_{0\text{-}4}$ is rejected in favor of H_4.

The positive association found between regular delivery and perceived project success is confirmation of the underlying philosophy of an agile implementation, embodied in principle one and seven of the agile manifesto (Fowler & Highsmith, 2001). Furthermore, these results align with existing consensus in literature that regular delivery is a critical success factor for agile implementations (Chow & Cao, 2008; França et al., 2010), with França et al. (2010) finding it to have the strongest correlation with project success.

Hypothesis 5: Collaborative development

Though the agile manifesto encourages collaborative practices as per principle six (Fowler & Highsmith, 2001), collaborative practices such as pair programming is not found to be a critical success factor in agile implementations in literature (Chow & Cao, 2008). However, the responses obtained in this research show a statistically significant correlation of 0.270 at a confidence level of 0.05 (95%) between collaborative development practices and perceived project success. Thus, the null hypothesis H0-5 is rejected in favor of H_5.

However, this construct was found to have the weakest correlation of all the constructs. Though collaborative techniques have been found to result in improved code quality and increased business knowledge (Bipp et al., 2008), working only for new and complex problems when the proper mix of skills, personality and expertise are involved (Hannay et al., 2009). More specifically, collaborative development techniques have been found to be less effective amongst experienced developers (Hannay et al., 2009) and since the majority of the respondents for this study have more than six years of agile experience the weak correlation found is possibly due to prevalence of more experienced re-

spondents, aligning to existing findings (Hannay et al., 2009). Due to the limitations of this study it is not feasible to perform more in-depth analysis to explain the results obtained in further detail, however it could be a topic for future research.

Hypothesis 6: Test-driven development

A statistically significant correlation of 0.496 at a confidence level of 0.01 (99%) between test-driven development and perceived project success was found. Thus, the null hypothesis $H_{0\text{-}6}$ is rejected in favor of H_6.

As previously discussed, a key component of perceived project success in an agile environment is quality (Serrador & Pinto, 2015), which is "the most subject to variation in perception by multiple project stakeholders" (Prabhakar, 2008, p. 7). Test-driven development activities have been shown to improve the quality of the implemented software (Sanchez et al., 2007), whilst ensuring frequent delivery (Patel & Ramachandran, 2009a). Whilst an increase in the quality has been found to improve project success (Serrador & Pinto, 2015), the frequent delivery aligns with principle three of the agile manifesto "Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale." (Fowler & Highsmith, 2001, p. 35). The finding of this study is thus aligned with previous literature.

Hypothesis 7: Sustainable pace

The sustainable pace construct shows a statistically significant correlation of 0.340 at a 0.01 (99%) confidence level. Thus, the null hypothesis $H_{0\text{-}7}$ is rejected in favor of H_7.

Principle eight of the agile manifesto mentions "constant pace indefinitely" (Fowler & Highsmith, 2001, p. 31), which is the basis of this construct in the AMM. The practice of limiting the working week to forty hours is one of the principles in extreme programming (Sauter, 2006) and has been shown to be a critical success factor in agile implementation (Chow & Cao, 2008; Tanner & von Willingh, 2014). The finding from this research thus aligns with critical success factor research (Chow & Cao, 2008; Tanner & von Willingh, 2014). With a correlation of 0.340, the sustainable pace construct is found to have the second lowest correlation to perceived project success. A possible explanation for the low correlation is the negatively phrased questions used in the wording of one of the questions for this construct, which has sometimes been found to potentially adversely affect responses (Roszkowski & Soven, 2010).

Though Chow and Cao (2008) stress sustainable pace practice as a critical success factor, França et al. (2010) found sustainable pace to not correlate with project success. A possible explanation for this apparent misalignment of findings, is this study does not suffer from the same generalization restriction. The generalization restriction in the study by França et al. (2010) is primarily due to the size and localization of the survey participants. Though the current study has a similar response size, the sample does not suffer from the same localization restriction.

Hypothesis 8: Self-organizing team

The self-organizing team construct shows a statistically significant correlation of 0.540 at a confidence level of 0.01 (99%). Thus, the null hypothesis $H_{0\text{-}8}$ is rejected in favor of the hypothesis H_8. The responses obtained in this survey depict a positive association between the independent construct of a self-organizing team and the dependent construct of perceived project success.

The observation from this study is consistent with studies showing teams that operate in a "classic craftsman environment" (Boehm & Turner, 2003, p. 7), being able to select their own work is critical to the success of an agile implementation (Chow & Cao, 2008) and is shown to be critical in the success of the project (Tanner & von Willingh, 2014).

Hypothesis 9: Agile project management

The responses to the survey indicate a statistically significant correlation of 0.473 at a confidence level of 0.01 (99%). Thus, the null hypothesis $H_{0\text{-}9}$ is rejected in favor of H9. Principles seven "Working software is the primary measure of progress" (Fowler & Highsmith, 2001, p. 35) of the agile manifesto equates project success to the delivery of software of value, to the customer.

Agile Project Management (APM) within the AMM, focuses the management efforts on metrics to track the delivery of business value (Patel & Ramachandran, 2009a) and improving the quality of software (Verheyen, 2014). Ambler (2011) concludes agile projects are considered successful when deemed to be delivering value to the business, which is tracked by using agile methods such as burndown charts (Papadopoulos, 2015) and story completion rates being used to measure continuous value delivery and risk reduction (Verheyen, 2014). While not explicitly mentioned as a critical success factor, Chow and Cao (2008) lists the "Lack of agile progress tracking mechanism" (Chow & Cao, 2008, p. 963) as a failure factor for agile implementations.

Hypothesis 10: Defect prevention

The defect prevention construct was found to have a statistically significant correlation of 0.473 at a confidence level of 0.01 (99%) with the perceived project success construct. Thus, the null hypothesis $H_{0\text{-}10}$ is rejected in favor of H_{10}.

The defect prevention construct focusses on the quality aspects of agile delivery, in favor of future functionality (Patel & Ramachandran, 2009a). As discussed previously and highlighted by Highsmith (2004) and Leppänen (2013), quality, though subjective (Prabhakar, 2008; Serrador & Pinto, 2015) is a good indicator of project success. Thus, the observation from this study is aligned with previous findings.

Furthermore, considered in conjunction with the "Test-Driven Development" construct, which focusses on quality, a fairly high inter-item correlation of 0.564 is found, showing that the respondents consistently associate the focus on quality with perceived project success. However, the defect prevention construct focuses on the sacrificing future functionality in favor of quality activities (Patel & Ramachandran, 2009a). Given the limitation of this study it is not possible to test whether the observed association holds consistently for all agile roles represented amongst respondents.

Hypothesis 11: Performance management

The responses obtained for this research indicates a statistically significant correlation of 0.626 at a 0.01 (99%) confidence level, between performance management and perceived project success. Thus, the null hypothesis $H_{0\text{-}11}$ is rejected in favor of H_{11}.

The focus of the performance management construct is customer satisfaction and continuous customer involvement (Patel & Ramachandran, 2009a) and was found to have the strongest correlation to perceived project success. Consistent customer involvement in the daily development activities is repeatedly found to be a critical success factor for successful agile implementations (Tanner & von Willingh, 2014), which aligns with the findings of this study. The strength of the correlation could be explained by the distribution of respondents by agile role. There is a high representation of either business representatives, in the form business representative (10 respondents, 8%), business analyst (8 respondents, 6%) or line management (19 respondents, 14%), which is further evidenced by the observed mean of 4.04.

The presence and constant involvement of the customer in successful agile delivery is embedded in agile principle four "Business people and developers must work together daily throughout the project" (Fowler & Highsmith, 2001, p. 35). The observed association between the consistent involvements of the customer with the daily development activities is thus both congruent with the agile manifesto and previous studies highlighting the importance of customer involvement (Hoda et al., 2011; Sverrisdottir et al., 2014).

DISCUSSION OF THE FINDINGS

All the constructs show a statistically significant positive correlation with the construct of perceived project success. The secondary research questions posed for this research, namely "How are the specific process areas of the different maturity levels in the AMM associated with perceived project success?" is answered diagrammatically by Figure 8.

The only construct observed to have a statistically significant correlation > 0.6 is performance management, from maturity level five of the AMM. Given that the focus of this construct is on customer satisfaction (Patel & Ramachandran, 2009a), the underlying philosophy of agile methods is strongly observed in the responses. The PerfMan construct in this research specifically focuses on when functionality is accepted as being delivered, stressing all acceptance criteria to have been met as the sole measure of delivery, aligned with agile principle seven "Working software is the primary measure of progress" (Fowler & Highsmith, 2001, p. 35). Critical success factor research emphasizes regular delivery as a key factor but does not relate it to the satisfaction of the customer (Chow & Cao, 2008). Performance management is thus observed to be a focus area for practitioners to achieve improved perceived project success.

The construct found to have the second strongest statistically significant correlation is RM, from maturity level two. This construct specifically focuses on understanding what functionality the customer wants to be developed within an iteration. Viewed in conjunction with the performance management construct, it is evident that requirements management shows a statistically significant correlation of 0.456 at a confidence level of 0.01 (99%) with performance management. Thus, practically the ability to deliver what the customer wants (Performance Management construct) is associated with knowing what the customer wants (Requirements Management construct). This is further confirmed by critical factor research (Chow & Cao, 2008; Tanner & von Willingh, 2014). The observed correlation is possibly skewed by the bias in the responses to the Scrum methodology, since requirements management in the context of scrum relies heavily on the presence of the customer during development for clarification of requirements (Baruah, 2015).

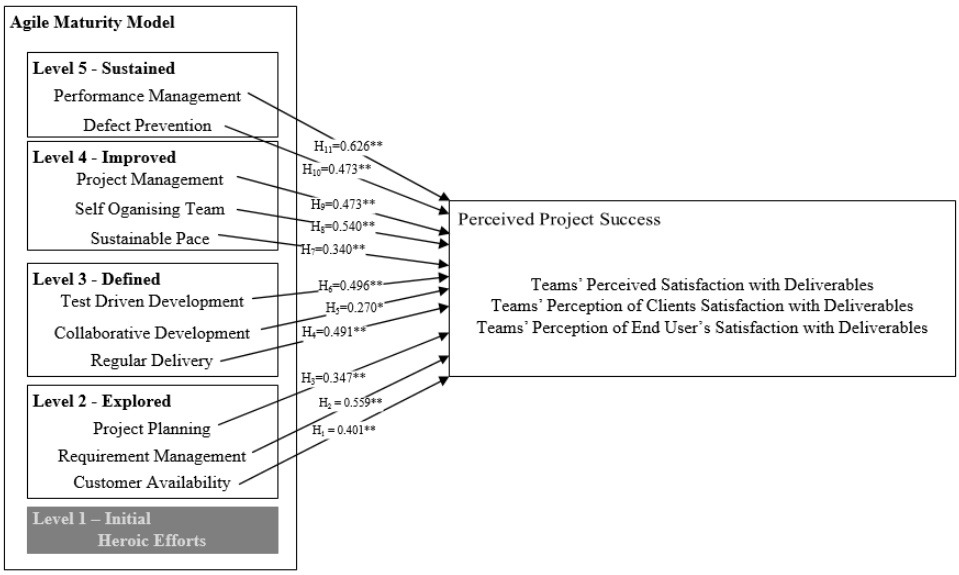

Figure 8: Conceptual model showing correlation found between constructs and perceived project success

The RM is observed to have the strongest statistically significant correlation of 0.504 at a confidence level of 0.01 (99%), with the Regular Delivery construct (RD), from maturity level three of the AMM.

Whilst RM focuses on knowing what the customer wants and PerfMan on the satisfaction of the customer, RD in the context of this research focused on the capability of this delivery and itself shows a strong statistically significant correlation with Perceived Project Success (PPS). The observed correlation between RD and PPS is consistent with findings from previous research (França et al., 2010). RD in turn shows the strongest statistically significant correlation with the Customer Availability construct (CA), from maturity level two of the AMM, which once again has been shown to be a critical success factor for agile implementations (Tanner & von Willingh, 2014). The observation is aligned with previous findings which show a strong correlation between customer availability and project success (Hoda et al., 2011).

The construct found to have the third strongest statistically significant correlation is Self-Organizing Team (SOT), from maturity level four of the AMM. This observation is consistent with previous studies which found SOT to be in the top three constructs in terms of strength of correlation to project success (Misra et al., 2009). Interestingly in the observed results, SOT shows the strongest statistically significant correlation with the previously mentioned constructs of PerfMan (0.541), CA (0.540) and RD (0.524) at a confidence level of 0.01 (99%).

The primary research question "How are the different maturity levels of the Agile Maturity Model (AMM) as proposed by Patel and Ramachandran (2009a) associated with perceived project success?" is answered by reviewing the results found in Table 14 and depicted in Figure 9. Interestingly all the maturity levels are found to have statistically significant correlations to the perceived project success construct. Notably the correlation varies from $r = 0.507, p \leq 0.01$ at level two, $r = 0.482, p \leq 0.01$ at level three, $r = 0.575, p \leq 0.01$ at level four with a peak of $r = 0.616, p \leq 0.01$ at maturity level five, as shown in Figure 10. The solid line depicts the specific correlations found for each of the levels whilst the dotted line shows the trend observed across the different maturity levels. As observed, besides the decrease in the strength of the correlation at level three, the correlation increases as the maturity level increases.

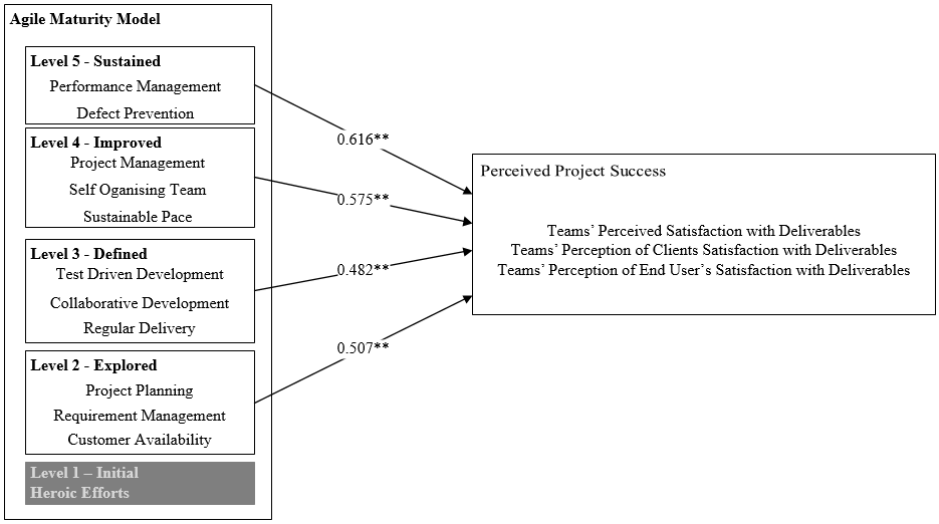

Figure 9: Maturity levels correlation to perceived project success

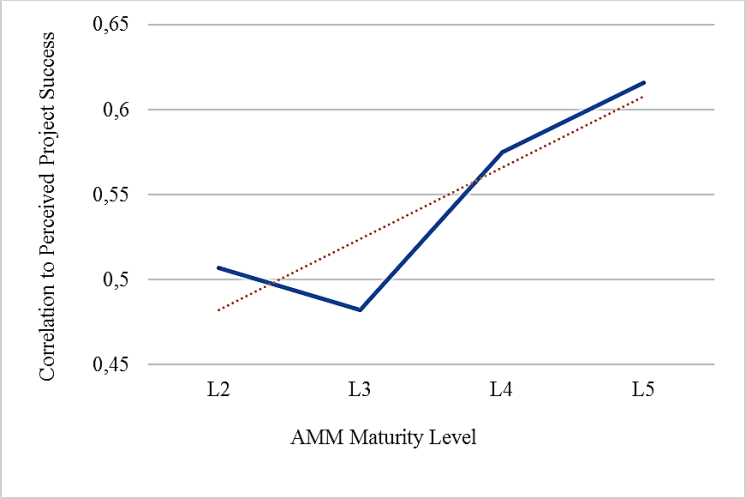

Figure 10: Correlation between maturity level and perceived project success

Notably the observed correlation at level three deviates from the overall observed behavior of increasing correlation as maturity levels increase. However, it should be noted that the collaborative development construct (CD), which forms part of the level three maturity was found to have low internal consistency and reliability measures. The decrease in this correlation could thus be influenced by the reliability of the CD and if it was ignored, the observed correlation would change to a value of 0.570 at a confidence level of 0.01 (99%), which would result in a more linear progression between the strength of the correlation and the maturity level, as shown in Figure 11.

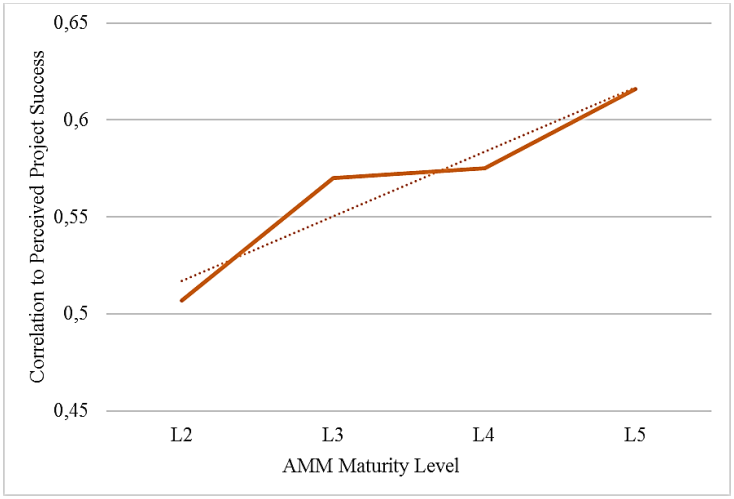

Figure 11: Correlation between maturity level and perceived project success when Collaborative Development construct is omitted

The increasing strength in the correlation as well as the higher correlation at maturity level five, stands in contrast to studies relating CMMI maturity and agile success. This is as expected though, since these previous studies are in consensus CMMI maturity levels above three are difficult to achieve without sacrificing agility (Fritzsche & Keil, 2007; Łukasiewicz & Miler, 2012; Marçal et al., 2008; Potter & Sakry, 2009). The results obtained in this study thus both confirm the AMM by Patel and Ramachandran (2009a) and highlight the findings of previous research that the observed behavior of an agile maturity model differs from the traditional maturity levels in the CMMI.

Thus, in answering the primary research question it is found from the responses obtained, achieving higher levels of agile maturity in the AMM can be associated with an improved perception of project success. Since a maturity model describes the evolution of a process over time, with each successive level of maturity equating to an improvement in the desired outcome (Fontana et al., 2015), the results of this survey support the AMM as a maturity model for agile implementations.

In providing an answer to the research sub-question: "How are the specific process areas of the different maturity levels in the AMM associated with perceived project success?", the observation shows the activities are interspersed across maturity levels two, four and five but show strong correlation with activities from other maturity levels. The activities in the higher levels of maturity show a reliance on the customer availability construct (CA). Even though CA is found to have a statistically significant correlation with PPS, it was found to be one of the weaker correlations amongst respondents.

CONCLUSION

Though the most commonly accepted maturity model, the Capability Maturity Model Integrated (CMMI) (Leppänen, 2013) has been found to be less compatible with agile methods, particularly at higher levels of maturity. Given the alignment of agile maturity models with the agile principles it can be reasonably assumed achieving higher levels of maturity could be associated with an improvement in the successful delivery of projects. This research was specifically conducted to ascertain whether an association exists between the maturity levels of the Agile Maturity Model (AMM) (Patel & Ramachandran, 2009a) and the Perceived Project Success (Serrador & Pinto, 2015).

The sixty-nine responses were analyzed using correlation analysis and found to strongly align with prior research focusing on critical success factors for agile implementations. The strongest correlations are found between Performance Management (0.626), Requirements Management (0.559) and Self-Organizing Teams (0.540). Interestingly these activities occur at different maturity levels within the AMM but all the element of either customer involvement and/or collaboration with the customer embedded.

The data analysis found varying statistically significant positive correlation exists between maturity levels and perceived project success. The strongest correlation was found at the highest maturity level, with relatively weaker correlation at the lower levels of maturity. It can thus be concluded that a higher level of maturity in the AMM is positively associated with perceived project success. The contribution from this research is the validation of the conceptual model relating the activities and maturity levels of the AMM as the independent variables to the dependent variable of perceived project success. For practitioners, the study has practical implications in systematically identifying the critical agile activities, such as the use of story cards, continuous delivery and the presence of a knowledgeable customer to improve perceived project success. With the activities arranged in a proper maturity model the results of this study can guide practitioners as to the order in which activities should be introduced into an environment.

The primary limitation of the research is the bias towards more technical roles within an agile team, with the majority of the respondents from a development role with a limited number of respondents indicating themselves to be business representatives. A further limitation is the limited number of responses obtained. With sixty-nine valid responses, the possible statistical analysis is limited and does not offer the researcher the opportunity to, for example, segment the responses by agile role or find moderating variables, such as industry or experience, within the responses.

To address some of the limitations mentioned it would be useful to perform this study, using the same conceptual model as a basis for a qualitative study. This would allow the researcher the opportunity to strictly define the population as well as obtaining input from the technical and business representatives from the same agile teams. Additionally, this would allow the researcher to provide comparisons on whether the perception of project success is consistent between the technical and busi-

ness team members. Finally, the agile maturity model selected for this research is one of a number currently under discussion in literature. It would be possible to re-use the conceptual model used in this research and substitute a different agile maturity model, to determine if similar results will be obtained.

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APPENDIX

DEMOGRAPHIC INFORMATION

Specify the industry of the project	*<Dropdown of predefined selection options, including "Other" option>*			*Other: Please specify*			
Specify the agile method being used for the project	*<Dropdown of predefined selection options, including "Other" option>*			*Other: Please specify*			
Approximately how long has the project been using agile?	Less than 1 year	Between 1 and 2 years	Between 2 and 3 years	Between 3 and 4 years	Between 4 and 5 years	Between 5 and 6 years	More than 6 years
How much personal experience do you have using agile?	Less than 1 year	Between 1 and 2 years	Between 2 and 3 years	Between 3 and 4 years	Between 4 and 5 years	Between 5 and 6 years	More than 6 years
What is your current job title?							
What role/roles do you currently fulfil within the agile team?							

QUESTIONNAIRE

Customer Availability		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	The customer is present in at the beginning of a development cycle to explain the business requirements					
2	The customer is available daily to answer questions					
3	The customer is NOT knowledgeable in the business domain of the requirements being developed					
Requirements Management		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
4	Requirements are presented using stories (story cards)					
5	The user requirements contain sufficient detail to know what to deliver to satisfy the customer					
6	Detailed tasks can be created from the requirements					
7	Changes are NOT allowed to the user requirements once development has commenced					

Project Planning		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
8	The implementation team estimates the work required for the functionality to be developed in the iteration					
9	Estimation techniques such as planning poker are used					
10	Estimation is done at the start of the iteration cycle					
11	The customer is present during estimation					
12	The estimates provided are used as input in planning the work for the iteration					
13	Availability of team members for the iteration is NOT taken into account when doing the iteration planning					
Regular Delivery		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
14	Functionality developed is demonstrated to the customer at regularly intervals					
15	When functionality is demonstrated the customer provides feedback					
16	Feedback on functionality previously demonstrated is used in future iterations					
Collaborative Development		**Never**	**Rarely**	**Sometimes**	**Often**	**All of the Time**
17	Implementation is done using pair programming					
18	Coding peer reviews are conducted					
19	Developers are allowed to alter any part of the source code or system required to complete a development task					
Test-Driven Development		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
20	Test cases are created before the corresponding code is developed					
21	Test cases are derived from user requirements					
22	All tests cases must pass before promoting code to production					
23	All newly developed code must have accompanying test code					

Sustainable Pace		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
24	Management limit the number of hours worked weekly to a maximum of 40 hours					
25	On average I do not work more than 40 hours a week					
26	I do not work more than 40 hours a week for two consecutive weeks					
Self-Organising Team		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
27	The team look at areas for improvement affecting the successful delivery of functionality					
28	The development team, including the customer, select the work being undertaken for an iteration					
29	The development team are allowed to implement the simplest solution to meet the requirement					
Agile Project Management		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
30	Progress within an iteration is tracked using measures such as burn-down charts or stories/features completed or similar measure					
31	The team only undertake work which can be completed in an iteration					
32	Only work which is of high priority for the customer is undertaken					
Defect Prevention		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
33	If/when bugs are found in production the team (including the customer) allocates time to diagnose and fix the root cause of the problem					
34	If/when bugs are found in production the team (including the customer) test cases are implemented to avoid the future reoccurrence of the bug					
35	If/when bugs are found in production the team (including the customer) the scope of the current iteration is NOT sacrificed in favour of resolving the problem					

Performance Management		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
36	Functionality is only accepted for development if the acceptance criteria are explicitly stated					
37	Functionality is only considered to be completed once all acceptance criteria have been met					
38	The customer is available throughout the day to clarify requirements and provide feedback					
39	We DO NOT keep track of the number of production bugs being reported within a development iteration					
Perceived Project Success		**Very Dissatisfied**	**Dissatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
40	How do you rate the project team's satisfaction with the quality of the project deliverables?					
41	How do you rate the customer's satisfaction with the quality of the project deliverables?					
42	How do you rate the end users' satisfaction with the quality of the project deliverables?					
43	How do you rate the project team's satisfaction with the value delivered in the project?					
44	How do you rate the customer's satisfaction with the value delivered in the project?					
45	How do you rate the end users' satisfaction with the value delivered in the project?					

BIOGRAPHIES

Vaughan Henriques obtained a B Eng (Hons) degree in Electronics Engineering from Canterbury University in 1996 and subsequently a B Com (Hons) degree from the University of Cape Town specializing in Information Systems in 2003 and is presently pursuing a Master's degree in Information Systems at the University of Cape Town. Having 19 years of industry experience spanning various sectors ranging from mining, media, telecoms and financial services, in various roles including software developer, development manager and architecture, his research interests include team motivation, software development methods, IT architecture and design.

Assoc Professor Maureen Tanner has been teaching systems analysis and de- sign at the Department of Information Systems of the University of Cape Town since 2009. Her research interests lie in Agile software development related issues (for both collocated and distributed teams), UML, software engineering and social aspects of social engineering, global software development, virtual teams, and team collaboration.

Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

A CASE STUDY: CROWD SOURCED AI PROGRAMMING [RESEARCH IN PROGRESS; ABSTRACT]

Christine Bakke — University of Minnesota, Minneapolis, MN, USA — cbakke@umn.edu

ABSTRACT

Aim/Purpose	To examine crowd-sourced programming as an experiential learning, instructional medium. The goal is to provide real-time, real-world, artificial intelligence programming without textbook instructional materials.
Background	Open source software has resulted in loosely knit communities of global software developers that work together on a software project. Taking open source software development to another level, current trends have expanded into crowd sourced development of Artificial Intelligence (AI). This project explored the use of Amazon Alexa's tools and web resources to learn AI software development.
Methodology	This project incorporated experiential and inquiry educational methods that combined direct experience with crowd-sourced programming while requiring students to take risks, solve problems, be creative, make mistakes and resolve them. The instructor facilitated the learning experience through weekly meetings and structured reports that focused on goal setting and analysis of problems. This project is part of ongoing research into small group creative works research that provides students with real-world coding experience.
Contribution	Undergraduate students successfully programmed an introductory level social bot using experiential learning methods and a crowd-sourced programming project (Amazon Alexa social bot).
Findings	A summary of the experience and findings will be included with final paper release
Recommendations for Practitioners	Crowd sourced programming provides opportunities and can be harnessed for semester long coding projects to develop student programming skills through direct involvement in real open sourced projects.

Accepted by Editor Michael Jones | Received: January 20, 2020 | Revised: February 18, 2020 | Accepted: February 20, 2020.

Cite as: Bakke, C. (2020). A case study: Crowd sourced AI programming [Research in Progress; Abstract]. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp 157-158. Informing Science Institute. https://doi.org/10.28945/4516

Recommendations for Researchers	There is a high rate of failure associated with software projects, yet programming courses continue to be taught as they have been for decades. More research needs to be done and instructional materials developed for the undergraduate level that use real programming projects. Can we improve the rate of success for software projects by requiring experiential education in our courses?
Impact on Society	Crowd-sourced programming is an opportunity for students to learn to program and build their portfolio with real world experience. Students participating in crowd-sourced programming are involved in creative works research and gain experience developing real-world software.
Future Research	Future research will explore experiential learning such as crowd-sourced and other open source programming opportunities for undergraduate students to participate in real software development.
Keywords	crowd-sourced programming, artificial intelligence, software development, programming, experiential learning, inquiry education, mob programming, artificial intelligence

OVERVIEW

This paper examines crowd sourced programming as an experiential instruction methodology, following the educational experiences of undergraduates learning artificial intelligence programming through use of publicly available resources primarily developed through Amazon's crowd sourced Alexa Prize social bot challenge. Students reported weekly following a structured report format that guided them through the real programming project (learning to code an AI social bot). Weekly analysis and discussion covered goal setting, trouble-shooting/problem solving, resource analysis, coding techniques and terminology.

BIOGRAPHY

Christine Bakke earned her PhD in Information Technology Instruction for Higher Education after 18 years of career experience that included a range of programming, database management and network administration. She emphasizes instructional methods that provide experiential learning and inquiry-based education. Since 2008, she has been an instructor of Information Technology, Computer Science, and Software Engineering courses.

Proceedings of the Informing Science + Information Technology Education Conference

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Online July 7-8, 2020

SYSTEMATIC LITERATURE REVIEW TO IDENTIFY AND RANK THE MOST COMMON REASONS FOR PLAGIARISM

Frederik Hattingh*	Tshwane University of Technology, Pretoria, South Africa	hattinghfg@tut.ac.za
Albertus Buitendag	Tshwane University of Technology, Pretoria, South Africa	buitendagaak@tut.ac.za
Manoj Lall	Tshwane University of Technology, Pretoria, South Africa	lallm@tut.ac.za

* Corresponding author

ABSTRACT

Aim/Purpose	In this paper the authors explore and analyse the literature to determine the common reasons why a student may choose to plagiarise. The predominant purpose of the research formed part of a larger study to develop metrics and methods to identify potential plagiarism within coding-based assignments.
Methodology	A systematic literature review with the objective to identify and rank the most common reasons for plagiarism was conducted. This was achieved by identifying primary studies conducted on the reasons for plagiarism. The identified studies were subsequently subjected to a top down quality assessment with a number of criteria. In total, 37 studies made it through the selection process. The results of the selected studies were synthesized to obtain a ranked list of reasons why students plagiarise.
Contribution	This paper contributes a ranked list of reasons that may influence a student's decision to plagiarise, based on a set of categories emerging from the literature.
Findings	Eleven possible categories indicating the common reasons behind a student's decision to plagiarise are identified. The literature revealed that aspects such as the external values of the student and attitudes towards academia and teaching styles are significant factors that impact a student's willingness and decision to plagiarise.
Impact on Society	Instructors may gain a better understanding on why their students decided to plagiarise.

Accepted by Editor Michael Jones | Received: February 6, 2020 | Revised: June 2, 2020 | Accepted: June 16, 2020.

Cite as: Hattingh, F., Buitendag, A., & Lall, M. (2020). Systematic literature review to identify and rank the most common reasons for plagiarism. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp. 159-182. Informing Science Institute. https://doi.org/10.28945/4576

Keywords students' attitudes towards plagiarism, plagiarism metrics, plagiarism deterrents

INTRODUCTION

The predominant characteristic of the information age is the large scale "computerisation of information" (Carr, 2006). As a direct result of the technological advances brought about by what has generally become known as 'the information age', the way students acquire knowledge has either changed or is already changing to some degree. Aasheim et al. (2012) hypothesized that students have different perceptions about what constitutes academically dishonest activities and behaviour in relation to programming assignments, as opposed to assignments involving maths and essays.

The Internet is the main advancement of the information age and thus had a significant impact on education. The increased rapid access to information does bring some advantages, but academics are increasingly worrying about the effect this is having on students plagiarizing (Austin & Brown, 1999; M. Jones & Sheridan, 2014).

Helgesson and Erikson (2015) define plagiarism as: "using someone else's intellectual product (such as texts, ideas, or results), thereby implying that it is their own." It is pointed out that using the intellectual product of another without proper attribution may happen intentionally or sometimes unintentionally (Das & Panjabi, 2011).

RESEARCH PROBLEM

An academic institution may use proactive plagiarism prevention methods to try and discourage plagiarism from taking place. The institution may also choose to use a reactive method like plagiarism detection combined with disciplinary action to limit future plagiarism. Both proactive and reactive approaches and their respective techniques applied to prevent or detect plagiarism, present problems that need to be examined and addressed (Ganguly et al., 2018; Haskins & Pieterse, 2016; Louw & Pieterse, 2015; Portillo-Dominguez et al., 2017).

Reactive plagiarism prevention measures do not show why a student may have plagiarised work. After submission the instructor will make the final determination on whether a student plagiarised code by analysing the metrics produced by the plagiarism detection engine. A 'metric' is described as a rule that can convert a document into a numeric value for representing similarity when compared to other documents (Lancaster & Culwin, 2004). When the instructor reviews the metrics, the focus is often only on finding cases where definite plagiarism has occurred. With metrics from traditional detection engines the instructor cannot determine why the student chose to plagiarise in the first place.

According to Devlin and Gray (2007) the only way for the instructor to determine the reason for plagiarism occurring is to conduct detailed interviews with the students. Because there is no timeline of how the student constructed the body of work, any direct evidence that the student tried to conceal when plagiarising the assignment is also lost.

With the above in mind it was possible to distil the multitude of problems as follows into one single problem statement: "General plagiarism detection engines give no clue about why the student plagiarised and do not add any value to teaching and learning education." To investigate the problem, the researchers set two main objectives. The first of these objectives is presented as part of this paper. The result from investigating the first objective will be used to investigate the second objective in later research work.

RESEARCH QUESTION AND OBJECTIVES

When embarking with a research project, the researcher formulates and classifies the research question as the first step to selecting the correct research design (Easterbrook et al., 2008).

The research question to be addressed was formulated as follows:

> *How can a real-time plagiarism detection engine be designed to produce metrics that can assist in plagiarism detection and support student education on plagiarism?*

Two different types of research question classifications often found in research are exploration and design type questions. It was identified by the researchers that the above research question can be classified to belong to both areas. The first area is of an exploratory nature with the second one being of type design. These areas respectively entail the following:

- The exploratory question can be answered by investigating different aspects connected to plagiarism and using the conclusions from this, to later identify metrics that can be used in real-time plagiarism detection.
- The design question relies on the conclusions reached from investigating the exploratory questions to start the design process. This especially focuses on what metrics a real-time plagiarism detection engine needs to generate. It then asks how one would design such an engine to make full use of these metrics.

Both areas referred to above are represented in the research question. Therefore, the choice fell on the application of a mixed method research approach. The mixed method approach allowed for the most applicable methodology to be used to answer each question area. Consequently, the mixed method approach applied here consisted of a systematic literature review to explore, identify, and apply a design science effort to design.

This paper presents the exploratory area of the mixed method approach in the form of a systematic literature review with the objective to identify and rank the most common reasons for plagiarism. It is hoped that the results of reaching this objective can provide a theoretical base to build on during the design science process for objective two to follow as part of a later research effort.

METHODOLOGY

In general a literature review is defined as "the analysis, critical evaluation and synthesis of existing knowledge relevant to your research problem, thesis or the issue that you are aiming to say something about" (C. Hart, 2018, pp. 3-4). Viewed from the perspective of function, Ridley (2012, p. 5) identifies three types of literature reviews, namely, the traditional review, the standalone review, and the systematic evidence-based review. The traditional review serves as the starting point of some primary research. The standalone review consists only of a literature review and its resulting insights. The systematic evidence-based review comprises an overview of all the available primary research studies from a particular field.

Cronin et al. (2008) explain that the traditional literature review will provide the reader with thorough background information and point out new research developments on the research topic. The focus will be broad, covering both the topic and related material. Both Ridley (2012) and Cronin et al. (2008) clearly distinguish between a traditional review and a systematic (evidence-based) review.

As stated by Cronin et al. (2008), unlike traditional narrative literature reviews, the systematic review needs to be more structured, delineated, and follow a step by step approach that can be explained and validated. Briner and Deyner (2012) and Briner et al. (2009) argue that a traditional literature review differs from a systematic review in five distinct ways. Firstly, the question that a systematic review is going to address is well defined and answerable. Secondly, the question under review is constructed and investigated from the perspective of many stakeholders. Thirdly, the literature re-

viewed comes from an extensive search into not only published, but also unpublished work. Fourthly, to ensure that bias to the researcher's own opinion is eliminated, the criteria for work to be included in the study is determined at the start of the study. Finally, the results from a systematic review are presented in such a manner that other researchers can validate the findings for themselves.

Although a systematic review does not provide direct answers, it will give the most accurate depiction of the question under review (Briner et al., 2009). The advantage of a systematic review is that bias is less likely. Another advantage is that the researcher can base results on many different methodologies and approaches used in the primary research. Because a systematic review combines the results from different studies, it is easier to detect smaller effects not immediately evident in the original individual studies (Kitchenham & Charters, 2007).

When analysing the different approaches to conducting a good quality systematic literature review, there are some interpretation and execution differences (Alderson et al., 2004; D. Evans & Pearson, 2001; Khan et al., 2003; Kitchenham & Charters, 2007; Okoli & Schabram, 2010). Yet, a pattern emerges that shows some agreement on the different steps to be followed. A well-defined question and problem should be the starting point for the systematic review. Using the question and problem as a framework, an initial literature search may then proceed. The studies identified during the initial literature search, should firstly be assessed for quality and then collectively synthesised. This is followed by discussing the synthesised results in the research report.

By combining different elements form the work of Khan et al. (2003), Alderson et al. (2004), Kitchenham and Charters (2007), Okoli and Schabram (2010) and D. Evans and Pearson (2001) a sequential approach to conducting a systematic literature review was constructed consisting of the six sequential steps indicated in Figure 1.

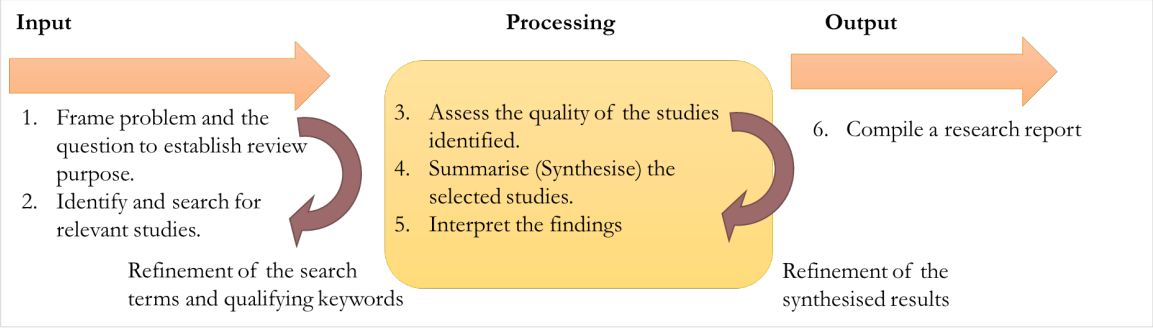

Figure 1: Sequential steps to conduct systematic literature review

In moving forward with this research, the results from conducting steps two through five are presented. By discussing the research problem, research questions and objectives earlier, the purpose of the systematic review is clarified. Thus, in executing the first step in the systematic review stated as to frame the problem and the question to establish the review purpose, the purpose of the review is described as to identify why students choose to plagiarise, and subsequently to develop metrics substantiated, grounded, and validated from the literature that would align with these reasons. This was followed by the next step, namely, to search and identify studies for inclusion in the systematic literature review.

IDENTIFYING AND SEARCHING RELEVANT STUDIES

With a clear purpose established for the systematic review, the second step in the process was to identify existing studies to the included. The purpose of this step was not to judge the quality or analyse any of the identified studies, but rather to create a reproducible search protocol. Initially a very broad search was conducted, and the results were analysed to construct a number of search terms.

The search terms were then used to search different academic databases for specific applicable literature.

The Initial Search

The goal of the initial search was to discover and identify search phrases and keywords that were to be used in the later detailed search of academic databases. The starting point of this initial discovery search was Google Scholar. The specific search parameters used for the initial Google Scholar search were to exclude patents while including citations. The date filter was set to anytime and the results were sorted by relevance. An initial search was conducted with the search phrase "why do students plagiarise" using the search parameters mentioned above. This initial search yielded a total of 19,400 results. To further refine and to discover more search terms and keywords, the abstracts of the first 50 results were reviewed and analysed. From this analysis additional search terms and keywords were derived.

Keyword and Search Term Analysis

Additional keywords identified from the initial search included 'perception', 'qualitative', 'analysis', 'interview', 'empirical', 'understanding', 'questionnaire', 'intervention', 'cheating', 'discussion groups', 'cultural values', 'view', 'reasons', and 'survey'. The search terms shown in Figure 2 were developed to place these keywords into context:

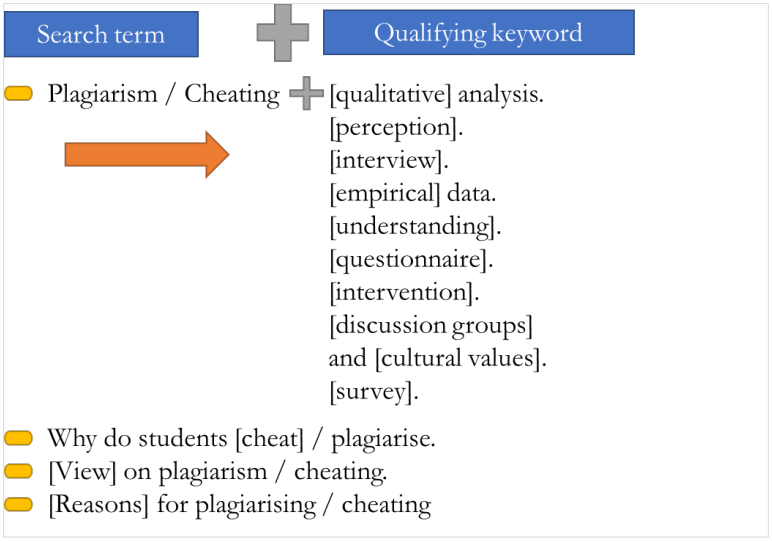

Figure 2: Search terms and qualifying keywords

The newly identified keywords and search phrases were subsequently used to search three academic databases.

Searching Academic Databases

In total, three academic databases/search engines/digital libraries were searched by using the identified search phrases. Although it is technically correct to use the phrase 'search engine', for Google Scholar, 'digital library' for EBSCOhost, and 'database' for Sabinet African Journals, for the sake of brevity, they will collectively be referred to as 'databases' in this document. Google Scholar and EBSCOhost were selected due to their multidisciplinary nature and large collections of journal articles and conference proceedings. To get the African perspective, Sabinet African Journals was included in the search effort as, according to the database maintainers, "This service is the most comprehensive,

searchable collection of full-text African electronic journals available on one platform which focuses on information originating from or pertaining to Africa" (Mitchell, n.d.).

When available in the search parameters (settings) patents, books, pamphlets, citations, and similar content were excluded. In all cases the search results were limited to content published after and including the year 1995. The only source that specifically mandated that individual databases be specified before searching was EBSCOhost. In this case most databases were excluded due to them not being relevant (example American Doctoral Dissertations, 1933 - 1955). The relevant internal databases that were selected in EBSCOhost were Academic Search Premier, CAB Abstracts, and Library, Information Science & Technology Abstracts. For most databases, the full text option was selected and, if available, it was indicated that only peer reviewed or peer accredited publications should be returned. Where possible, the results were limited to English and sorted by relevance as determined by the database.

Using the search parameters, each database was searched with the search terms identified. Table 1 shows the total amount of results returned for each search term by each of the databases searched. The search order was EBSCOhost, Sabinet African Journals, and finally Google Scholar. With Google Scholar and Sabinet African Journals it was possible to use the original search term using free text search. EBSCOhost returned more relevant results if a Boolean search was used. For this reason, the original search term was modified and converted to a Boolean format where necessary. Both Google Scholar and EBSCOhost returned at least one unique paper for every search term. Sabinet African Journals returned unique papers for the first five search terms, but it was clear that the resource was exhausted by search term six as no further unique results were returned.

Table 1: Search results from academic databases

Original Search Term	Modified for search requirements	Academic database	Results returned	Unique Papers Imported	Tag Code
Plagiarism Cheating qualitative analysis	(Plagiarism OR Cheating) AND qualitative analysis	Sabinet African Journals	18	8	SABNE1
		Ebscohost	50	18	EBS1
		Google Scholar	6230	16	SCOL1
Plagiarism Cheating perceptions	(Plagiarism OR Cheating) AND perceptions	Sabinet African Journals	25	6	SABNE2
		Ebscohost	276	30	EBS2
		Google Scholar	15100	29	SCOL2
Plagiarism Cheating interviews	(Plagiarism OR Cheating) AND interviews	Sabinet African Journals	15	2	SABNE3
		Ebscohost	68	9	EBS3
		Google Scholar	11900	23	SCOL3
Plagiarism Cheating empirical data	(Plagiarism OR Cheating) AND empirical data	Sabinet African Journals	15	2	SABNE4
		Ebscohost	5	2	EBS4
		Google Scholar	7380	19	SCOL4
Plagiarism Cheating understanding	Plagiarism OR Cheating) AND understanding	Sabinet African Journals	43	1	SABNE5
		Ebscohost	155	22	EBS5
		Google Scholar	16500	13	SCOL5

Original Search Term	Modified for search requirements	Academic database	Results returned	Unique Papers Imported	Tag Code
Plagiarism Cheating questionnaire	Plagiarism OR Cheating) AND questionnaire	Sabinet African Journals	23	0	-
		Ebscohost	110	29	EBS6
		Google Scholar	15500	12	SCOL6
Plagiarism Cheating Intervention	(Plagiarism OR Cheating) AND Intervention	Sabinet African Journals	10	0	-
		Ebscohost	56	9	EBS7
		Google Scholar	8030	19	SCOL7
Why do students cheat plagiarise	(Plagiarism OR Cheating) AND why	Sabinet African Journals	30	0	-
		Ebscohost	69	14	EBS8
		Google Scholar	16000	6	SCOL8
Plagiarism Cheating discussion groups	(Plagiarism OR Cheating) AND discussion groups	Sabinet African Journals	31	0	-
		Ebscohost	25	4	EBS9
		Google Scholar	16700	9	SCOL9
Plagiarism Cheating and cultural values	(Plagiarism OR Cheating) AND cultural values	Sabinet African Journals	31	0	-
		Ebscohost	21	1	EBS10
		Google Scholar	14300	23	SCOL10
View on plagiarism cheating	(Plagiarism OR Cheating) AND views	Sabinet African Journals	38	0	-
		Ebscohost	103	13	EBS11
		Google Scholar	13400	19	SCOL11
Reasons for plagiarising cheating	(Plagiarism OR Cheating) AND reasons	Sabinet African Journals	44	0	-
		Ebscohost	100	19	EBS12
		Google Scholar	1980	58	SCOL12
Plagiarism cheating survey	(Plagiarism OR Cheating) AND survey	Sabinet African Journals	21	0	-
		Ebscohost	151	18	EBS13
		Google Scholar	14400	19	SCOL13

To avoid adding duplicate papers from multiple sources, each paper identified was assigned a unique tag code. This tag code indicated where the paper was first found and with what search term it was found. This tagging process was managed by the Paperpile reference manager (https://paperpile.com/). Once a paper was tagged and imported, the paper was not imported a second time if that paper was previously found in a different source or with a different search term.

For each search term the titles for the first fifty results were evaluated for possible inclusion. This initial evaluation was based on the title and in the case of some sources a small snippet of text pre-

sented with the title. The evaluation protocol at this stage was not strict as the goal was to obtain as many relevant papers as possible. Searching the academic databases resulted in finding many initial papers that needed to be reviewed and subjected to a final thorough selection process as part of a quality assessment.

QUALITY ASSESSMENT AND SELECTING STUDIES

The third step in the systematic review process is to scrutinise all studies found (the corpus) when searching the different academic databases. Each study was subjected to a defined criterion for inclusion or exclusion. In this case the criteria for including or excluding literature were created and applied by a single researcher. This avoided a common problem as explained by Mallett et al. (2012) and Dhillon and Gill (2014) that in large research teams, the criteria may be interpreted differently by each member evaluating the research corpus. The abstracts for all papers identified in the academic databases using the search terms, were reviewed according to the criteria in Figure 3. If an abstract did not provide the required information, the full text was reviewed. In almost all cases it was necessary to evaluate the methodology section.

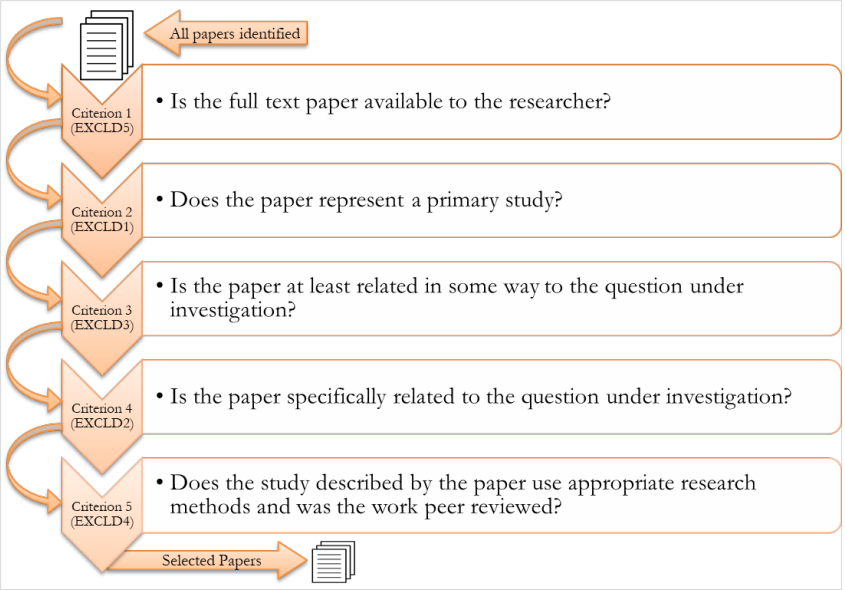

Figure 3: Selection criteria applied to papers for inclusion in the study

The criteria applied for each paper was subjected to a top down approach. If the paper made it through all the selection criteria, it was included in the study. In total, each paper was subjected to five criteria that could disqualify a paper for inclusion. Four of the criteria were based on quality, with one criterion based on accessibility. Each paper that was disqualified was assigned a unique tag code in the Paperpile reference manager for future reference. Table 2 contains detailed reasons that would have excluded a paper categorised according to the exclusion tag code.

The first criterion (EXCLD1) that could exclude a paper was one of accessibility. The full text for some papers identified was not accessible. Every effort was made to obtain these papers through official channels.

Table 2: Reasons for excluding paper from study

Code	Reason
EXCLD1	• Full paper not available
EXCLD2	• Study not related to broad research topic of plagiarism.
EXCLD3	• Not primary study. ▫ Review previous literature to determine other implications or synthesising studies by means of meta-analysis. ▫ Views based on previous studies or new insights, arguments or models by reinterpreting previous primary studies. ▫ Introducing, defining and explaining concepts based on previous primary studies. ▫ Determinations made on why students plagiarized, based on other topics under investigation (thus not from primary data but rather an effect observed). ▫ Applying new concepts, arguments to an existing model or framework and drawing new conclusions. ▫ Making arguments, recommending some action or defining new methods to deal with plagiarism, based on anecdotal, personal or institutional experience. ▫ Making arguments or recommending some action or way forward based on reviewing literature.
EXCLD4	• Research study not aligned with question under investigation. ▫ Investigating the impact of educating students, providing policy statements, honour codes, or using plagiarism detection tools on academic dishonesty. ▫ Paper investigates types of plagiarism, general perceptions of plagiarism, general cheating behaviour or cheating behaviour in different learning environments, with very little or no focus on why students plagiarise. ▫ Evaluating a specific plagiarism prevention system or technique or some plagiarism prevention system or technique to support plagiarism education or to investigate the impact on students. ▫ Retroactively scanning students or journal content for plagiarism prevalence and reporting on results. ▫ Reporting on very narrow and specific cheating scenarios or factors. ▫ Seek to establish a link between individual traits, personality, ethical matters, cheating behaviour or moral reasoning and a cheating plagiarism in general. ▫ Exploring the relation between participating in academic dishonesty and later unethical behaviour or as future indicator in professional practice. ▫ Identifies what students or academic staff regard as plagiarism and grades the seriousness of the perceived plagiarism, tests the student knowledge of plagiarism before or after plagiarism/cheating education. ▫ Explores the response from academic staff to plagiarism including general awareness of policies and other holistic prevention efforts. ▫ Study exploring statistical methodologies using plagiarism as an example.
EXCLD5	• Study used questionable research methods or research methods that produce data not easily interpreted. • Study used extremely small population size. • Data not presented fully or only presented in a condensed form, thus not allowing reinterpretation. • Journal or conference paper of questionable quality. • Research not subjected to peer review, working papers, white papers, newspaper articles etc.

The second criterion (EXCLD2) was to establish if the paper under review was in some way related to the broad topic under investigation. This criterion did not serve to limit results relating to the question under investigation (why students plagiarise) but rather filtered out papers that were in no way related to the broad topic of plagiarism and cheating. As the initial list of papers up for selection was added with the goal to review as many papers as possible and the keywords selected for the

search were rather broad, some papers initially selected in the first round were later found not to be related to the general topic.

The third criterion (EXCLD3) checked if the paper was a primary study. Systematic reviews rely on the summation of primary studies. Many papers identified and subsequently excluded, contained views based on previous studies or arrived at new insights, made new arguments, or constructed models by reinterpreting previous primary studies (Austin & Brown, 1999; Flowerdew & Li, 2007; M. Hart & Friesner, 2004; Howard, 1995; McCabe et al., 2001; Valentine, 2006; Whitley, 1998). Papers were also found to make arguments, recommend some action, or define new methods to deal with plagiarism based on anecdotal, personal or institutional experience (Bachore, 2015; Briggs, 2003; Conradson & Hernández-Ramos, 2004; Gerhardt, 2006; Harris, 2002; Howell et al., 2009; Kiehl, 2006; McCabe & Stephens, 2006; McDowell & Brown, 2001; Rowe, 2004; Scanlan, 2006; Thomas & Sassi, 2011; Vaka'uta, 2008). Once a paper was found to be based on primary data the fourth criterion was applied.

The fourth criterion (EXCLD4) focussed on refining the remaining papers and selecting only those closely related to the question under investigation. With this criterion the goal was to exclude studies that were not specifically reporting either in full or as a component part on reasons for plagiarism.

Papers found not suitable investigated types of plagiarism, general perceptions of plagiarism, general cheating behaviour, or cheating behaviour in different learning environments, with little or no focus on why students plagiarise (Baruchson-Arbib & Yaari, 2004; Grijalva et al., 2006; Lim & See, 2001; Marshall & Garry, 2005, 2006; Pecorari, 2003; Scanlon & Neumann, 2002; Sheard & Dick, 2011).

Papers would investigate a specific plagiarism prevention system, technique, or tool, including honour codes or using policy statements to support plagiarism education, or to investigate the impact of plagiarism prevention activities on students (Betts et al., 2012; Bing et al., 2012; Bretag et al., 2014; Chao et al., 2009; R. Evans, 2006; Graham-Matheson & Starr, 2013; LaSalle, 2009; Ledwith & Rísquez, 2008; Stapleton, 2012; Sutherland-Smith, 2005). Some papers also evaluated plagiarism education activities by testing students' knowledge of plagiarism before or after educating students on plagiarism or academic cheating (Belter & du Pré, 2009; Ercegovac, 2005; Roig, 2001; Smedley et al., 2015; Yeo, 2007).

Other papers focussed on the psychology of academic dishonesty. The goal here was to establish a link between individual traits, personality, ethical matters, cheating behaviour, or moral reasoning and cheating or plagiarism in general (Clegg & Flint, 2006; Coyne & Thomas, 2008; East, 2009; Etter et al., 2006; Ferrari, 2005; Jackson et al., 2002; Thorpe et al., 1999; Williams et al., 2010). Somewhat related papers were also found that explored the relation between academic dishonesty and later unethical behaviour or, inversely, current academic dishonesty as a future indicator of unethical behaviour in professional practice (Lawson, 2004; Martin, 2005; Mirshekary & Lawrence, 2009). Papers were not only focussed on students, but also dealt with staff by investigating the response from academic staff to plagiarism, including generally their awareness of policies and other holistic prevention efforts in the academic institution (Coren, 2011; Macdonald & Carroll, 2006; Parameswaran & Devi, 2006; Willen, 2004).

In applying the fifth criterion (EXCLD5), the remaining papers not excluded by the first four criteria, were subjected to a final thorough check focusing on the methodology applied and the quality of the publication that contained the paper. In this regard, although this does not necessarily reflect on the final conclusion reached, studies using an extremely small population size were excluded (Bamford & Sergiou, 2005; Li & Casanave, 2012; Love & Simmons, 1998). Studies were also found that did not present the data gathered fully or only presented gathered data in a condensed form, thus not allowing reinterpretation (Flint, 2005; Ma et al., 2007; Pupovac et al., 2008; Sutherland-Smith, 2005). Such studies were also excluded. Finally, all papers were excluded that were not subjected to peer review (Hayes, 2003; Slobogin, 2002).

By assessing the papers initially identified according to the five-exclusion criteria a large number of studies was excluded from the final two steps of the systematic review.

SUMMARY AND SYNTHESIS OF THE SELECTED STUDIES

In selecting the studies to be used in this research, a total of 37 studies made it through the selection process and were further investigated for the purpose of synthesis and summary as part of step 4 in the systematic literature review process. When and where the data were collected, and the sample size for each study was summarized to indicate the study year distribution, the representation level of different geographical areas, and average sample size.

SUMMARY OF SELECTED STUDIES

If it was not specifically stated in a paper during which year the data were collected, the paper publication year was used. For the most part, Figure 4 shows that the selected papers were distributed evenly over the years of the study search limit of between 1995 and 2015. Most papers used (29) were published between 2010 and 2015.

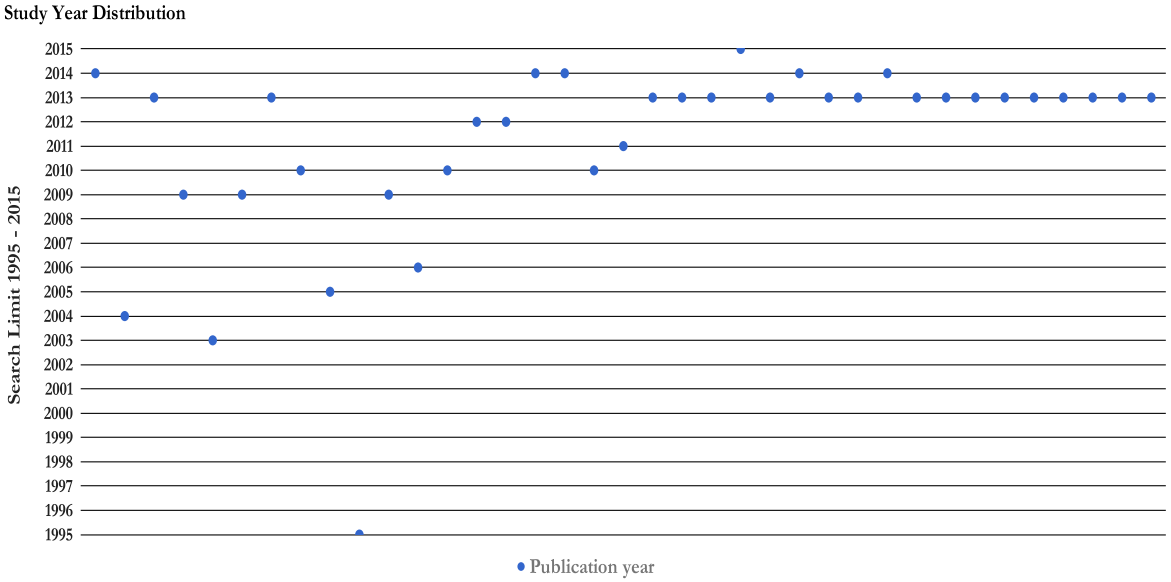

Figure 4: Study publication date distributed

In most cases each paper identified the country where the data were gathered. If this was not the case, like with Yardley et al. (2009), the country was coded as the country in which the first author's institution was located. In total the selected papers gathered data from 25 countries.

The United States was the most represented single country from which data were collected with five studies, followed by Australia (3) and South Africa (3). Europe (Including the UK) was well represented with 24 studies, followed by the Far East with three studies. The large number of studies from Europe was due to the project Impact of Policies for Plagiarism in Higher Education Across Europe (IPPHEAE).

Partly funded by the European Union under the Erasmus Lifelong Learning Programme, IPPHEAE set out to "compare and evaluate the different approaches to plagiarism and academic misconduct" between twenty-seven EU countries (*IPPHEAE*, 2013). In total IPPHEAE (2013) produced twenty-seven reports, each focusing on a single EU country. Of the 27 reports, those from the Netherlands, Belgium, Hungary, Italy, Latvia, Denmark, Luxembourg, and Sweden were not included due to a low response rate (Demoliou, 2013; Glendinning, 2014; Glendinning et al., 2013a, 2013c, 2013d;

Glendinning & Orim, 2015; Jóźwik et al., 2013; Stabingis et al., 2014). As far as Africa is concerned, other than papers from South Africa, only papers from Botswana and Zambia were evaluated.

In almost all the cases data were collected, aggregated, and summarised by means of a survey. The only exception being the paper by Doró (2014), who in the author's own words used an exploratory investigation that asked students to write a short opinion essay on why they plagiarise. The opinion essay was then subsequently analysed for the reasons provided.

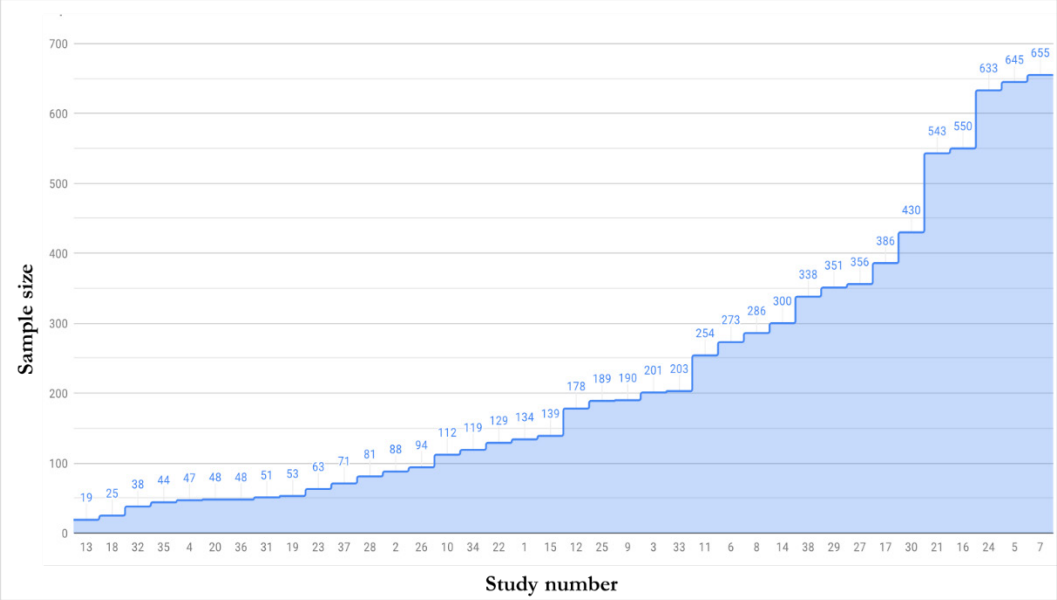

Figure 5: Sample size across all selected studies

The total sample size across all studies for all students, were eight thousand three hundred and sixty-four respondents with a mean sample size of two hundred and twenty per study (SD=189). The biggest sample as depicted in Figure 5, was that of E.-J. Park et al. (2013) (n=655), while the study with the smallest sample overall was the one from Mooko and Robinson (1999) (n=19). Mooko and Robinson (1999) sampled exclusively from university faculty members in their survey. The study with the smallest sample of student responses was that of Doró (2014) (n=25). All studies, except the one of Mooko and Robinson (1999), sampled either students exclusively or both students and faculty members. The only other exception was the reports produced as part of the Impact of Policies for Plagiarism in the Higher Education Across Europe (IPPHEAE) project that included responses from university students, faculty members, organisations, and institutions. The results from organizations and institutions were not included in the summary presented here. The data gathered by each study were further extracted and evaluated.

Synthesis of Collected Data

For each paper evaluated two sets of results were extracted if available. The first set of results contained the ranked reasons that may lead to plagiarism according to students. The second set of results listed the ranked reasons that may lead to plagiarism according to faculty members. All but one paper presented reasons for plagiarism according to students. Seventeen studies presented both the students and faculty members' reasons.

In keeping with the purpose of the systematic review, to identify why students choose to plagiarise and develop metrics that will align with these reasons, in going forward with the current research, only the reasons for plagiarising from the students' perspective were synthesised. This disqualified the paper by Mooko and Robinson (1999) from this phase of the review.

To synthesize and interpret the data in the selected papers, the different reasons presented by each paper needed to be categorized to find commonality for comparison.

Categorization and coding of different reasons for plagiarism

As the studies under review not part of the IPPHEAE project used different terminology to describe reasons for plagiarism, it was decided to code and categorise the ranked reasons for plagiarism as presented by each study into a predefined category and then average the position of the category across the different studies.

A typology of plagiarism reasons fine grained enough to accommodate the various reasons presented by the different papers evaluated in this systematic review, was presented by C. Park (2003) after reviewing the work of Stevens and Stevens, Davis et al., and Straw. C. Park (2003) presented nine possible reasons for plagiarism, namely, a genuine lack of understanding, efficiency gain, bad time management, personal values or attitudes, defiance, students' attitudes towards teachers and class, denial or neutralisation, temptation and opportunity and lack of deterrence. It was deemed necessary by the authors of this work to add an additional two categories to the original nine to accommodate the wide variety of reasons presented in the papers under review. The additional categories are 'academic difficulties' and 'external values/attitudes. Consequently, for the purpose of this research, the different reasons for students plagiarising collected from the studies under review was coded and categorised as follows.

R-GLU: Genuine lack of understanding. Students may plagiarise because of a lack of understanding or knowledge of the matter at hand or by accident. Ignorance, a lack of proper referencing skills, and unfamiliarity about the ethical considerations applied in research, may also play a role.

Examples of reasons reported in the studies under review subsequently coded as R-GLU, include "Ignorance/inadequate referencing skills" (Dawson, 2004) and "I'm not sure what plagiarism means/I didn't realize I had plagiarized" (Kwong et al., 2010).

R-EG: Efficiency gain. The economy of effort plays a role in this category. Students may plagiarise to get a better grade more quickly. They may also want to save and reduce their workload by plagiarising or attempting to use plagiarism to make the assignment easier, thereby improving their grades. A student may furthermore be retaking a prescribed class or course and may just want to pass it with little regard to learning from the content. In addition, efficiency gain may be linked to the future expected monetary reward that students believe comes with a obtaining a higher-grade average.

Examples of reasons reported in the studies under review subsequently coded as R-EG, include "Want to get a better job in the future" (E.-J. Park et al., 2013) and "To increase the mark" (Franklyn-Stokes & Newstead, 1995).

R-BTM: Bad time management. Plagiarism also occurs because of time pressures. Turning to plagiarism due to a lack of time could be a result of the student taking too many classes, extracurricular activities, or working a part-time job. Sometimes students would try to complete the assignment but find that their time is running out, or that the assignment due date coincides with that of other assignments. Students could therefore turn to plagiarism. Losing time because of laziness or procrastination is an additional time management factor that could lead to plagiarism.

Examples of reasons reported in the studies under review subsequently coded as R-BTM, include "Laziness or bad time management" (Wilkinson, 2009) and "The limited time they have to study" (Theart & Smit, 2012).

R-PVA: Personal values/attitudes. Plagiarism could also take place because of personal crises, circumstances, values, or attitudes. Students may plagiarise due to a fear of failure or conversely because they regard plagiarising as a challenge with the associated satisfaction that can be gained if not caught. Some students may furthermore believe that it is not unethical to plagiarise. Self-confidence

or a lack of it may also play a role as students may believe their own writing is not good enough to meet the demands.

Examples of reasons reported in the studies under review subsequently coded as R-PVA, include "Wanted to see if would get caught plagiarizing" (Vogts, 2009) and "Fear of failure" (Dawson, 2004).

R-D: Defiance. Defiance towards accepted institutional procedures or social rules regarding plagiarism or a complete lack of self-motivation may lead to plagiarism taking place. In turning to plagiarism, students may show a lack of respect for authority or attempt to rebel against authority. They may also show defiance in how they regard the importance or the value of the work they are required to complete. A disinterest in the task or a negative attitude towards assignments and tests may also play a role.

Examples of reasons reported in the studies under review subsequently coded as R-D, include "Felt the assignment was of no educational value" (Henning et al., 2014) and "Did not need to learn the topic" (Akakandelwa & Sitali, 2010)

R-SATC: Students' attitudes towards teachers and class. Plagiarism may also result from a negative attitude towards the teacher, class, content, or the way content is presented. Students may believe the instructor (teacher) does not care if students plagiarise or may not bother to check their work for plagiarism. In addition to not liking the lecturer, the student may also believe the lecturer's expectations for the class are unfair or too high. They may, moreover, feel that the instructor failed to explain all the rules and requirements clearly in class.

Examples of reasons reported in the studies under review subsequently coded as R-SATC, include "Due to the knowledge or feeling that the lecturer to whom the assignment is to be submitted does not thoroughly read the assignments" (Comas-Forgas & Sureda-Negre, 2010) and "No big deal; does not matter to professor" (D. Jones, 2011)

R-DN: Denial or neutralisation. Legitimising behaviour by means of denial or by passing the blame to others could be a reason for plagiarism. Students may claim they have "always done it like that" or that all their peers plagiarise anyway. When cheating is involved, they may legitimise behaviour by saying they were not adequately prepared. Students would often not see anything wrong with plagiarism as they believe it is a victimless crime and they are not hurting anyone.

Examples of reasons reported in the studies under review subsequently coded as R-DN, include "Everyone does Internet plagiarism" (Eret & Ok, 2014) or "Because others do it" (Russikoff et al., 2003).

R-TO: Temptation and opportunity. Easy access to information sources and the availability of opportunities could make it tempting for students to plagiarise. A large amount of information is freely accessible via the Internet and other sources. The opportunity may also exist for students to hire others to complete their assignments.

Examples of reasons reported in the studies under review subsequently coded as R-TO, include "It is easy to cut and paste from the Internet" (Glendinning et al., 2013b) and "It was easy – the temptation was too great" (Brimble & Stevenson-Clarke, 2005).

R-LD: Lack of deterrence. The perceived benefit resulting from plagiarism outweighs the risk of punishment due to a low chance of getting caught and non-severe consequences if ever caught. Students may also not be aware of penalties if caught.

Examples of reasons reported in the studies under review subsequently coded as R-LD, include "Permissive plagiarism practice" (Doró, 2014) and "I hadn't heard of other students being penalised before" (Brimble & Stevenson-Clarke, 2005).

R-AD Academic difficulties. Various academic deficiencies leading to plagiarism were found. Students may have a difficulty with the topic under study or feel the task is far beyond their academic

comprehension and ability. The lack of language ability and comprehension may also be a reason for plagiarising.

Examples of reasons reported in the studies under review subsequently coded as R-AD, include "Did not understand the assignment" (Sentleng, 2010) and "They feel the task is completely beyond their ability" (Foltynek, 2013).

R-EVA: External values / attitudes. Plagiarism could result because of external influences or inter-personal relationships. Students may often be under external pressure to succeed due to high expectations and pressure exerted by family members or as a requirement of a scholarship. On an interpersonal level a student may cheat to maintain a good relationship with their peers or because of peer pressure to share their work. Examples of reasons reported in the studies under review subsequently coded as R-EVA, include "They feel external pressure to succeed" (Glendinning et al., 2013e) and "Family pressure to succeed" (Henning et al., 2014).

The ranked reasons for plagiarism according to each individual study under review were coded and combined into a single dataset for further analysis and reporting.

INTERPRETATION OF SYNTHESISED STUDIES

Conducting Step 4 of the selected systematic research methodology resulted in a single dataset that contains the categorised ranked reasons for plagiarism for each of the selected studies under review. By using this dataset, Figure 6 was generated indicating the average position (1 most likely, 11 least likely) for each reason across the selected studies, as ranked by students.

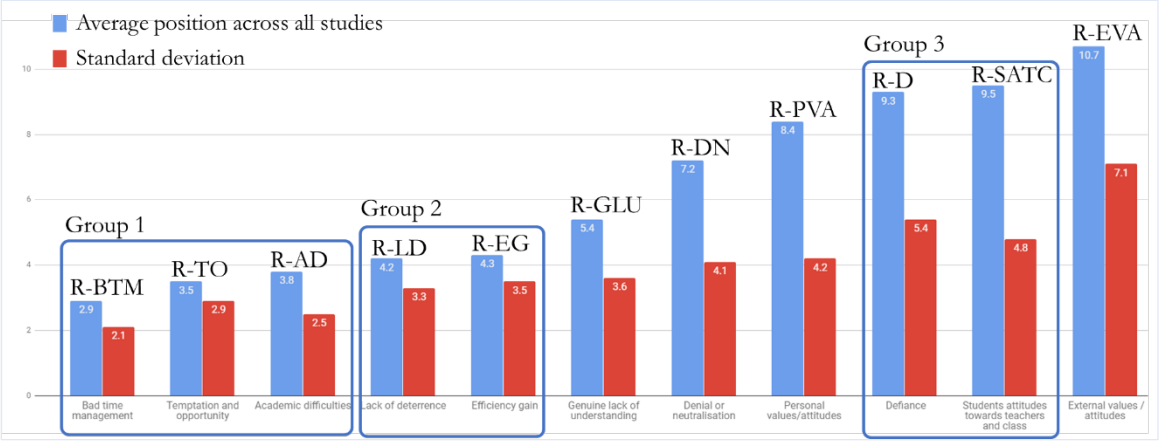

Figure 6: Synthesised and categorised data indicating the average position for plagiarism reasons across thirty-seven studies

As portrayed in Figure 6, the different study respondents on average ranked 'Bad time management' as the most likely reason leading to the decision to plagiarise, closely followed by 'Temptation and opportunity', and 'Academic difficulties'. The three reasons may be grouped closely (group 1 in Figure 6) as one of them may aid the likelihood of the others being the actual reason for plagiarism. It may start with bad time management in the form of procrastination or extracurricular activities on the student's side, as the student is not spending enough time on his or her studies, academic difficulties may arise. To mitigate the academic difficulties the student may be tempted to plagiarise.

'Lack of deterrence' and 'Efficiency gain' followed the first group and was ranked similarly in terms of likelihood (group 2 in Figure 6). The reason for the similar ranking in likelihood may have to do with risk and reward behaviour. The student may decide to plagiarise due to possible efficiency gain outweighing the deterrence measures.

Becoming a less likely reason for plagiarising is 'Genuine lack of understanding' followed by 'Denial or neutralization' and 'Personal values/attitudes'.

On the less likely side 'Defiance' and 'Student attitudes towards teacher and class' were again ranked similarly (group 3 in Figure 6). The teacher, how the class is presented, and teaching and learning methods used may contribute to defiant behaviour together leading to plagiarism.

The lowest ranking reason for plagiarism consisted of external values and attitudes. This would suggest that students are less likely to plagiarise due to external pressure from parents, the school, or their peers.

CONCLUSION

Using a systematic review methodology, the information in thirty-seven studies was used to find the factors that will influence students' decisions to plagiarise.

To normalise the data gathered from the different studies, several categories that were fine grained enough to accommodate the various reasons presented were identified. The categories included a genuine lack of understanding, efficiency gain, time management, personal values or attitudes, defiance, student attitude towards teacher and class, denial or neutralisation, temptation and opportunity, lack of deterrence, academic difficulties, and external values or attitudes.

When the ranked reasons from the individual studies under review were combined, it was discovered that both the individual IPPHEAE studies and the rest of the studies mostly agreed about the top reasons that influenced students to plagiarise. The top reasons why according to students, they plagiarise were because of -

- temptation and easy opportunity;
- a lack of deterrence;
- bad time management;
- academic difficulty; and
- expected gain in efficiency when plagiarising.

It would thus indicate that students would consider plagiarism when running out of time. As they realise they will not complete the work in time, they may investigate other avenues and be tempted by easy access to information to plagiarise from it to meet a deadline.

Time pressures and the temptation to plagiarise may be compounded by academic difficulties or language and comprehension problems. As these pressures start to increase, the perceived lack of deterrence comes into play. The student may believe the chances of getting caught are low or the penalties if caught are not severe enough to outweigh the efficiency gain expected from plagiarising.

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BIOGRAPHIES

Frederik Hattingh is a lecturer at Tshwane University of Technology. His research interests include Living Labs, Virtualization and Plagiarism detection. Other areas of interests include Open Source Software and emerging technologies.

Bertie Buitendag is a lecturer at the Tshwane University of Technology in Pretoria, South Africa. His core research area includes ICT Knowledge support for emergent farmers and Living Labs, SMART LL operations and knowledge management. Other areas of interest include the: Semantic Web, (WEB 3.0) and WEB 2.0, and ICT's for community upliftment.

Manoj Lall is a senior lecturer in the department of Computer science at Tshwane University of Technology, Pretoria, South Africa. He obtained a doctoral degree in Computer Science from the University of South Africa in 2013. His research interests include Formal methods, Machine learning, and Agent based modelling. He has published over thirty international refereed conference and journal papers.

Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
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Online July 7-8, 2020

READINESS OF UNIVERSITIES FOR THE 21ST CENTURY DIGITAL ECONOMIES: A LOOK AT SELECTED LECTURERS FROM UNIVERSITIES IN BUFFALO CITY METROPOLITAN IN EASTERN CAPE PROVINCE, SOUTH AFRICA [ABSTRACT]

Agyei Fosu — Walter Sisulu University, East London, South Africa — afosu@wsu.ac.za

ABSTRACT

Aim/Purpose: The purpose of this study is to expand the knowledge base on factors likely to impede implementation and adoption of web-based learning management systems to blend with traditional methods of lecturing in universities to cater for the next generation of learners in Africa and Eastern Cape Province South Africa in particular.

Background: The shift from the industrial economies to 21st century digital and knowledge-based economies, fueled by rapid Information and Communication Technologies (ICTs) such as Internet, YouTube, Chartrooms, Skype, Social media networks and its introduction to the educational system not only resulted in a new teaching approach globally but also paved way to usher in new generation of learners (anytime, anywhere learners) in the higher education system. Despite the fact that universities and other institutions of higher education in developed countries and some Africa countries have since recognized that the 21st century global digital and knowledge-based economies evolution has ushered in the next generation of learners, and as a result have taken the necessary steps to blend the traditional method of lecturing in higher education with web-based learning management systems in order to accommodate these learners. However, in Africa not much research has been done on the readiness of higher education institutions in terms of blending web-based learning management systems with the traditional method of lecturing to cater for the next generation of learners.

[The full paper was previously published as Fosu, A. (2019). Readiness of universities for the 21st century digital economies: A look at selected lecturers from universities in Buffalo City Metropolitan in Eastern Cape Province South Africa. *International Journal of Community Development & Management Studies, 3*, 65-77. http://ijcdms.org/Volume03/v3p065-077Fosu5523.pdf]

Methodology	Quantitative and two non-probability sampling methods, namely, quota and purposive sampling was used to investigate the technological skills of selected lecturers from universities within Buffalo City Metropolitan as one of the core component to check the readiness of their faculty for the next generation of learners.
Contribution	This research will add to the growing knowledge about the blending of web-based learning management with the traditional style of lecturing in higher education in the 21st century digital economies.
Findings	The results indicated that the participating lecturers need to be trained and supported in the skills of using of the ICTs and computer programs applicable to enhance web-based learning in teaching and learning environment in higher education in order to cater for the next generation of learners associated with the 21st century digital economies.
Recommendations for Practitioners	Much as there is a need for increased in investment in infrastructure within higher education institutions to support teaching and learning, continuous support and training for academics to be technologically literate and also be abreast on rapidly evolving field of ICTs is paramount as it can expedite the teaching and learning process in higher education.
Recommendations for Researchers	There is the need to explore in depth the other two components suggested by Mishra and Koehler that can serve as barriers for successfully integration of technology into teaching and learning by locus of knowledge.
Impact on Society	The research will assist stakeholders, policy makers and agencies tasked with transforming institutions of higher learning to identify the barriers likely to hinder transformation efforts and address them accordingly.
Future Research	Checking technological skills of students are critical in this context.
Keywords	ICTs, next generation of learners, teaching, technological skills, lecturers, web-based learning management system, 21st century digital economies

BIOGRAPHY

Agyei Fosu is a lecturer in the Department of Information Technology at the Walter Sisulu University where he teaches Information Technology Skills as well as mathematics for IT. He is actively involved in technology in education and in business research.

Proceedings of the Informing Science + Information Technology Education Conference

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Online July 7-8, 2020

EXPLORATORY STUDY: DIGITAL BADGING

Terry M. McGovern — University of Wisconsin-Parkside, Kenosha, WI, USA — Mcgovert@uwp.edu

ABSTRACT

Aim/Purpose	To inform educational stakeholders about of the emerging digital educational badging technology, the industry, and how it applies to adult learning.
Background	An overview of the developing badging system, concepts, key terminology, advantages, challenges, and examples of badge utilization.
Methodology	Exploratory study
Contribution	Makes known how the current state of the badging system, its fit with adult learning theories, its features, its issues, and offers avenues for future research.
Findings	Digital badges align well with adult learning theories. Badges can improve adult student access to higher education, aid in reducing credential fraud, increase granularity of academic records, and allow for more personalized learning. The challenges include a crowded badging platform market and concerns with the value proposition of badges by employers.
Recommendations for Practitioners	Before an organization engages in a badging strategy for adult learners, it needs to understand the badging system to include the advantages and challenges of this rapidly growing practice.
Recommendations for Researchers	Understand the badging system, how adult learning theories apply to digital badging, and the research needs associated with this developing credential.
Impact on Society	Badging marks a shift in how we think about formal human development; from institution-centric and bounded to learner-centric and unbounded.
Future Research	Most current research involves motivational impacts on K-12 learners. This article highlights the need for more research regarding impact of badges on adult learning is needed.
Keywords	badges, open badges, badging, access to higher education, transcript ambiguity, credential-fraud, open pathways, badge challenges

Accepted by Editor Eli Cohen | Received: January 14, 2020 | Revised: April 30, 2020 | Accepted: May 3, 2020.

Cite as: McGovern, T. M. (2020). Exploratory study: Digital badging. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp. 185-204. Informing Science Institute. https://doi.org/10.28945/4556

INTRODUCTION

A pedagogical outcome of the changing higher-education industry is the development of the digital academic badge. Although new to academia, physical badges used as representations of rank, experience, or achievement are well known throughout the modern world. Though badges are often associated with Boy or Girl Scout merit badges, historians have dated badge-use to denote rank by Roman legions hundreds of years Before the Common Era (Speidel, 1996). Only since 2011 have digital academic badges appeared on the higher-educational landscape (Gibson et al., 2015). Since 2013, Surman (2018) posits that millions of badges have been issued by governments, industry, and educational institutions. Fong et al. (2016) found that 20% of U.S. colleges have issued badges since 2016. Technavio analysts forecast the global digital badge market will see a compounded annual growth rate of 31% from 2018-2022 (as cited in Technavio, 2017), which translates to a $205 million digital badge market by 2023 (Marketsandmarkets, 2019).

Research by Raish and Rimland (2016) posit that Human Resource (HR) professionals welcome the idea of badges, providing more granular information on a job candidate's skills and knowledge. Yet, most HR managers were unsure of the validity of open educational badges. Liyanagunawardena et al. (2017) acknowledge limited research exists on open badges. The problem is the peer-reviewed research that does exist does not consider how badges might be useful for adult learners and current research fails to address the development of the emerging global system associated with the badging movement.

The purpose of this exploratory research is threefold: expand knowledge of a novel idea, disseminate knowledge, and identify future research needs. The goal of this investigation is to answer three questions: How do theoretical frameworks of adult education apply to badging? What developments are occurring with the global digital badging ecosphere? What are the research needs associated with digital badging? This study provides an overview of the emerging global badging system, highlights key terminology, provides examples that demonstrate how organizations are utilizing badges, and emphasizes future research needs associated with this emerging technology.

RESEARCH METHODOLOGY

The research approach used is best described as an exploratory study. Yin (1993) argues the exploratory approach is ideal for background investigation, making known the unknown, before engaging in formal social research via explanatory and descriptive studies. Yin (1994) contends that using varied sources of evidence ensures validity of the exploratory construct.

Table 1: Types of exploratory research (Swedberg, in press)

Types of exploratory study	Goal of the study
Standard exploratory study type 1	To be the first investigation in a topic where little is understood, a publishable work using multi-methods
Standard exploratory study type 2	Create new hypotheses and notions for a topic that is already known and produce publishable work using standard methods and significant sample size.
Informal exploratory study (pre-study)	Expand the development of novel ideas by any means; sample size may be small.
Pilot study or exploratory study for thesis proposal	Investigate a topic informally in order the general design for a dissertation yields important results. Standard and irregular methods may be used; a representative sample is not necessary.

Types of exploratory study	Goal of the study
Exploratory study for student exercises	Used to teach students how to theorize empirical issues without rigid methodological procedures.
Institutionally supported high-risk exploratory study	Develop radical ideas where risk for failure is high.

Swedberg (in press) posits that exploratory research in social sciences is often noted as the essence of good science and was once widely practiced but has become neglected and forgotten. Swedberg argues exploratory research consists of five diverse types (see Table 1).

This study is best described as an informal exploratory study (Swedberg, in press). Researchers new to the badging development can use this report as a starting point to gain a better understanding about the history, facts, applications, and systemic developments related to academic digital badges. Although the concept of badging has been researched quite extensively since 2011, the insights of thought leaders focused on the developing badging ecosphere has not been captured in the academic literature. Documenting the perceptions of badging developers is a goal of this investigation as the original thoughts are useful to researchers to better understand the overarching badging concept. Although academic badging has been around formally for seven years (Open Badges, n.d.), it is still a novel idea to many within and outside of higher education. Swedberg argues a key purpose of informal exploratory studies is to expand novel ideas by any means. For these reasons, the research in this report involved accessing a mixture of peer-reviewed studies and open source information.

Since much of the research associated with the Instructional Management System (IMS) Global Learning Consortium's (e.g., Global) effort for establishing global badging standards is not in scholarly literature, the author used media reports, corporate websites, trade outlets, press releases, and personal communications to gain insights regarding how the global badging system is maturing. I utilized the University of South Florida's online database and its version of Google Scholar for scholarly, peer-reviewed research. Keywords included *digital badges, open badges, digital badges,* and *badging;* sometimes, these terms were paired with specific secondary terms such as *employment, platforms,* and *ecosystem*. Yin (1994) espouses that external validity is more difficult with exploratory cases; however, it is possible through the use of theoretical connections and the ensuing generalizations that could be made. This research focuses on variations of adult learning theories as they relate to academic digital badges. Many other theories, including additional learning theories and human capital development theories, are also possible theoretical linkages with respect to academic digital badges but not addressed in this exploratory case.

THEORETICAL FRAMEWORK

Regarding digital badge research, much of it has focused on intrinsic and extrinsic motivation (Mah, 2016). An EBSCOHost database search using the terms "digital badges" between 2009-2020 results in 2,219 articles. Narrowing the search to "academic digital badges adult learners" using the same period results in 8 peer-reviewed academic journals. Of the 8 articles identified, only 4 focused on digital badges as related to adult learners.

A second search using the terms "academic digital badges adult learning" yielded an additional peer-reviewed reference. Cross-referencing these five journals with Google Scholar provides insights as to how often the research is cited by other scholars (see Table 2). This literature review suggests that much of the current literature related to digital badges is not centered on adult learners and what is available is not widely regarded. Gross and Clark (2018) posit that 35% of college students, some 6.6 million people, are considered adult learners (aged 25 or above), so research that provides theoretical links between adult learning theory and digital badges is highly relevant.

Table 2: EBSCOHost digital badge adult learner/ing results cross-referenced with Google Scholar

Citation	Type of Study	Number of times referenced
Young, D., West, R. E., & Nylin, T. A. (2019). Value of open microcredentials to earners and issuers: a case study of national instruments open badges. *International Review of Research in Open & Distance Learning*, *20*(5), 105–121.	Case study	1
Mathur, A., Wood, M. E., & Cano, A. (2018). Mastery of transferrable skills by doctoral scholars: visualization using digital micro-credentialing. *Change*, *50*(5), 38–45. https://doi-org.ezproxy.lib.usf.edu/10.1080/00091383.2018.1510261	Case study	2
Raish, V., & Rimland, E. (2016). Employer perceptions of critical information literacy skills and digital badges. *College & Research Libraries*, *77*(1), 87–113. https://doi-org.ezproxy.lib.usf.edu/10.5860/crl.77.1.87	Empirical study	52
Fields, E. (2015). Making visible new learning: professional development with open digital badge pathways. *Partnership: The Canadian Journal of Library & Information Practice & Research*, *10*(1), 1–10. https://doi-org.ezproxy.lib.usf.edu/10.21083/partnership.v10i1.3282	Descriptive	16
Ady, K., Kinsella, K., & Paynter, A. (2015). Digital distinction: badges add a new dimension to adult learning. *Journal of Staff Development*, *36*(4), 24–27.	Descriptive	2

Like many industries, education is seeing demand from its stakeholders for more customized learning versus the one-size fits all factory model of education that has been the standard for more than 150 years. Bulger (2016) conveys that personalized learning is the buzz-word in education circles; however, scholars cannot agree on a shared definition as the concepts of personalized learning are broad (see Figure 1). Examples are discussed in the findings as to how badges support tailored learning. Self-directed and self-paced fall within this broad range of terms. Knowles' (1990) theory on adult learning, andragogy, includes the ideas of self-directed and self-paced learning.

Knowles (1990) argues that six foundational assumptions are related to how adults learn differently than adolescents:

1) They have a need to know; they understand the benefits of acquiring new knowledge or skills or understand the drawbacks of not knowing or lacking a certain skill
2) They possess an independent sense of self-understanding that makes them self-directed
3) They have more experiences than young learners
4) They develop a sense of willingness to learn based on the knowledge and skills they need in their current situations

5) Their orientation to learning is life-centered, which is different from the subject-centered orientation by younger learners and

6) Adults have different motivators for learning, such as work promotions, career changes, improving self-esteem, better quality of life, etc.; a course consisting of a range of badges where learners choose which subjects to focus on more intently based on their current situation may be appealing for adult learners

Figure 1: Personalized learning terms (Bulger, 2016)

In addition to Knowles, numerous other adult learning theories are worth considering with respect to digital badges and personalized learning. See Table 3 for a brief overview of some well cited adult learning models.

The highlighted theories of adult learning suggest that learning for adults is a highly personalized event. Badges support this notion by allowing scaffolding of badges that is personalized to the learner. For example, an adult working in healthcare who wants to learn about operations management might create an operations course based on personal experience in healthcare operations as well as select badges in areas of operations management tailored to his/her unique healthcare background and life/career needs.

The idea of highly personalized learning pathways will change how faculty think about curriculum design. Standardized approaches to learning will become outdated. For example, operations management courses in university business programs vary from one school to another. In a badged future, operations management knowledge and skills may vary from one adult student to another while both are enrolled in the same course. Outcomes will differ depending on the student's self-direction, expe-

riences, characteristics, willingness, and life or career-stage. Two students might have different operations management experiences, which may be a better reflection of reality as real-world operations vary by company and industry. Operations in a manufacturing facility are quite different from a hospital setting. Like any developing technology, badging is highly dynamic; however, to understand what is happening, one must first become familiar with the phenomenon and its vernacular.

Table 3: Selected learning theories

Author	Findings
Jarvis (1987, 2006)	Learning process theory. Experiential learning depends on post-experience outcomes involving the inter-association between a person's personal store of knowledge, the nature of the person, the nature of the experience, the nature of the interaction, the social context, and the chronology of events related to the experience. Not all experiences are important, some are insignificant.
Cross (1981)	Characteristics of the learner and the learning environment influence the learning process. Adult characteristics such as employment status, marital status, parenthood, age, etc. combined with learning style influence adult learning.
Caffarella (1993)	Self-directed learning theory. Adults initiate learning; adults plan and manage their own learning with a balance between autonomy and reliance.
Kolb (1976)	Experiential learning theory offers a 4-stage model that begins with concrete experience (stage 1) as the foundation for observation and contemplation (stage 2) which are then formed into ideas and generalizations (stage 3) resulting in guides for generating new experiences (stage 4).

FINDINGS

It is a challenge to investigate a developing innovation as it is still developing. Digital badges have had exponential growth since the idea was put forth in 2011 (Open Badges, n.d.; Mozilla Foundation et al., 2012). Millions of badges are being issued across the world each year by a range of organizations for a wide variety of reasons. For higher education however, an industry dependent upon the value of its credentials, it is vital to understand the facets of this innovation prior to engaging in a badging strategy. Likewise, for researchers investigating badges, it is essential to know about the history and various features of a badging system beginning with a shared understanding of what a digital badge is.

A DIGITAL BADGE IS:

A digital representation of a skill, learning achievement or experience. Badges can represent competencies and involvements recognized in online or offline life. Each badge is associated with an image and some metadata. The metadata provides information about what the badge represents, and the evidence used to support it. (Mozilla, 2014).

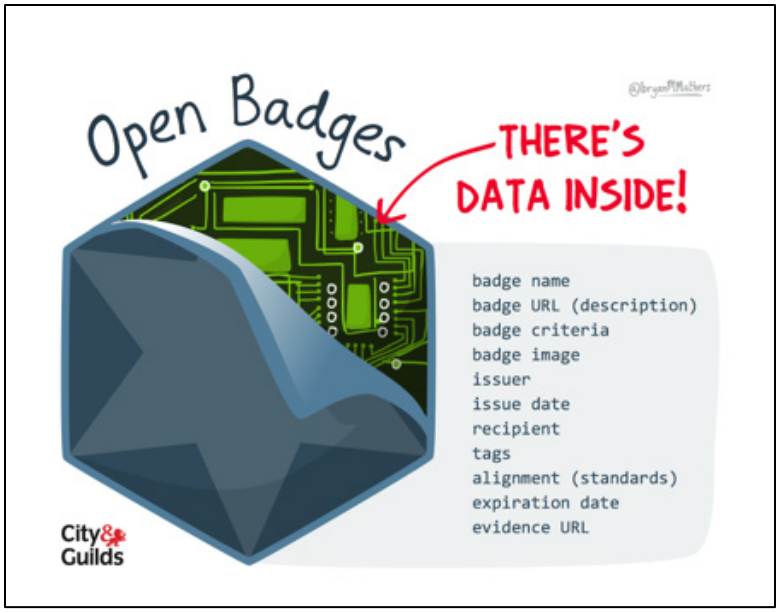

Figure 2: Badges contain metadata (Mathers, 2016)

Learners earn educational digital badges through short courses, online, in-person, and hybrid formats that cost much less than full credit college courses. This range of learning mediums, along with lower costs promotes greater access to higher education by adult students. Additionally, the short courses allow adult learners more choices which aligns with Knowles (1990) adult learning theory and the idea that adult learners are life-centric learners who desire to tailor education to meet their current needs. For example, an adult learner who works full time in health care may not be interested in pursuing a general course of study in project management, instead they might decide to stack a series of badges focused on health care specific project management.

The Badges provide more information than a traditional transcript because they contain rich metadata, such as the issuer of the badge, standards alignment, evidence of learning, learning objectives, and could even include Uniform Resource Locator (URL) links to short videos of the student communicating what s/he learned (see Figure 2). A significant advantage of academic badges is the ability for the learner to transport, display, and share badges. Furthermore, the digital securing of badges allows potential employers the ability to verify the authenticity of the credential with a mouse click. A robust effort is underway by an assortment of stakeholders from education, industry, and government to assist with the implementation of this new educational product.

The IMS Global is a non-profit collaborative consisting of more than 500 organizations focused on creating and guiding policies and standards for the future EdTech system; it serves as the organization providing the oversight, policy, and guidance on badging standards for the Academy (IMS Global, 2018b). IMS understands that because future digital credentialing (not just badges but also micro-certificates, continuing education certificates, business-application specific certificates, nano degrees, etc.) is secure, verifiable, portable, transcriptable, exchangeable, and managed by the learner, it will require a set of open standards to provide better value by avoiding high-cost, single-proprietary integrations. With this goal in mind, IMS manages the Open Badges Infrastructure (OBI) standard for a specific type of digital badge, the open badge.

Open badges

Learner-agency principles serve as the foundation of the open badges concept (IMS Global, 2018b). Learner-agency means students assume control of their credentials; they can claim and display badges across a range of digital mediums (e.g., LinkedIn, Facebook, Twitter, etc.). Three key roles (issuers,

earners, displayers) pertain to OBI and its overarching goals center on building an adaptable, decentralized framework that captures learning wherever it takes place, allows anyone to issue badges, and provides earners control over how they characterize their learning (Mozilla, 2014). More formally, Hickey and Otto (2017) cite the Bologna Open Recognition Declaration created during the ePortfolio & Identity (ePIC) Conference in Bologna, Italy, in 2016, which espouses:

> Open Badges, the open standard for the recognition of learning achievements, has proved the power of a simple, affordable, resilient and trustworthy technology to create an open recognition ecosystem working across countries, educational sectors, work, social environments and technologies. Open Badges have demonstrated that we have the means and the opportunity to put an end to the disparities of the recognition landscape. Connecting and informing competency frameworks, they become the building blocks of an open architecture for the recognition of lifelong and life-wide learning achievements. They create the conditions for individuals to be in control of their own recognition, to establish their identity and agency, whether formally (within institutions) or informally (across communities) (1st paragraph "The Importance of Open Recognition" section).

Open badges are also open because they do not rely on one system, such as a single learning management system, social media platform, or badging site, which means open badges provide greater freedom of badge issuing and application of badges by organizations and individuals. For adult learners who are self-directed (Knowles, 1990), open badges are compelling. Using the aforementioned healthcare project management example, the adult learner may choose to take courses through a variety open offerings such as their workplace, local colleges, online universities, or government agencies to scaffold a meaningful skillset for their particular situation. Understanding the developmental history and origins of the open digital badge provides insight into the evolving badge system and brings to light other concepts associated with this unique credentialing model.

The concept of alternative credentials first surfaced in the early 1980s (Green, 1980 as cited in Grant, 2016). Moodie (2011) raised awareness about the digital badging ideal and the MacArthur Foundation's $2 million competition for designing an open badging standard that could be used by a wide range of stakeholders to verify accomplishments and experiences of individuals. This competition eventually led to the first open badges coalition.

The first Open Badges system was initiated in 2011 by a network of partners with the non-profit Mozilla as the key coordinator. The effort, funded by the MacArthur Foundation, was based on a 2010 white paper titled "Open Badges for Lifelong Learning" by Knight et. al. (Open Badges, n.d.; Mozilla Foundation et al., 2012). From 2011-2013, Mozilla developed the badging infrastructure then launched Open Badges version 1.0 in 2013 (Open Badges, n.d.). In the spring of 2014, a group of business and education organizations made public assurances to support the distribution of educational digital badges, which later formed into the Badge Alliance (Open Badges, n.d.). The Badge Alliance created 11 working groups focused on badging infrastructure and system. On January 1, 2017, Mozilla and the Badge Alliance transferred the responsibility for the progression of the open badges' technical standards and communities of practice to IMS Global, which, along with the Mozilla Foundation and Collective Shift (a non-profit focused on social change and owner of the LRNG learning platform), serves as the Badge Alliance Steering Committee (IMS Global, 2018a; Badge Alliance, n.d.) to provide oversight and guidance for the evolving badge system.

The developing global badge system

The major pieces of the IMS digital badge system include platforms, open pathways, backpacks, CLR (Comprehensive Learner Record), and CASE® (Competencies and Academic Standards Exchange). The goal of the system is to capture all learning: formal, informal, and non-formal (Merriam et al.,

2007), achievements, and experiences throughout a person's life into a secure, verifiable digital record maintained by the student. Badges allows for the stacking of micro-credentials from a wide range of trusted issuers into advanced credentials using an integrated data exchange system. A close look at each facet of the badging system provides a better understanding of the overarching system. The concept of badge platforms is a suitable place to start understanding the badging system as it provides a broad vision of the developing badging industry.

Badge platforms

What started as a 2011 white-paper idea of an open badge prototype has grown to scale with an evolving system to include more than 15 million open badges issued by tens of thousands of issuers since 2013 (Surman, 2018). Issuers, which might be a worksite supervisor, a small business, a college department, or some other person or firm, are using a variety of badge platforms. Platforms provide services such as baking (securing / encrypting), verifying, storing, showing pathways, and providing issuers with analytics. Appendix A includes a list of the more well-known badge platform providers (Badge Wiki, 2018). Recognizing the rapid rise of badge platforms and a need for standardization and integration, IMS Global established a certification program for badge platform companies to ensure interoperability between products and content.

Seventeen badge platforms (13 different organizations), certified to issue, display, and host badges, are listed in IMS Global's (2018d) official list of certified open badges v2.0 products (see Appendix B). Certification by IMS is possible for badging systems that issue, display, or host badges (IMS Global, 2018e). Certification requires membership in the IMS alliance or affiliate, passing all tests associated with the service type (issue, display, or host), agreement to have the tests completed by a designated IMS representative and confirmation that the results are accurate and free of misrepresentation. The tests include proof of conformance to Open Badges specifications, which requires the candidate to issue a baked badge (see glossary) and demonstrate various functions, depending on the service type. Certifications to be re-run on an annual basis (IMS 2018e). A recent development by Concentric Sky's Badgr platform builds on the idea of learning pathways.

Learning pathways, open pathways

Whitehead (1929) introduced the idea of scaffolding learning with more recent support by Van de Pol et al. (2010) and Coe (2011). Scott's (1992) research into how students learn physics brought to light the notion of learning pathways; it is a course of learning, chosen by the learner, that includes a series of stages from pre-conception to targeted outcomes, where learning transitions are unique to each learner based on subjective experiences and abilities (Jih, 1996). Applying this idea to the badging system helps to understand the value of open pathways.

IMS Global (2018c) explains that open pathways consist of taking a competency framework or set of learning standards and converting it/them into a pathway, or a series of pathways, to guide learners while earning badges and stacking them into more substantial credentials. IMS Global's vision is for learners to be able to stack badges across platforms and institutions to allow greater flexibility in attaining one's educational goals. This concept aligns well with Knowles' (1990) adult learning theory given adults are self-directed, understand their learning needs, and are motivated based on their unique circumstances. The pathway would be shared in a digital portfolio showing earned badges as well as uncompleted badges.

The pathway in Figure 3 consists of badges from 10 different issuing agencies using three different badging platforms (Acclaim, Credly, and Badgr) (Skipper, 2018). The curriculum in the pathway shown aligns to California's Career Technical Education (CTE) Model Curriculum Standards for Biotechnology. Students earn the Biotech Lab Assistant Certificate using badges issued from a variety of sources. The application of this certificate towards the Associate Degree demonstrates the cross-in-

stitutional stacking capability of the open pathway system. An interactive example of the open pathway shown in Figure 3 exists at: https://pathways.badgr.io/public/pathway/5ad8eee4c9494851f4893554.

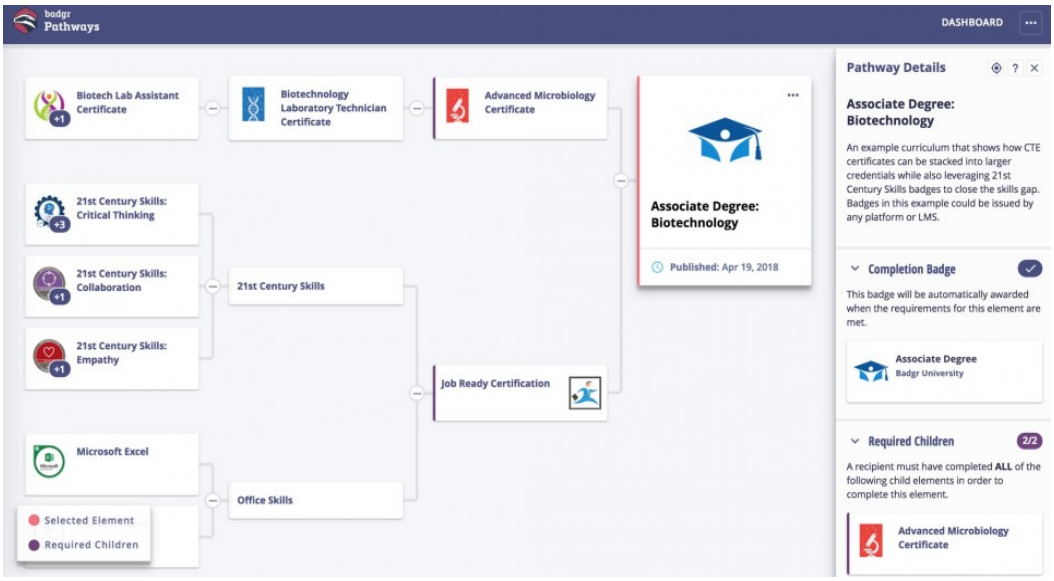

Figure 3: Open pathway example (Skipper, 2018)

Given the plethora of experiences, achievements, formal and informal learning activities that are documented securely through a badging system, earners can create unique, personalized pathways. One goal of the pathway system is to highlight more substantial credentials available to earners once they earn a badge. For example, referring to the open pathway shown in Figure 3, once a student earned the 21st Century Skills: Critical Thinking badge, several pathways could appear on that student's pathway dashboard, including the pathway to an associate degree in biotechnology. Such a system also allows for the potential push-pull signaling to employers once a learner earns a high-demand credential. BeCode, a Belgian non-profit that offers a no-cost six-month coding boot camp for those with no coding or developer background, is working towards such a push-pull badging system.

BeCode requires potential students to complete 25 badges related to code and web development from the Codeacademy's free online platform (International Telecommunication Union [ITU], 2018). The Chief Operating Officer (COO) of BeCode, Cedric Swaelens, envisions using badges to push a signal to employers when a student has mastered a high-demand programming skill and has begun beta-testing such a system (C. Swaelens, personal communication, July 2018). This system may allow students, most of whom are either unemployed or under-employed, to gain employment as a software developer while enrolled in BeCode's boot camp, before completing the boot camp. For example, if a student earns her HTML5-programming badge while enrolled in the boot camp and employers are looking for HTML5-trained developers, once the student earns the badge, BeCode's system automatically notifies employers, which may lead to an employment outcome. Likewise, in a badging system, an employer or potential employer could pull skillset data, based on earned badges, to match employees for specialized jobs or projects. A similar open pathway system could add value to U.S. higher education institutions.

Using badges as prerequisites for college programs or *badging-out* college courses by breaking the course content into a series of badges allows prerequisites more tailored to specific program requirements and greater transparency regarding the specific course outcomes as well as the student's progress. Wayne State University Graduate School has added badges to its Graduate and Postdoctoral Professional Development program (Mathur et al., 2018). The Wayne State badges are focused on

skills determined desirable by employers of doctoral graduates. Wayne State uses pathways to scaffold subskills into larger competencies. For example, the Interpersonal Awareness competency consists of subskills such as negotiation, conflict management, empathy, and perspective taking. Badging a course also allows greater customization with the curriculum for each student which again aligns with Knowles (1990) adult learning theory. For example, an adult student enrolled in a business operations course who works full time might choose to tailor his operations management course with more focus on project management and less on inventory management if his full-time job requires him to manage projects, not inventories. This student's business operations pathway might look different than a student more engaged with logistics or supply chain management.

Likewise, the operations management course badges may offer lessons more industry specific than the general approach used by most business programs. Hence, a healthcare worker completing a business degree may opt to earn healthcare related operations badges while a different student who works in retail may desire badges centered on retail operations. Both students will stack their badges to fulfill the credits in operations management as required by their degree program.

Another advantage of badged courses is they allow students to stop a course mid-way, then begin at a different time without having to repeat the entire course. Badged courses also allow older workers to take focused lessons to update their skills instead of having to take an entire course. Additionally, open pathways allow for more flexibility with transfer students.

Prior Learning Assessments (PLA), where adult students earn academic credit based on lived experiences, has become commonplace for university admissions programs. However, PLAs are a challenge to manage. For a student who wants to earn credit for prior experiences, the school requires the student to submit a portfolio of evidence. Building such a portfolio is onerous for the student while verifying the evidence is time-consuming for most universities. Organizations recognizing experiences using badges could make the PLA process more efficient with the metadata and verification baked into the badge. The student could share the badges with the university admissions department, and the department could verify the named agency issued the badges.

Consider a student who wishes to study in an engineering program that specializes in additive manufacturing (e.g., 3D printing). A student may include badges on her college resume that she has earned through volunteer work related to 3D printing, such as those offered by the E-Nable Community. E-Nable (2019a) describes itself as "…an amazing group of individuals from all over the world who are using their 3D printers to create free 3D printed hands and arms for those in need of an upper limb assistive device" (para. 4). Volunteers can earn a range of badges (see Figure 4), including unique badges for fabricating each of the various hand designs, and distinctive badges for assembling each hand design (a different badge for each different design) (E-Nable, 2019b). Also, E-Nable offers badges for performing roles within the E-Nable community, forming an E-Nable chapter or working group, participating in community activities, completing design challenges for generating new assistive designs, and learning about the E-Nable community (E-Nable, 2019c). This type of flexibility and access in a badging system may prove useful to a wide range of learners and educational administrators.

Kazin and Clerkin (2018) posit badges could play an essential role in military members transitioning into the private sector and note the U.S. Army's proto-type testing of such a system, MIL-CRED in 2017. A link to MIL-CRED information provided by Kazin and Clerkin takes one to the Department of Defense's Advanced Distributed Learning (ADL) Initiative webpage. According to an ADL message, the webpage no longer exists. Additional searches of the internet and academic databases did not locate any information regarding the progress of the MIL-CRED or whether the program still exists. While an open pathway demonstrates some potential with digital badges, such as stacking, personalizing, and streamlining the PLA process, it also highlights a challenge: where to store the thousands of badges a learner collects over a lifetime of learning, experiencing, and achieving? The digital backpack is such a device.

Figure 4: Examples of E-Nable badges (E-Nable, 2019a)

Digital badge backpacks

Mozilla released its backpack feature in 2013 with the Open Badges 1.0 release (Thompson, 2013). The backpack serves as a visual record of the student's badges. Mozilla created its backpack as a digital storage area for learners to house the various badges they were earning from a wide range of open badging sites. The badge earner decides which badges to share with the public and which to keep private. Since its original release, most badging platforms offer some type of backpack feature, and many individual platforms work with Mozilla's backpack, allowing badge earners to import/export badges seamlessly from Mozilla's backpack to their platform backpack. However, Mozilla no longer manages its backpack feature.

In August of 2018, recognizing that IMS' work with badging standards marks the next phase in the evolution of the badging ecosphere, Mozilla announced it was stopping its role as a direct service provider in the badging sector and migrating its Mozilla Backpack to Concentric Sky's Badgr platform (Surnam, 2018). The backpack migration followed an earlier press release that the Instructure's

Canvas Learning Management System (LMS) would offer Open Badges through Badgr's platform as a native feature within its LMS (Canvas, 2018). Badgr allows users to store any open badge in its backpack, not just those issued by Badgr (Badgr, n.d.). Several other badging platforms have partnerships with Canvas, including Accredible, Credly, Canvasbadges, BadgeSafe, and Open Badge Factory (Heppenstall, 2018). Nearly all these other platforms have some kind of backpack feature and integrate with the original Mozilla backpack that is managed by Badgr. Developers at IMS Global recognize that not all achievements, experiences, knowledge, and skills will be badges, hence the need for the Comprehensive Learner Record (CLR).

Comprehensive learner record

Traditional academic transcripts, rooted in the 20th Century, paper-based information systems, provide limited information, such as course title and grades earned, about a student's learning. These transcripts fail to reflect the wide variety of knowledge, learning experiences, competencies, and achievements of the learner. Conventional transcripts designed for one-time learning periods, such as four years at a university, do not work well for the modern world's rapid pace of change and need for life-long learning. With support from the Lumina Foundation, the National Association of Student Personnel Administrators, and the American Association of Collegiate Registrars and Admissions Officers (AACRAO), IMS Global is advancing the CLR as the 21st-Century educational record (Shendy et al., 2019).

The genesis for the CLR started in 2015 at an IMS Global CBE (Competency Based Education) Workgroup that included 35 C-BEN (Competency-Based Education Network) institutions. This group recognized higher education record-keeping must change to support the evolving educational landscape (IMS Global, 2019a). IMS Global created a vision of the CLR, formerly referred to as Extended Transcripts, as a secure, verifiable, learner-centered digital record. This digital record requires a standardized format that captures a more granular picture of a learner and supports a broad range of educational activities, including traditional educational courses, competency-based education, badges, technical skills, soft skills, experiential learning, achievements, and co-curricular activities. IMS launched its first version of the CLR in August of 2019 (Shendy et al., 2019); examples of versions uploaded by institutions can be viewed at http://projects.imsglobal.org/clr-viewer/. The CLR is designed to work with open badges and open pathways, allowing for a record of learning that is easier to understand and more detailed for human educational stakeholders who read them. The Competencies and Academic Standards Exchange (CASE®) extends access further by putting educational information in a format that is read easily by software.

Competencies and academic standards exchange

The IMS is developing the Global CASE,® a set of technical requirements designed to make it possible to electronically transmit learning standards in a constant, referenceable manner by IT applications, tools, and systems (IMS Global, 2019b). Using common identifiers published in a dynamic database allows for the easy sharing of evidence between a range of educational systems, including learning management systems, rubrics, and curriculum management applications. This system allows for the more efficient and comprehensive development of badge pathways. To do this, IMS proposes a framework for CASE® that includes four items, 1) competency documents, 2) competency items, 3) competency associations, and 4) competency rubrics. The specifications for the CASE® framework were released in version 1.0 in July of 2017 (IMS Global, 2017) (See Figure 5).

CASE® aims to transform static documents, typically formatted in HTML, .pdf, or print format and designed to be read by humans, into a universal format compatible with a range of educational software to ensure the proper interpretation of learning standards by various educational organizations (IMS Global, 2017). Competency documents act as the container for a group of learning standards, usually arranged hierarchically or by the classification system, which indicates expectations of a stu-

dent's competencies within a subject area comprised of one or more levels. Competency items include a statement linked with other statements or documents to form a construct. Items include things such as academic standards, competencies, sub-competencies, goals, skills, learning outcomes, objectives, etc. Competency associations indicate the relationship between competency documents or competency items delineated by being a precise match of the source, related to, part of, replaced by, precedes, or as a prerequisite. A competency rubric expresses the expectations of excellence regarding an assignment, artifact, or act to define consistent grading benchmarks. IMS Global (2017) notes four pilots involving machine-readable standards occurred in Texas, Georgia, and Wisconsin.

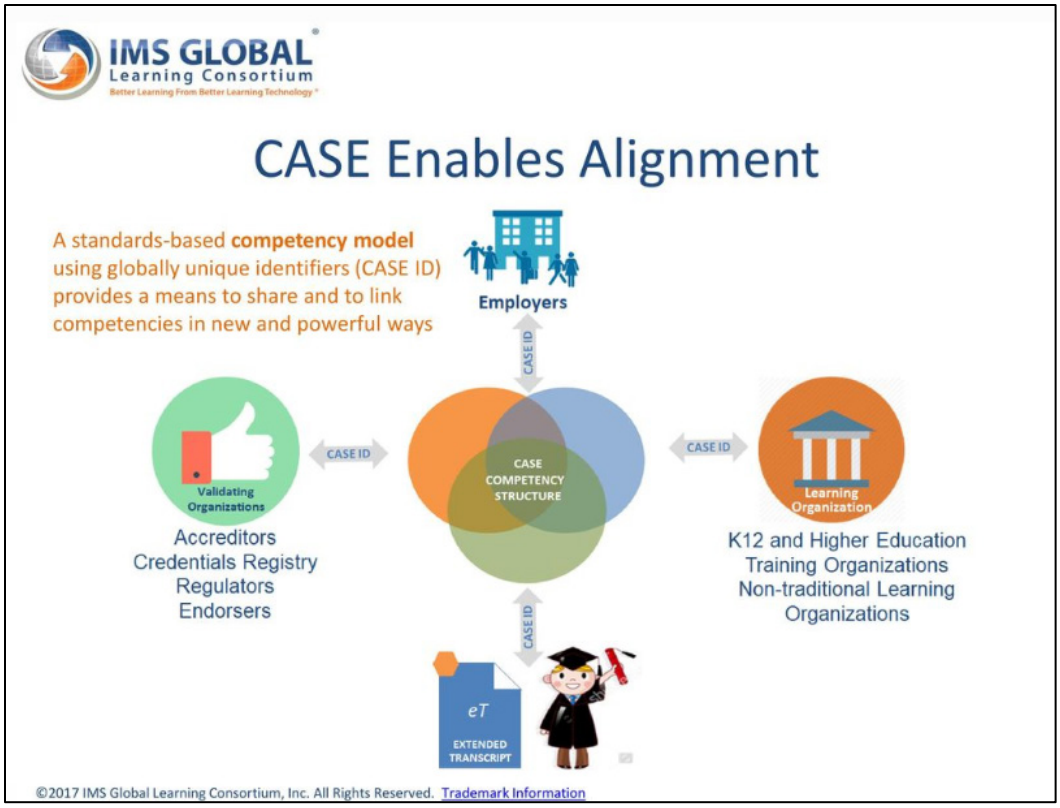

Figure 5: CASE® conceptual diagram (https://slideplayer.com/slide/13620038/)

CONCLUSION

The development of the badging ecosphere presents many areas where research is needed. Research aligned to key badging stakeholders such as issuers, earners, and consumers of digital badges is essential. For issuers, research associated with badging strategies, costs, design, and associated best practices is needed. For faculty utilizing digital badges, research into their perceptions of how the technology impacts curriculum design and execution for adult learners is vital. Likewise, case studies of faculty implementation into curriculum and focus on personalized learning is also desirable. For badge earners, research that provides insights as to badge value in the job market, utility in terms of knowledge, skills, and ability development, as well as usefulness of the credential as a signaling device is needed. In terms of consumers, employer perceptions of badges, as well as insights from college admissions professionals that are seeing badges as examples of prior learning, is also appropriate to understand this educational innovation better. Theoretical research associated with badging is needed to determine how this new approach aligns with theory. Understanding how badging supports or refutes theory related personalized learning, scaffolding, experiential learning, credentialing, and adult learning theories is also useful in creating better learning systems, more useful credentials, and developing life-long learners.

The goal of this exploratory study centers on making known the developing digital badge system and how such a system might be of value to adult learners. IMS Global is leading the development of the open educational badging standards for the system. This system consists of badging platforms that bake badges to ensure they are secure and verifiable. The baked badges become stackable when placed in a badging pathway. Badge earners store their badges in digital backpacks retaining the right regarding which badges are or are not made visible. In a formal setting, the badges are recorded in a CLR (Comprehensive Learner Record) designed to provide human readers much more granularity of detail than traditional transcripts regarding the learner's knowledge and skills. Finally, the CASE® (Competencies and Academic Standards Exchange) is an effort to develop machine-readable competency specifications that support digital standards to allow seamless interoperability between educational software. CASE® allows learners to customize their badging pathway independently through machine-enabled support. The overarching goal of the badging system is to capture all learning, achievements, and experiences throughout a person's life into a secure, verifiable digital record maintained by the student. This allows for the stacking of micro-credentials from a wide range of trusted issuers into advanced credentials using an integrated data exchange system. Understanding the badging system provides a useful foundation for educational professionals considering employing a badging strategy.

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APPENDIX A: GLOSSARY OF TERMS

Badge: A digital representation of a skill, learning achievement or experience. Badges can represent competencies and involvements recognized in online or offline life. Each badge is associated with an image and some metadata. The metadata provides information about what the badge represents, and the evidence used to support it. (Mozilla, 2014).

Badge backpack: Digital storage area for learners to house the various badges they were earning from a wide range of open badging sites. Badge earners decide which badges to make public.

Badge Baking: The process of embedding verifiable information about a recipient's achievement into a badge image so when a user shows a badge on a website, software which is Open-badges ready and automatically extract the data and verify the badge's authenticity. A baked badge image must be either PNG or SVG format. (IMS Global 2018f).

Badge Stacking: The process of combining two or more badges to create a greater credential such as a certificate, license, college course, or degree program. Badge stacking is made visible via Open Pathways.

Competency-Based Education (CBE): An educational construct that allows for greater student flexibility by permitting students to advance as they exhibit proficiency in the academic subject matter regardless of time, location, or rate of learning. This approach allows a range of ways that college credit can be earned or awarded which leads to customized learning opportunities (U.S. Dept of Education, n.d.). This approach arranges academic content and distribution based on competencies, that is what a student knows and can perform, rather than following a more conventional approach such as by a course; a CBE program measures progress using clock or credit hours (Mahaffie, 2014).

Comprehensive Learner Record (CLR): The aim of the CLR, formerly referred to as Extended Transcripts, is to create a standardized format that captures a more complete picture of a learner and supports a range of educational programs to include traditional educational courses, competency-based education, badges, skills, experiential learning, achievements, and co-curricular activities in a digital and verifiable format (IMS Global, 2019a).

Digital badge: A digital representation of a skill, learning achievement or experience. Badges can represent competencies and involvements recognized in online or offline life. Each badge associates with an image and some metadata. The metadata provides information about what the badge represents, and the evidence used to support it. (Mozilla, 2014).

Direct Assessment Competency-Based Education: Another form of CBE that measures progress exclusively based on a student demonstrating mastery of a competency (knowledge or skill related to a specific subject); a direct assessment CBE program does not use credit hours to stipulate the amount of instructive activity is expected to complete in order to finish an academic program. The direct assessment program, however, must offer students educational resources, which involves substantive interaction with instructors, for students to demonstrate command of each competency required for program completion (Mahaffie, 2014).

Learning Pathway: A learning pathway is a course of learning, chosen by the learner, that includes a series of stages from pre-conception to targeted outcomes, where learning transitions are unique to each learner based on personal experiences and abilities (Jih, 1996; Scott, 1992).

Open Badges: A unique type of digital badges that follows OBI standards maintained by the IMS Global Consortium. Earners control these badges in claiming and displaying them across a range of online sites. These badges are verifiable and transportable (rather than proprietary to one single system) and contain metadata about the issuing institution, the earner of the badge, and evidence that supports the person earning the badge (IMS Global, 2018b).

Open Pathways: A competency framework or set of learning standards and converted into a pathway, or a series of pathways, that a learner would use as a guide while earning badges and stacking them into more considerable credentials. The vision is for learners to be able to stack badges across platforms, across institutions, to allow greater flexibility in attaining one's educational goals. The pathway can be shared in a digital portfolio that shows earned badges as well as uncompleted badges. (IMS Global, 2018c).

APPENDIX B: IMS GLOBAL LIST OF CERTIFIED OPEN BADGES V2.0 PRODUCTS

1. Acclaim v20190925 by Credly
2. Accredible v1.1 by Accredible
3. AEFIS v3.53 by AEFIS
4. Badgewell 2.0 by Badgewell
5. Badgr v3 by Concentric Sky
6. Bestr v2.16 by Cineca
7. C-box v1.2 by Italian Quality Company IQC Srl
8. CanCred Factory v2019.01 by CanCred
9. CanCred Passport v2.8.1 by CanCred
10. Credly v20190925 by Credly
11. iQualify LMS v2019-02-21 by iQualify
12. LRNG v1.33 by Collective Shift/LRNG
13. Milestone v1.0 by Campus Labs
14. Moodle v3.8 by Moodle
15. Multiverse v3.0 by NetLearning Holdings, Inc
16. My Open Badges v1.2 by Reiss Romoli srl
17. MyMantl v1.0 by Campus Labs
18. Open Badge Factory v2019.09 by Open Badge Factory
19. Open Badge Passport v3.5.5 by Open Badge Factory
20. Openbadges.me v1.0 by MyKnowledgeMap Limited

BIOGRAPHY

Terry McGovern received his Doctorate of Business Administration from the University of South Florida's Muma School of Business and his Doctorate of Management from the University of Phoenix's School of Advanced Studies, his M.H.S. from Providence University and his M.S. from the Air Force Institute of Technology. He is currently an Assistant Professor of Business Management at the University of Wisconsin-Parkside. Dr. McGovern's areas of expertise include professional development and strategy. He is interested in case research and has been recognized by the North American Case Research Association as best new case writer and a Lawrence Case Writing Fellow. Dr. McGovern also has done consulting in the areas of strategic planning, leadership development, digital badging, family business succession planning, and multi-generational workplaces. He has authored numerous articles, presented in a wide range of settings including academic and industry conferences. His DBA doctoral dissertation included a résumé audit study that examined employer outcomes and digital badges. His DM dissertation investigated executive development in the United States Air Force. He currently teaches graduate and undergraduate courses in strategy and issues in management concerning multi-generational workforces. He teaches in various delivery formats, including face-to-face, blended, and online. Prior to his academic career, Dr. McGovern served for 20 years as a U.S. Air Force officer in the areas of nuclear missile operations, satellite operations, and staff positions including flag-officer speech writer, faculty member, and director of an enterprise-level research cell while stationed in the Pentagon. Dr. McGovern also served as the Program Manager of the University Learning Store, a digital badging consortium involving six major U.S. universities, while working with the University of Wisconsin's Extended Campus.

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Online July 7-8, 2020

OVER MOUNTAIN TOPS AND THROUGH THE VALLEYS OF POSTGRADUATE STUDY AND RESEARCH: A TRANSFORMATIVE LEARNING EXPERIENCE FROM TWO SUPERVISEES' PERSPECTIVES [ABSTRACT]

Joy Penman*	Monash University, Melbourne, Australia	Joy.Penman@monash.edu
Glenna Lear	University of South Australia, Adelaide, Australia	Glenna.Lear@unisa.edu.au

* Corresponding author

ABSTRACT

Aim/Purpose	The purpose of this paper is to illuminate the learning that happens in assuming a supervisee's role during the postgraduate study.
Background	The facilitators and barriers students encountered while pursuing postgraduate studies, strategies to achieve success in postgraduate studies, and how to decrease attrition rates of students, have been sufficiently explored in literature. However, there is little written about the personal and professional impact on students when they are being supervised to complete their postgraduate studies.
Methodology	Autoethnographic method of deep reflection was used to examine the learning that transpired from the supervisee's perspective. Two lecturers (a Senior Lecturer in Nursing and an Aboriginal Tutor) focused on their postgraduate journeys as supervisees, respectively, with over 30 years of study experience between them, in Australia and abroad.
Contribution	Future postgraduate students, researchers, would-be supervisors and experienced supervisors could learn from the reflections of the authors' postgraduate experiences.
Findings	Four themes surfaced, and these were *Eureka moments*, *Critical friend(s), Supervisory relationship*, and *Transformative learning*. The authors highlighted the significance of a supervisory relationship which is key to negotiating the journey with the supervisor. Essential for these students also were insights on finding the path as well as the destination and the transformative aspects that happened as a necessary part of the journey.

This Proceedings paper was revised and published in the journal *Issues in Informing Science and Information Technology, 16,* 1-20. https://doi.org/10.28945/4546]

	Conclusion. The postgraduate journey has taught them many lessons, the most profound of which was the change in perspective and attitude in the process of being and becoming. Personal and professional transformative learning did occur. At its deepest level, the authors' reflections resulted in self-actualization and a rediscovery of their more authentic selves.
Recommendations for Practitioners	This article highlights the importance of the supervisory relationship that must be negotiated to ensure the success of the candidate. Reflections of the transformation are recommended to support the students further.
Recommendations for Researchers	Quality supervision can make a significant influence on the progress of students. Further research on the supervisory relationship is recommended.
Impact on Society	The support in terms of supervision to ensure postgraduate students' success is essential. Postgraduate students contribute to the human, social, professional, intellectual, and economic capital of universities and nations globally.
Future Research	Further reflections of the transformative learning will advance the understanding of the personal and professional changes that occur with postgraduate supervision.
Keywords	postgraduate study, supervisee, autoethnographic reflection, supervisory relationship, transformation

BIOGRAPHIES

Dr Joy Penman graduated in nursing from the University of South Australia in 1993. She has since obtained her Masters and Doctoral degrees from the same university. She practiced as a nurse in the local hospital and clinics, but quickly moved to university teaching and research. She has lectured in both undergraduate and postgraduate nursing programs for over 25 years. Joy was also a pharmacist before pursuing nursing. Recently, she served as Stream Lead for the Australian Nursing Studies program at the Monash University, where she is a Senior Lecturer. She has worked to provide professional and clinical education for internationally qualified nurses wishing to join the Australian workforce. She has earned over AUD 400K in internal and external research funding for various collaborative projects. She is well published in peer-reviewed journals and books and has presented her work in national and international conferences.

Dr Glenna Lear began her third age university career in 1997. The University of South Australia awarded her PhD in 2011 for research on rural women's third age learning. Her lifelong passion is learning and she tutors Indigenous students at the University of South Australia's regional study hub in her local community which is classified as remote.

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Online July 7-8, 2020

DESIGN OF A KNOWLEDGE MANAGEMENT SYSTEM FOR THE RESEARCH-TEACHING NEXUS: EVIDENCE FROM INSTITUTIONAL AUDIT REPORTS [ABSTRACT]

Alrence Santiago Halibas*	RMIT University Vietnam, Ho Chi Minh, Vietnam	alrence.halibas@rmit.edu.vn
Rolou Lyn Rodriguez Maata	Gulf College, Muscat, Oman	rolou@gulfcollege.edu.om
Mohamed Varusai	Gulf College, Muscat, Oman	varusai@gulfcollege.edu.om
Ali Al-Badi	Gulf College, Muscat, Oman	aalbadi@gulfcollege.edu.om
Peyman Nouraey	Gulf College, Muscat, Oman	peyman@gulfcollege.edu.om

* Corresponding author

ABSTRACT

Aim/Purpose	The need for Higher Education Institutions (HEIs) to maximize the use of their intellectual property and strategic resources for research and teaching has become ever more evident in recent years. Furthermore, little attention is paid in developing an enabling system that will facilitate knowledge transfer in the Research-Teaching Nexus (RTN). Hence, this study assesses the current state of practice in knowledge management of the nexus in higher education in Oman. It also explores the context of how Knowledge Management System (KMS) for the nexus can be designed and utilized by HEIs and challenges them to rethink their traditional approaches in managing their knowledge assets to boost individual and organizational learning.
Background	This study provides a Knowledge Management-based framework and design of a knowledge management system that support the academic community towards the improvement of the nexus. This study sets out ideas from various academic and professional experts on how academic stakeholders in the higher education can improve and promote knowledge transfer and make better use of its knowledge and research assets for teaching and learning. It stressed the importance of having the knowledge assets or resources that can easily be pooled, accessed, and made available to its intended stakeholders.
Methodology	Data were gathered from 29 out of 49 institutional quality audit reports of all HEIs in Oman. The panel comments were coded and analysed to extract valuable insights regarding the management of knowledge assets in research. Additionally, data were gathered from the institutional accreditation

This Proceedings paper was revised and published in the journal *Issues in Informing Science and Information Technology, 16,* 21-40. https://doi.org/10.28945/4548

	outcomes page of the same website. Manifest and latent content analyses were used in reporting the findings of the panel.
Contribution	The study will contribute to a greater understanding and acceptance of Knowledge Management (KM) in higher education and extended the body of knowledge concerning knowledge management for the RTN.
Findings	The reports revealed a very limited practice of the nexus in terms of people and culture, structure ad processes, and computing and web technologies. A few staff are involved in RTN work, there is an uneven understanding of the RTN among staff, limited joint research between staff and students are some of the reasons for this. Significantly, there is no explicit research framework or policy for the RTN, and systems and/or mechanisms are limited. Furthermore, the reports did not account any use of computing and web technologies for the nexus. These limitations can lead to students with less academic, research, and graduate skills. Hence, this study presents a feature design of a KMS that incorporates various RTN best practices, as informed by the reports and literature. The design will allow the staff to utilize the research assets in the classroom, at the same time, engages students in research and scholarly undertakings.
Recommendations for Practitioners	All HEIs must have a innovative system that integrates a formal agenda and approach, and set initiatives, strategies, policies, and procedures for knowledge management in utilizing research assets for teaching and learning. It must be designed so that RTN practices remain up-to-date, relevant, and responsive to the needs of the stakeholders, as well as, address academic accreditation challenges.
Recommendation for Researchers	Researchers can evaluate the knowledge management of RTN practices of other HEIs outside of Oman to effectively recommend the proper course of action for teaching and learning improvement.
Impact on Society	This study will redefine the role and contribution of HEIs, which are key players in advancing a knowledge economy. HEIs are expected to be powerhouses where academic knowledge is discovered, created, disseminated, shared, and re-invented. They must be able to fully grasp the value of managing knowledge to be able to effect positive and purposeful change to the community.
Future Research	Future work should include staff and student surveys that examine the knowledge management need of the learning organization to better inform the design of a KMS for the RTN. Thereafter, future research can test the stage to test the effectiveness of the conceptual design.
Keywords	knowledge management, knowledge management system, research-teaching nexus, social computing, tacit knowledge

BIOGRAPHIES

Dr. Alrence S. Halibas is a seasoned administrator and educator who has an excellent academic track record for the past 20 years. She is currently the Senior Program Manager for Digital Marketing at RMIT University, Vietnam. She once served as an Assistant Professor and Program Leader of the Faculty of Computing Sciences at Gulf College, Oman from Apr 2012- Jan 2020. Prior to joining Gulf College, Dr. Halibas held the post of the Dean of the College of Computer Studies and Associate Dean of the School of Engineering and Information Technology at La Salle University, Philippines, from Jul 2000 to Mar 2012.

Dr. Halibas is a holder of several IT certifications, an active researcher, and a reviewer. She has published research papers in several refereed journals and peer-reviewed conference proceedings, including the Institute of Electrical and Electronics Engineer (IEEE) and Informing Science Institute (ISI), USA. Her research works are indexed in Scopus, EBSCOhost, IEEE, Google Scholar, and other reputable research databases. Moreover, Dr. Halibas has participated as a technical panel member and session chair in numerous international research conferences. Her current research interests include learning analytics, educational management and technology, entrepreneurship, and marketing.

Dr. Rolou Lyn R. Maata is a PhD holder, certified SAP lecturer, licensed professional teacher, research reviewer, and a computer science professor taught in higher education institutions from various universities in Philippines, Bahrain and Oman. She has more than eighteen (18) years of administrative and teaching experience in academe and held various positions such as Department Head for Information Management and Computer Science, Associate Dean for College of Computer Studies and Engineering, Dean and Alumni Head.

She joined Gulf College in 2014 as Lecturer and was promoted as Assistant Professor in 2017. Presently, she is the Final Year Project (FYP) coordinator of Faculty of Computing Sciences (FCS). Also, Dr. Rolou is a certified SAP Lecturer issued by SAP University Munich, Germany and the main contact of SAP University Alliances EMEA from her previous international university in Bahrain. She was also one of the professors who led the integration of SAP for the improvement of Business Informatics Curriculum in Bahrain. She attended various trainings related to SAP ERP in Napier University, Scotland, UK and SAP University, Waldorf, Germany.

Dr. Rolou is also a certified research reviewer of The Research Council (TRC) Oman and Institute of Informing Science in USA. She presented and published research papers in local and international conferences and research journals. Her research interests lie in the area of IoT, Educational Technology, Enterprise Applications, and Computer Security.

Mr. Mohamed Abdul Kader Varusai is a computing lecturer, programmer and internal quality auditor. He has 15 years of total teaching experience in India and Oman. He also worked as a Senior Software Engineer in the IT industry and had worked for many international projects. Mr. Varusai is currently pursuing his Ph.D. degree in Data Mining. He completed his Master of Philosophy in Computer Science from Periyar University, India in 2007, Master of Computer Applications in 1999, and B.Sc. Computer Science in 1996 from Manonmaniam Sundaranar University, India. He is an excellent teacher as well as a lifelong learner. Also, Mr. Varusai is a Certified Internal Auditor and a holder of several IT certifications. Additionally, He serves as a supervisor and assessor for final year projects students in Gulf College. He has published research and conference papers in journals including IEEE. His research interests include software engineering, human-computer interaction, and data mining.

Dr. Ali Al-Badi is the Deputy Dean for Academic Affairs and Research, at Gulf College; previously he worked as an Assistant Dean for Postgraduate Studies & Research, Associate Professor in the Department of Information Systems at Sultan Qaboos University (SQU), Muscat, Oman. Dr. Ali received his education in different countries (Oman, Kingdom of Saudi Arabia, UK and USA). Ali has more than 27 years of practical and academic experience in IS/IT field. Immediately, after obtaining his B.Sc. in Computer Science from Reading University, UK in 1991, he worked in the Center for Information Systems, SQU, where he gained most of his practical experience. Ali joined the academia in 1999 and completed his PhD in UK in 2005. From Sep 2007 – March 2011 Ali held the CIS Director's position, sharing his time between managing the Center and performing his academic duties. From Sep 2012 – Sep 2015 Ali held the Head of Department position at the Information Systems, College of Economics & Political Science, Sultan Qaboos University, Oman. Furthermore, Ali contributed to 15 different IT-focused committees both at the university and national level.

Dr. Ali Al-Badi is an active researcher, having a good record of publication (citations: 910; h-index: 145; h10-index: 25), published more than one hundred and twenty-four (124) international conference/journal papers, chapters in a book or report. His work has been cited in ISI, DBPLP, Scopus, ACM, IEEE, Google Scholar and other databases. He regularly reviews papers for international journals and conferences. In addition to publishing single or co-authored papers, Dr. Ali is also well-known for his patience and commitment in helping and empowering our students in sharpening their research skills. As a result of his hard work and his scholarly activities, he received a number of awards/recognitions including "Excellence in Research Award" from Clute Institute, Colorado, USA, "Certificate of Outstanding Contribution in Reviewing" and "Best Researcher Award" from Sultan Qaboos University, Oman, and "Best Paper Award" at a conference in Paris, France. He also co-supervised, supervised/ supervising number of postgraduate students at local, regional and international universities. Dr. Ali Al-Badi received several internal, TRC and HMTF strategic grants and Microsoft worth total of 142,393 OMR. He is on editorial board of number international journals and reviewers for international journals. Dr. Ali also chaired local and international conferences/workshops and was invited as a Keynote speaker at 5 different conferences.

Mr. Peyman Nouraey has been teaching English as a Foreign Language for more than ten years. He has taught at both institutional and higher education level. At present, he is an English Language Lecturer at the Centre for Foundation Studies (CFS) and the College Research Coordinator at Centre for Postgraduate Studies and Research (CPSR). His area of interest in research includes Translation Studies, Teaching English as a Foreign Language (TEFL), Critical Discourse Analysis, Linguistics, and Comparative Literature. He has published his research papers in reputable international refereed journals. To date, he has published four books on Translation Studies, as well as English language and literature and presented his research papers in various reputable conferences.

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WHAT IS RESEARCH RIGOR? LESSONS FOR A TRANSDISCIPLINE [ABSTRACT]

T. Grandon Gill*	University of South Florida, Tampa, FL, USA	grandon@usf.edu
Thomas R. Gill	University of South Florida, Tampa, FL, USA	thomasgill@usf.edu

* Corresponding author

ABSTRACT

Aim/Purpose	Use of the term "rigor" is ubiquitous in the research community. But do we actually know what it means, and how it applies to transdisciplinary research?
Background	Too often, rigor is presumed to mean following an established research protocol scrupulously. Unfortunately, that frequently leads to research with little or no impact.
Methodology	We identify a sample of 62 articles with "rigor" in the title and analyze their content in order to capture the range of perspectives on rigor. We then analyze how these findings might apply to informing science.
Contribution	This paper offers an approach to defining rigor that is theory based and appropriate for transdisciplinary research.
Findings	Rigor definitions tend to fall into one of two categories: criteria-based and compliance-based. Which is appropriate depends on the research context. Even more variation was found with respect to relevance, which is often used as a catch-all for research characteristics that aren't associated with rigor.
Recommendations for Practitioners	Recognize that when researchers are referring to rigor and relevance, they often mean these to apply to other researchers rather than to practice. When funding research, it is important to understand who the rigor and relevance are directed towards.
Recommendations for Researchers	When using the term "rigor", think carefully about which meaning is intended and be transparent about that meaning in your writing.
Impact on Society	A great deal of public money is invested in achieving research rigor. Society should be aware of what it is buying with that funding.

This Proceedings paper was revised and published in the journal *Informing Science: The International Journal of an Emerging Transdiscipline, 23,* 47-76. https://doi.org/10.28945/4528

Future Research	Developing a better understanding of research fitness and the factors that contribute to it.
Keywords	rigor, relevance, resonance, interdisciplinary, transdisciplinary, research

BIOGRAPHIES

Grandon Gill is a professor in the Information Systems and Decision Sciences Department of the University of South Florida. He is also the Academic Director of the Doctor of Business Administration Program at the Muma College of Business. He is Editor-in-Chief of the Muma Business Review and the past Editor-in-Chief of Informing Science: The International Journal of an Emerging Transdiscipline and the Journal of IT Education: Discussion Cases, also serving as a Governor and Fellow of the Informing Science Institute, where he was elected President in 2019. He was also the inaugural recipient of the Zbigniew Gackowski Award for informing science research

Thomas R. Gill is a doctoral student in the Information Systems and Decision Sciences Department at the University of South Florida. He has a Bachelor of Science in Computer Science from the College of William and Mary and a Master of Science in Business Analytics and Information Systems from the University of South Florida. He co-authored an article published in Cancer Informatics.

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Online July 7-8, 2020

FROM AN ARTIFICIAL NEURAL NETWORK TO TEACHING [ABSTRACT]

Dror Mughaz *	Dept. of Computer Science, Bar-Ilan University, Ramat-Gan, Israel, and Dept. of Computer Science, Lev Academic Center, Jerusalem, Israel	myghaz@gmail.com
Michael Cohen	Dept. of Computer Science, Lev Academic Center, Jerusalem, Israel	michael.co24@gmail.com
Sagit Mejahez	Ministry of Education, Jerusalem, Israel	sagmej@gmail.com
Tal Ades	Dept. of Computer Science, Lev Academic Center, Jerusalem, Israel	talades8@gmail.com
Dan Bouhnik	Dept. of Computer Science, Lev Academic Center, Jerusalem, Israel, and Dept. of Information Science, Bar-Ilan University, Ramat-Gan, Israel	dan.bouhnik@biu.ac.il

ABSTRACT

Aim/Purpose	Using Artificial Intelligence with Deep Learning (DL) techniques, which mimic the action of the brain, to improve a student's grammar learning process. Finding the subject of a sentence using DL, and learning, by way of this computer field, to analyze human learning processes and mistakes. In addition, showing Artificial Intelligence learning processes, with and without a general overview of the problem that it is under examination. Applying the idea of the general perspective that the network gets on the sentences and deriving recommendations from this for teaching processes.
Background	We looked for common patterns of computer errors and human grammar mistakes. Also deducing the neural network's learning process, deriving conclusions, and applying concepts from this process to the process of human learning.
Methodology	We used DL technologies and research methods. After analysis, we built models from three types of complex neuronal networks – LSTM, Bi-LSTM, and GRU – with sequence-to-sequence architecture. After this, we combined the sequence-to-sequence architecture model with the attention mechanism that gives a general overview of the input that the network receives.

This Proceedings paper was revised and published in the *Interdisciplinary Journal of e-Skills and Lifelong Learning, 16,* 1-17. https://doi.org/10.28945/4586

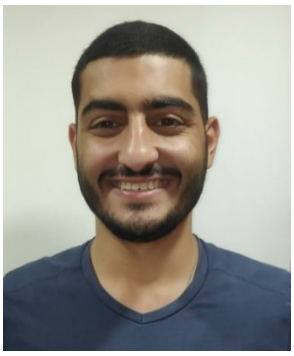
Contribution	The cost of computer applications is cheaper than that of manual human effort, and the availability of a computer program is much greater than that of humans to perform the same task. Thus, using computer applications, we can get many desired examples of mistakes without having to pay humans to perform the same task. Understanding the mistakes of the machine can help us to understand the human mistakes, because the human brain is the model of the artificial neural network. This way, we can facilitate the student learning process by teaching students not to make mistakes that we have seen made by the artificial neural network. We hope that with the method we have developed, it will be easier for teachers to discover common mistakes in students' work before starting to teach them. In addition, we show that a "general explanation" of the issue under study can help the teaching and learning process.
Findings	We performed the test case on the Hebrew language. From the mistakes we received from the computerized neuronal networks model we built, we were able to classify common human errors. That is, we were able to find a correspondence between machine mistakes and student mistakes.
Recommendations for Practitioners	Use an artificial neural network to discover mistakes, and teach students not to make those mistakes. We recommend that before the teacher begins teaching a new topic, he or she gives a general explanation of the problems this topic deals with, and how to solve them.
Recommendations for Researchers	To use machines that simulate the learning processes of the human brain, and study if we can thus learn about human learning processes.
Impact on Society	When the computer makes the same mistakes as a human would, it is very easy to learn from those mistakes and improve the study process. The fact that machine and humans make similar mistakes is a valuable insight, especially in the field of education, Since we can generate and analyze computer system errors instead of doing a survey of humans (who make mistakes similar to those of the machine); the teaching process becomes cheaper and more efficient.
Future Research	We plan to create an automatic grammar-mistakes maker (for instance, by giving the artificial neural network only a tiny data-set to learn from) and ask the students to correct the errors made. In this way, the students will practice on the material in a focused manner. We plan to apply these techniques to other education subfields and, also, to non-educational fields. As far as we know, this is the first study to go in this direction – instead of looking at organisms and building machines, to look at machines and learn about organisms.
Keywords	deep-learning, text-mining, Hebrew, subject-tagger

BIOGRAPHIES

Dror Mughaz is a doctoral student in the Department of Computer Science at Bar-Ilan University (BIU) under the supervision of Professor Yaakov HaCohen-Kerner and Professor Dov Gabbay. Dror is also a lecturer at the Computer Science Department in the Jerusalem College of Technology (JCT). Dror is a co-author of 20 papers. Dror's current main research is in Text Mining of temporal issues. Other research fields that he works on are text clustering, citation extraction and analysis, word embedding, n-gram embedding, opinion mining, features and key-phrase extraction, data enrichment and author verification. Much of his research was done on Hebrew texts with a focus on rabbinical texts. He was a member of COST research actions of the EU.

Michael Cohen is a B.Sc student in the Department of Computer Science and M.Ba student in the Department of Business Administration & Data Science at Jerusalem College of Technology. Michael's main research is in NLP By dedicating relations in Hebrew sentences with Keras & Tensorflow. Other research fields that he works on are text analysis, Big-Data solutions for data scientists, scalable data flows, data routing, transformation, and system mediation logic. Among other things Michael is a Backend Big Data Developer.

Sagit Mejahez holds an M.A. degree in Education Systems Administration from the Or Yehuda Center for Academic Studies. She holds a B.A. degree from the Department of Jewish art and from the Department of Land of Israel Studies and Archaeology she also holds a teaching certificate from Bar Ilan University. Sagit is an educator and teacher in the Ministry of Education of the State of Israel she. She has over 20 years of experience in different teaching & management positions in the elementary, middle and high schools. During her career Sagit put a special emphasis on integrating new technologies in the teaching processes. Today, her main job is elementary school education and teaching. As part of her work, she managed a young division in a heterogeneous population school. She taught in middle schools and she worked at a high school for high-risk youth in order to keep them in the community. Today Sagit is a second grade educator.



Tal Ades is a graduated B.Sc in the Department of Computer Science and M.Ba student in the Department of Business Administration & Data Science at Jerusalem College of Technology. Tal's main reaserch is in NLP By dedicating relations in Hebrew sentences with Keras & Tensorflow. Other fields of interest which he works on are fullstack web programming. Among these things Tal is a java real time backend developer.

Prof. Dan Bouhnik is the head of the Engineering and Computer Science Department in the Jerusalem College of Technology (JCT) and a faculty member in the Information Science Department in Bar Ilan University (BIU) in Israel. He is the author of a number of books used for teaching advanced computer sciences and his professional interests include knowledge management, information Security, Big Data and the infusion of new technologies in the learning environment.

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EFFECTS OF MULTICULTURAL TEAMWORK ON INDIVIDUAL PROCRASTINATION [ABSTRACT]

Ruti Gafni*	The Academic College of Tel Aviv Yaffo, Tel Aviv, Israel	rutigafn@mta.ac.il
Anat Goldstein	The Academic College of Tel Aviv Yaffo, Tel Aviv, Israel	anatgo@mta.ac.il

* Corresponding author

ABSTRACT

Aim/Purpose	The purpose of this study is to discover usage differences in task performance by students of different cultures, by examining procrastination patterns from a national cultural perspective, exploring the effect of multicultural virtual teamwork on student's individual procrastination.
Background	This study aims to examine higher-education entrepreneurial learning in the context of multicultural virtual teamwork, as actually performed during participation on a Global Entrepreneurship course.
Methodology	In the examined course, there were 177 participants, from 3 different countries: United Kingdom, France and Israel. The students were grouped into 40 multicultural virtual (not face-to-face) teams, each one composed of at least participants of two countries. This research is based on analysis of objective data collected by Moodle, the LMS used in the In2It project, in its built-in log system, from the Global Entrepreneurship course website, which offer students diverse entities of information and tasks. The primary methodology of this study is analytics of the extracted data.
Contribution	This study aims to discover the effects of multicultural teamwork on individual procrastination, while comparing the differences between cultures, as there are only a few studies exploring this relation. The uniqueness of this study is also by using and analyzing actual data of student procrastination from logs, while other studies of procrastination in multicultural student teams have measured perceived procrastination, collected using surveys.
Findings	Results show statistical differences between countries in procrastination of individual assignments before team working: students from UK were the most procrastinators and Israeli students were the least procrastinators, but almost all students procrastinated. However, the outcome of the teamwork was submitted almost without procrastination. Moreover, procrastination in

The final version of this paper will be published in the *Interdisciplinary Journal of e-Skills and Lifelong Learning* (IJELL) and a link to the full paper will be placed here.

	individual assignments performed after finishing the multicultural teamwork, dramatically decreased to 10% of the students' prior individual procrastination.
Recommendations for Practitioners	The results from this study, namely, the decline of the procrastination after the multicultural virtual teamwork, can be used by global firms with employees all over the world, working in virtual multicultural teams. Such firms do not need to avoid multicultural teams, working virtually, as they can benefit from this kind of collaboration.
Recommendation for Researchers	These results can be also beneficial for academic researchers from different cultures and countries, working together in virtual multicultural teams.
Impact on Society	Understanding the positive effect of virtual multicultural teamwork, in mitigating the negative tendency of students from diverse cultures to procrastinate, as concluded in this study, can provide a useful tool for higher education or businesses to mitigate procrastination in teamwork processes. It can also be used as an experiential learning tool for improving task performance and teamwork process.
Future Research	The relation between procrastination and motivation should be further examined in relation to multicultural virtual teams. Further research is needed to explore the effect of multicultural virtual teamwork during the teamwork process, and the reasoning for this effect.
Keywords	procrastination, virtual teams, multicultural teams, individual procrastination

BIOGRAPHIES

Ruti Gafni is an Associate Professor and the Head of the Information Systems B.Sc. program at The Academic College of Tel Aviv Yaffo. She holds a PhD from Bar-Ilan University, Israel (in the Business Administration School), focusing on Information Systems, an M.Sc. from Tel Aviv University and a BA (Cum Laude) in Economics and Computer Science from Bar-Ilan University. She has more than 40 years of practical experience as Project Manager and Analyst of information systems.

Anat Goldstein is a lecturer at the Information Systems B.Sc. program, and the Head of the Entrepreneurship track in the Management and Economics B.A program, at The Academic College of Tel-Aviv–Yaffo. She holds an MA in Education management and an L.L.B (LAW) from Tel Aviv University. She is currently working on her PhD focusing on virtual technological platforms for entrepreneurial learning. Anat has more than 15 years of practical experience as senior marketing and business development director in the High-tech sector, and in Corporates. She has more than 5 years' experience in developing and managing face-to-face and virtual Hackathons and Accelerators.

Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication of the Informing Science Institute
InformingScience.org

InformingScience.org/Publications

Online July 7-8, 2020

EFFECTIVE USE OF CASE TEACHING IN LARGE UNDERGRADUATE CLASSES

Kenneth A. Grant*	Ryerson University, Toronto, ON, Canada	kagrant@ryerson.ca
Michael Moorhouse	University of Western Ontario, London, ON, Canada	mmoorhouse@gmail.com
Candace T Grant	Utica College, Toronto, Ontario, Canada	ctgrant@rogers.com

* Corresponding author

ABSTRACT

Aim/Purpose	To guide faculty who wish to use the case method in large undergraduate classes
Background	The paper reviews a range of case teaching methods and provides specific guidance on how to use them in various classroom situations
Methodology	Literature review, reflective experience, interviews, and surveys
Contribution	This paper addresses a gap in case teaching research which tends to focus on its use in graduate classes
Findings	Case teaching can be used effectively in large undergraduate classes, but needs to be used in different ways and with different techniques from those commonly recommended for graduate classes.
Recommendations for Practitioners	Be creative and go beyond the Harvard: case method and draw on the broader range of techniques used in active and experiential learning
Impact on Society	Better and more relevant classroom experiences
Future Research	Examine and evaluate field examples of innovative case teaching, especially in hybrid and online environments.
Keywords	case teaching, active learning, experiential learning, large classes

Accepted by executive review by Editor Michael Jones | Received: February 3, 2020 | Revised: June 25, 2020 | Accepted: June 29, 2020.

Cite as: Grant, K. A., Moorhouse, M., & Grant, C. T. (2020). Effective use of case teaching in large undergraduate classes. In M. Jones (Ed.), *Proceedings of InSITE 2020: Informing Science and Information Technology Education Conference*, pp. 221-236. Informing Science Institute. https://doi.org/10.28945/4591

INTRODUCTION

This essay is a personal reflection on the challenges of case teaching in large undergraduate classes. The lead author is a senior faculty member of a very large business school with more than 20 years of experience in using case teaching at both graduate and undergraduate levels in Europe, North America and Asia. Recently, he held the position of Faculty Teaching Chair, providing pedagogy support to some 200 faculty. The essay draws on literature review, and the personal experience of all three authors, and is supplanted by several surveys and interviews with faculty and students (Moorhouse, 2012).

THE CHALLENGE

Over the last few decades, in most developed countries, there has been a dramatic increase in the number of undergraduate students. For example, the proportion of young people attending university in the UK has grown from about 5% in 1960 to about 35% in 2000 with similar growth being observed in most countries (Mayhew et al., 2004). Further, the proportion of students choosing business as their major has also increased. In the United States, Canada, and the UK, business students make up the largest single discipline of students, some 20-25% of the total. It has been widely reported that, over the same period, the increases in faculty numbers has significantly lagged behind these increases in student enrolment. Further, budget allocation processes in many universities often draw on fees and funding provided for business students to support other more expensive programs. Finally, public universities in most developed countries are dealing with funding pressures as governments struggle with budget allocations, as well as facing increased demands to link funding to some set of performance indicators.

While MBA and other masters-level business classes still tend to be kept small, perhaps reflecting the high fees often paid by the student, the combination of these trends has resulted in steadily increasing class size in many undergraduate business schools.

Meanwhile, it has become increasingly recognised that the traditional lecture format, the "sage on stage," is not an effective delivery method in many subjects, accompanied by a move away from defining courses in terms of content delivered towards the identification of learning outcomes intended for the students after completion of the course and measurement of their achievement against these outcomes. A very frequently considered improvement is a move towards active and experiential learning which is seen as providing a better learning result in many different subjects (Freeman et al., 2014). While many techniques for this type of learning have been identified, one of the most popular used in business schools is that of case teaching. But, there is great uncertainty with many faculty as to whether this technique can be used in large classes.

CASE TEACHING IN BUSINESS SCHOOLS

Harvard Law School Professor Christopher Langdell introduced the case method into university classroom teaching in the 1870s, using accounts of recent court decisions to encourage discussion amongst his students (Osigweh, 1987). In the early 1900s, faculty at the recently established Harvard Graduate School of Business Administration recognized its apparent success (Merseth, 1991) and, soon after, it was adopted as the primary pedagogy for the Harvard Business School. Since that time many other business schools have followed suit. Indeed, one of the most frequently used methods of case teaching in business is described as the "Harvard Case Method (HCM)" and the majority of cases produced by case publishers (e.g. Harvard Business School, the Ivey Business School and The Case Centre) typically follow the standard Harvard case structure.

The case method is described as an "active learning" technique, where students must "do more than just listen" (Bonwell & Eison, 1991), and are expected to read, write, discuss, and especially use higher order thinking such as analysis, synthesis, evaluation, or problem solving. Proponents of active

learning believe that these techniques are not only preferred by the students over lecturing (Bonwell & Eison, 1991), but also help to develop the practical skills (listening, reading, writing) that students will need to succeed in their careers (Auster & Wylie, 2006). Well written cases "can lead to changing the way students think, by exposing them to experiences that would otherwise take much longer to understand and assimilate" (Sheehan et al., 2018).

From the literature, there are many benefits claimed for case method, with Osigweh (1987) (1987)providing a good summary (see Figure 1).

1. Cases apply knowledge tools to problem-solving and decision-making circumstances
2. Cases improve students' communication skills
3. Cases require thinking and analytical skills that help students master subject matter
4. Cases help illustrate the theories in a practical context
5. Cases let students experience true-to-life organizational situations
6. Cases allow a student to explore real world situations in a low-risk environment.
7. Cases promote constructive change in the management of an organization
8. Cases are engaging and motivating for students
9. Cases provide reference points that help students recall specific knowledge

Figure 1. Major benefits of the case method. (Osigweh, 1987)

Perhaps the most cited criticism of active learning techniques such as the case method is the instructor's diminished control(Bonwell & Eison, 1991). The case method places responsibility on the students to take a leadership role in their own and their classmates (Harvard Business School, 2019a), with the professor becoming the "guide on the side". While many might view this as a positive, critics argue that it relies on the students acting responsibly to ensure the success of each case session. If students come to class unprepared, or if they choose not to actively participate in the discussion, then the instructor is less able to help the students achieve their learning objectives.

Student participation is critically important to the success of the case method, with the method placing pressure on students to speak in class since participation marks can represent up to 50% of their final grade (Ewing, 1990). According to Ewing (1990), the most common complaint of Harvard students is a difficulty speaking in class, suggesting this may be due to an inability to think on their feet, an aversion to being the center of attention, or a fear of looking foolish in front of classmates. Mauffette-Leenders et al. (2007) suggest this fear of class participation may stem from two major sources: an inadequate level of individual or small group preparation; and cultural, social, or psychological factors causing a reticence to speak out in group settings.

The majority of discussion around the use of cases in business (e.g. the Ivey book series on Case teaching and Learning) have two underlying assumptions, not always stated explicitly. First, they are targeted at Masters (usually MBA) students and second an expectation of relatively small classes (sizes of 20-40 are typically mentioned). This paper addresses these limitations by examining the role of case teaching in large undergraduate classes.

THE EFFECT OF CLASS SIZE ON STUDENT LEARNING PERFORMANCE

One of the most divisive topics in the professoriate is the effect of class size on student performance. Many educators are convinced that smaller class sizes are superior to large classes (McKeachie, 1980).

Their belief is that students studying in smaller classes will outperform students of larger classes in standardized tests. However, a review of the research returns inconclusive results.

Class size testing has been performed since the 1920s, when Edmonson and Mulder (1924) compared the performance of two sets of education students. While small class students outperformed their large class peers on an essay and mid-term, large class students performed better in quizzes and the final exam. The results of many other studies throughout the 20th century have been similarly inconclusive.

Among the supporters of small class superiority, Glass and Smith (1979) authored one of the most famous and controversial studies. Their meta-analysis of 725 class size studies involving elementary, secondary, and post-secondary students concluded "all things being equal, more is learned in smaller classes." Their study analysed student achievement scores from the studies. However, the achievement score differentials were only particularly significant when the small classes were very small (i.e., 5 students or less), leading Follman (1994) to question the validity of the results. Each researcher appears to define what constitutes a "large" and a "small" class. The result is that the "large" classes defined in many studies might actually be considered small by many post-secondary educators. In the Glass and Smith study, the definitions of "large" classes ranged as low as 2 students in a class (which was compared to a "small" class of 1 student), and almost 40% of the "large" classes contained fewer than 35 students.

DEFINITION OF A "LARGE CLASS" FOR ACTIVE LEARNING AND CASE TEACHING

The primary purpose of this essay is to identify best practices that instructors can use to tailor case teaching methods to meet the demands of large classes. Thus, it is important to define a "large class". From the literature, the only generally accepted opinion of what constitutes a large class is "it depends". According to the Australian Universities Teaching Committee 'Teaching Large Classes Project' (2003), class size is a matter of perception: a class is "large" if the instructor and students perceive the class to be "large". This perception depends on the interaction of three key factors:

1. the number of students in the class
2. the teaching and learning activities
3. the facilities and physical environment

Thus, the definition of a large class varies according to the expectations placed on the students and the instructor. A lecture-based class with 200 students may not be considered large if the instructor is not required to make meaningful changes from teaching a class of 40. However, an interactive discussion-based class of 200 students may be difficult to manage and likely looks significantly different from a discussion-based class of 40 students.

Therefore, we need to define a large class in the context of case teaching. An important element of the case method is the rich discussion between students with different backgrounds, beliefs, and experience. According to the Harvard Business School (2019b), the proper facilitation of this discussion requires instructors to know each student's personal history and to address them all by name. Erskine et al. (2011)from the Richard Ivey School of Business says it best: "In case discussions a student is not a number. A student is not anonymous. A student cannot be allowed to hide" (p. 29).

For this reason, many case-teaching schools place the upper bounds on class size for case method at 100 students, with Erskine at Ivey suggesting that case teaching is appropriate for classes of 12-100 students, with the preferred size falling between 20 and 60 students, allowing all students to engage in class discussion (Erskine et al., 2011).

As might be expected, there has been significant discussion at Harvard on this issue with ranges of 20-100 students frequently being suggested as appropriate for case teaching (Barnes et al., 1994), and

the writings of several Harvard professors suggest that they consider large classes to contain 80+ students. Bruns (Hill et al., 1996) refers to a large class as one with 80-90 students and argues that these classes make it easier for students to hide since they typically participate in discussion only once every two or three classes. Garvin (2007) similarly makes a distinction of classes containing 80-100 students, reporting that a Harvard faculty committee had explored adding small group discussions to these larger classes to encourage students to work together more closely. Doran et al. (2011) used classes of 72 and 84 students to test case teaching strategies in large size classes.

From the Harvard and Ivey literature, we can conclude that a class becomes "large" for case teaching when it reaches perhaps 60 or 80 students and that the upper limit for classical HCM case teaching might be 100 students. Once a class moves towards 100+ students it is assumed that a new case methodology may have to be employed.

The effect of class size on student performance is possibly one of the oldest and most researched issues in the teaching profession. As mentioned earlier, despite the great amount of research on the subject, one cannot conclude that smaller classes with a lower student to faculty ratio will result in higher levels of achievement for students. Further, the bulk of research on the subject has not examined either active learning or the case method. Frequently not discussed in these studies is the effect of the instructor, with an implication that all professors are equally able in their teaching. Very few faculty receive any formal pedagogy education during their doctoral studies, in contrast to school teacher education, where significant effort is focused on this. Even fewer will have received any professional development in the Case Method, except perhaps from their exposure as graduate students in MBA programs or as teaching assistants.

Active learning practitioners have documented many practices designed to overcome large class challenges, which could potentially be exploited for use with case teaching.

For the purpose of distinction, we suggest three class size groupings for case teaching:

- **Normal** case classes with 30-60 students
- **Large** case classes with 60-100 students
- **Very Large** case classes" with 100+ students, perhaps several hundred.

TYPES OF CASES

When business faculty discuss "Cases", they tend to think first about Harvard type cases. However, there are a variety of other approaches to case teaching, and even the HCM has been subject to criticisms including its over-stylized approach and its focus on taking a management perspective, frequently ignoring other social and moral issues that might also be considered (Bridgeman et al., 2016). Thus, we suggest that a variety of case types are relevant to this discussion, with Zimmerman (2002) providing a useful summary. Each of these approaches has strengths and weaknesses and these are reviewed in Figure 2.

Method	Description	Advantages	Disadvantages
"Classical" HCM Model	Analysing published case using individual, small group and whole class discussion	Applies theory to real-world management situations High student participation	Long preparation time Oversimplification of issues Management perspective
"Short case"- mini case	1-2 pages or less likely focusing on a single theory or problem	Short preparation time Demonstrates theories in an efficient manner	Students cannot practice sorting through facts to find relevant issues

Method	Description	Advantages	Disadvantages
Role Playing and Simulation Games	Allows students to experience case situations	High student participation and level of discussion	Difficult to run in a large class Must be strictly managed
Descriptive Case	describe the entire situation including the final decisions	Helps illustrate theory Allow student discussion on the decision taken	Decisions are already made for the students
Mousetrap	Three or more different situations presented in sequence, with each calling for acceptance or denial of the same set of standards	Illustrates ethics/values Demonstrates faulty reasoning	Limited general application
Student Written Cases	students performing research on a real company and then writing the content into a case.	Improves writing and critical thinking	Wide variability of case data May not be consistent with teaching objectives
Non-traditional sources of cases (informal cases)	real-world and fictional situations gathered from newspapers, magazines, memos, novels and films	Can be chosen for specific classroom objectives Topical	Likely lack of good data Possible bias in sources
Real Case	A real-world organization brings a problem to the class to study	Students work on a real and current challenge Exposure to the actual organisation management	Relies on the commitment and capabilities of the organisation and its management Can crate conflict between students and organisation

Figure 2: Advantages and disadvantages of various case types.
(derived from Zimmerman, 2002)

THE CHALLENGES WITH TEACHING THE CASE METHOD IN LARGE CLASSES

As with other active learning techniques, student participation is a critical factor in case method learning, especially for class discussion. Class discussions are designed to help students develop core business skills such as communication and persuasion. Additionally, participation in class discussion is one of the best ways to ensure that students perform a thorough individual case preparation (Mauffette-Leenders et al., 2007). If a student feels that they can hide in a large class, they have less incentive to protect themselves from looking foolish due to lack of preparation.

In one of the very few studies expressly concerned with teaching the case method in large size business classes, Booth et al. (2000) interviewed students and faculty to explore how the use of cases was evolving to meet the realities of the growing and increasingly diverse classes in their undergraduate business programs. Students expressed concerns that the large classes hindered their ability to grasp

and learn the case material. The comments stem from a belief that large and anonymous class settings allowed students to "hide" and created a reluctance to prepare, to contribute, or to ask questions. Rather than the lively class debates that might be experienced in the typical Harvard method setting, many students reported that the large class setting more often led to fragmented discussions.

Another study on case method teaching in large classes confirmed several of the same large class challenges (Doran et al., 2011). While the authors observed some positive case teaching benefits including strong student engagement, the large class size necessitated strict time constraints and structure, which limited spontaneous peer interaction and large group discussion.

Gleason (1987) is concerned that there is not enough time for all students to participate in a large class, causing challenges for individual assessment, with time constraints often permitting only one group member to speak on behalf of each small group. Instructors may evaluate the performance of the entire group based on the participation of only a few individual members, likely leaving some students frustrated with their marks and questioning the assessment validity.

Lack of individual assessment may impact attendance. It is generally held (e.g., by Carbone, 1999, and Caldwell, 2007) that students are likely to attend class each week if they know or suspect that they will be evaluated. Students who feel their absence will not adversely affect their grades may be less likely to attend.

The large class issues identified from the active learning and case method literature can be distilled into three major teaching challenges:

1. Instructors are unable to provide individual attention and direction.
2. Students are unwilling or unable to participate in class discussion.
3. Instructors face challenges in providing individual assessment and feedback.

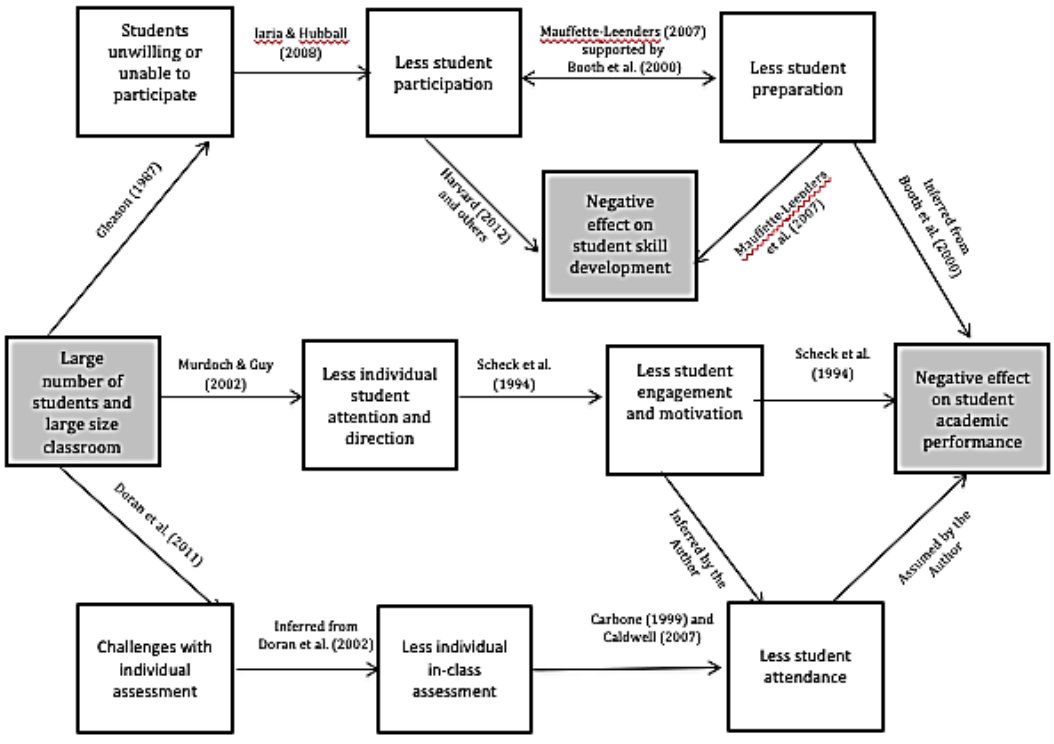

Figure 3: The challenges of active learning and case method teaching in large classes

The potential outcomes of the three major challenges and their effect on student learning are shown in Figure 3. These challenges create a situation that may lead to negative learning outcomes both for student performance and for critical skill development (analysis, problem-solving, decision-making, communication, etc.). Left unchecked, the challenges can lead to diminished student preparation, engagement, and/or attendance in class. Logic suggests that these three situations set up the possibility for lowered student performance, because a basic expectation for learning is that a student attends class, is prepared to learn, and is engaged in what she is learning.

"GOOD" PRACTICES FOR ACTIVE LEARNING AND CASE TEACHING IN LARGE CLASSES

We believe that large classes do not necessarily lead to poor performance, especially if instructors are able to act to overcome the three major challenges identified in the previous section. Despite limited research dedicated to the best practices of the case method in large classrooms, a review of the literature on active learning. discussion of individual practices of business faculty, and our own experiences have helped us identify techniques that can help to overcome large class case teaching challenges.

A summary of these "good" practices is provided below, organized as responses to the three major challenges – 'individual attention and direction', 'student participation', and 'assessment and feedback'. We follow this with some more specific guidance on various elements of large class case teaching.

PRACTICES FOR INDIVIDUAL ATTENTION AND DIRECTION

An instructor's ability to balance *structure* (i.e., context and direction setting) and *consideration* (individual attention and concern) is an important factor for student motivation (Scheck et al., 1994). Context setting is also important for creating an atmosphere that is conducive to active learning. By establishing ground-rules, expectations, and norms, instructors can create a climate where students feel comfortable asking questions and expressing their views (Auster & Wylie, 2006). Klionsky (1999) recommends setting the tone in the first class by letting students know that they are expected to interact and ask questions, and by assigning an activity that requires them to interact with their peers and the professor.

Instructors in large classes are simply not able to provide guidance to each small group interaction, nor can they be expected to interact one-on-one with each student in every class. However, instructors can provide the "illusion" of intimacy, despite the obvious impersonal atmospheres of most large classrooms. To make the classroom feel smaller, Carbone (1999)(1999) recommends reducing the physical distance between the instructor and the students by instructor movement.

Gleason (1987)(1987) suggests that instructors must attempt to learn as many student names as possible and to use them in class, a difficult challenge in a large class. Where names cannot be learned, Gleason suggests making personal comments on student assignments and calling out certain students who performed especially well. Carbone (1999) recommends the use of 'one-minute papers' (which give students, individually or in teams, one minute to write down their key questions or answers to specific problems), and if student names are attached, then the instructor can give personal feedback. Grades can be assigned simply for completing the paper, so the instructor does not have to read each submission. However, by reading a few of the more insightful papers in class, the instructor can give the impression that she has thoroughly reviewed each assignment and is interested in what each student has to say.

PRACTICES FOR STUDENT PARTICIPATION

Proper participation in the case method requires students to thoroughly prepare a case analysis and to engage in discussion during the class. Introducing the concepts of case analysis and discussion to students in junior-level and introductory courses may be difficult because the instructor must keep the attention of the large class and does not have the same opportunity for back and forth questioning to check for the understanding of all students.

For this reason, Brown et al (1987) suggest approaches that the student can easily follow and understand. The instructor begins by teaching the students the basic steps for case analysis. Brown et al. propose a simplified five-step case analysis that includes (1) inventory of key facts, (2) problem statement, (3) analysis of possible causes of the problem, (4) list of possible alternatives, and (5) justification for chosen solution.

A technique known as planned-fading can be used over the course of multiple cases, with the responsibility for analysis gradually shifting from the instructor to the students (Brown et al. 1987). For the first case, the instructor takes responsibility for leading the students through the full analysis, clearly and concisely demonstrating each of the five steps. To encourage participation, the instructor asks students to provide suggestions for each step. For the second case, the instructor leads the first few steps of the analysis, while the students are expected to complete the final steps. For subsequent cases, students complete all of the steps on their own. Brown et al. (1987) believe that this technique ensures that a majority of students in the large class can correctly follow and practice case analysis and provides junior level students with a positive first introduction to case teaching.

Teaching students a proper case analysis process is likely easier than encouraging active participation in large class discussion. This is because the physical characteristics of large classrooms make discussions difficult, and there is not enough time to hear from every student(Gleason, 1987). Instead, active learning practitioners recommend using collaborative learning groups or CLGs (Exeter et al., 2010). Instructors can call on certain groups to provide the class with a summary of their decisions and then use these summaries to encourage class discussion.

Small group activities in large classrooms can take many forms (see Figure 4).

1. *Informal Strategies with Extensions.* Students complete individual pre-work assignments and use them as a basis for small group discussion in class. Groups come to consensus on the issues, and one group member speaks on behalf of their group in class-wide discussion
2. *In-Class Project Work.* More complex and longer-term exercises that students work on together both inside and outside of class s
3. *Jigsaw Strategies.* Each student within the small group is responsible for learning a portion of course material and teaching it to the rest of the group. Cases help illustrate the theories in a practical context
4. *Structured Academic Controversy.* Groups are assigned a perspective on an issue and asked to prepare, present, and defend that point of view
5. *Problem-Based Learning.* Similar activity to case method. Groups are presented with a real-world problem and work collaboratively toward a solution.

Figure 4: Active learning small group activities. (Smith, 1987)

According to McKinney and Graham-Buxton (1993), CLG activities have been shown to increase attendance, reduce the anonymity of large classes, and contribute to student skills development and learning. However, they assert that many students are concerned with 'free riders' that do not contribute the same level of effort as the rest of their group members.

To deal with free riders, they require students to complete individual CLG assignments first and to hand in the individual assignments with the group assignments. Grades are derived by taking the average of the scores on the individual work and the group work. De Vita (2001) suggests that free riders and other group-related issues are best dealt with through proactive discussion with students, recommending that instructors clarify for students why group work is important and provide tips for success in the group environment. Additionally, instructors should advise students on potential group-related issues, and gain alignment from them on how to deal with them.

Practices for Individual Assessment and Feedback.

Individual assessment in large case classes is difficult, yet the practice of grading class participation is an important pillar of the HCM case method. Removal of this practice may lose some of the power of HCM because students may participate less or perform less preparation for the case discussion.

Brown et al. (1987)(1987) recommend using short multiple-choice exams because of the difficulty with assessing the individual participation of students in a large class. However, to be effective the instructor needs to create case-related questions that can reasonably be solved by the students that performed a thorough case analysis and not by students that skipped or glossed over the analysis.

To ensure that students remain motivated to attend class and to participate fully, we recommend that the practice of in-class grading should be maintained at least in some form. Stork (2003) suggests offering 'bonus' marks for class discussion. Since bonus marks are not a significant part of the final grade, the accuracy of assessment is less important, and the instructor is therefore not required to use the same level of rigor. However, the bonus approach tends to disadvantage those students who are less willing/able to speak up in class. One variation of this technique is to reward groups for special contributions in class discussion, allowing them to determine who speaks on their behalf.

Bentley et al. (2009) suggest a "hot seat" active learning approach. The participation of the class can be scored on the whole rather than individually, with the contributions of each individual impacting the class score. Class members will be motivated to prepare themselves for the discussion since they don't want to let down their peers. This approach is only effective if the instructor randomly calls on students or teams for their contribution (as in the "hot seat" method) because it then forces all students to prepare for the possibility of being called.

Specific Techniques to Facilitate Case Delivery in Large Classes

This section expands on the previous discussion, drawing on literature on large class and case teaching and the authors' own experiences as well as feedback obtained from instructors and students on effective class case activities. In essence, we provide a menu of possible choices that could be fitted together in a variety of ways to suit the particular plus situation. Most assume the constraint that the students, possibly several hundred, are sitting in a large lecture theatre with fixed seating and that students will likely be in case teams for at least part of the course. Cases may be individually assigned or to case teams.

These practices are considered in six categories: Choosing the case type; Structuring the experience; Encouraging student preparation; Encouraging student engagement; Reducing the assessment burden; and Team presentations.

Choosing the Case Type

While most of the case types discussed earlier might be used in a large class environment, some are easier than others to implement. The instructor must consider the purpose of each case (e.g., application of a theory or development of a skill) and the students' knowledge level. Mini-cases are particularly attractive as they simplify pre-class preparation (or allow for first reading of the case to take

place in class) and tend to focus on a single issue or problem. Where the instructor decides not to use classroom time for case analysis, the use of simulations in small group activities outside of class can be effective.

Where instructors are using cases throughout the course, they could start with the simplest form of cases (e.g., discussing descriptive cases), then moving on to cases of increasing complexity. The longer Harvard-type case can be used effectively if the case is taught over several sessions, with students being guided through the various stages of analysis and presentation. Finally, although this requires significant organization, students could be exposed to informal case challenges, based on current events or even a real-world situation presented to the class by a guest speaker.

STRUCTURING THE EXPERIENCE

Instructors and students benefit from a clear understanding of the approaches and expectations for the casework.

- **Forming case teams:** Working in teams is an important part of the case method and students should form case teams at the beginning of the course and should sit together at each lecture. This facilitates team discussion in class activities. It also facilitates calling a specific group to respond, rather than individual students.
- **Using a standard and simple case approach:** Introduce students to the case approach in their first class, outlining the key activities and expectations for consistent use throughout the course.
- **Split the class up:** Should scheduling and facilities allow, consider splitting the lecture time into two parts: the first involving the whole class, the second breaking out into sections, perhaps of 30 to 40 students (i.e., 4 to 8 teams), who will engage in team presentations and discussions with one another, with different teams presenting each week and, possibly, other teams providing assessment and feedback. Such sessions might be facilitated by teaching assistants with occasional visits from the instructor.

ENCOURAGING STUDENT CASE PREPARATION

Effective preparation is key to any case analysis, and can be addressed in a variety of ways:

- **Do everything in class:** Rather than requiring pre-class analysis, cases can be read and analysed by the students in class. Mini-cases can be handed out in class, or students can be directed to find the case in their textbook. The instructor gives the students a short period (perhaps 5-10 minutes) to read the case in class, and may also provide some time for the students to discuss the case with their neighbours, perhaps using a version of the "think/pair/share" technique. All students are then able to achieve a sufficient level of preparation to engage in the discussion.
- **Create short pre-work assignments**: Instructors can ask students (in teams or individually) to submit a one-page case analysis, either prior to class through online submission or to hand in at the beginning of class prior to the class discussion. Instructors should provide the students with specific questions to consider during the analysis and make the analysis short enough that it can be graded relatively quickly. The marks assigned to the analysis will encourage the students to complete the preparation work on the assignment. Handing in the pre-work at the beginning of class can also act as an effective attendance record.
- **Assess the pre-work with a multiple-choice test:** When the students arrive for class, they can be given a short multiple-choice test based on the facts provided in the case. The grades for the tests can be considered part of the participation marks for the course, and the tests also provide a measure on the attendance level for each class.

ENCOURAGING STUDENT ENGAGEMENT

Many of the standard techniques for engagement (with the material, with classmates, and with the instructor), are useful here, sometimes with adjustments to address the case element.

- **Create a participatory atmosphere:** Instructors should let students know in the first class that questions and comments are encouraged and expected. Ground rules should be set to create an inclusive atmosphere where students are able to challenge each other respectfully.
- **Make the class feel smaller:** One way to engage students in a large class is to walk around the room and amongst the students, wearing a wireless microphone. This reduces the physical distance between the instructor and the students, moving closer to students when answering their questions and by walking amongst the students during the class. To ensure that students can hear and follow along with one another's comments, microphones can be passed to students/teams who wish to contribute. If teaching assistants are available, they can be present in various parts of the lecture room and can also circulate and encourage interaction.
- **Do a team roll call:** Bring a class list organized by case teams to each lecture. Ask teams to identify themselves, in response to their number by a show-of-hands. Make a point of writing down the number present from the team. This is a quick way to identify teams that may not be working well. Instructors can use this list to call on specific teams to respond to case questions and to make notes on any matters, good or bad, related to that team. By the end of the course, they will have a good picture of the contributions of each team. Teaching assistants may be able to help in this task.
- **Integrate case work with other class activities:** Make sure that classes are made up of a number of activities, ideally no more than 10 to 15 minutes each, moving between lecture, small group work, and feedback.
- **Test the students on the class discussion:** Ask students to prepare one-page assignments in class as part of their group discussion. Students could collect blank forms when they enter the lecture room, with space for several contributions during the class, and would complete the form at various stages during the class, handing it in as group or individual submissions at the end of class.
- **Teach interesting cases**: Students will be more engaged in the case if they have an interest in the particular company or industry that is described by the case. Recent cases tend to be better, and local content also helps students to feel closer to the participants in the case. Instructors should try to avoid cases that will likely have been discussed in many other course situations (for example, Google, Amazon and Facebook).
- **Use small group discussion to start the class discussion:** The instructor can ask representatives from some of the case teams to start the discussion by summarizing their group decisions to the class. This can be repeated at various stages through the class.

REDUCING THE CASE ASSESSMENT BURDEN

- **Evaluate case team submissions.** Peer evaluations within the groups can add an additional measure to the assessment and can help reduce the risk of free riders. Instructors can use a "Group Contract" to establish the student roles (e.g., project leader, scribe, presenter), rules for how the work will be divided between group members, how group conflicts will be managed and team members evaluated.
- **Shorten the length of assignments.** Rather than asking students to prepare a full case analysis, instructors could ask for only the final recommendations with supporting arguments. Students must do a full analysis of the case issues to arrive at a reasonable conclusion, but the instructor need not spend time grading this part of the analysis. Instructors could also assign different parts of the case to different groups. For example, rather than having

each group do a full stakeholder analysis, each group could be assigned a different stakeholder, and be required to analyse the case from this particular stakeholder's point of view.

- **Use multiple-choice tests to assess case learning:** The instructor can develop multiple-choice tests that assess whether the students understand the main issues and most logical solutions for each case, perhaps doing this after case work in class.
- **Give frequent low value marks:** When student teams are asked to bring some completed work to class or hand in a class worksheet at the end of class, marks can be given for this without any detailed review. In essence, this is a form of class participation mark that would build to a significant portion of the final grade or the complete course.
- **Use peer feedback to evaluate the presentations:** To reduce the time required for feedback to the presenting group, the instructor can ask the other case teams to evaluate the presentation based on a set of predetermined criteria. The class can be given participation marks for their written evaluations, and the presenting group will get valuable feedback on their performance.

USING GROUP PRESENTATIONS

While it is challenging to have all the teams make case presentations, it is possible to include presentation elements in the large class environment.

- **Keep the length of presentations short (5-10 minutes):** These types of short presentations teach a useful business skill, since industry requires managers to make relatively quick, clear, and concise arguments in meetings.
- **Have multiple team presentations in a single class:** Two or more teams can present the same case -- a valuable way to show different points of view and to encourage debate with the rest of the class.
- **Use the "jigsaw" approach:** Student teams are given one element of the whole case analysis to carry out (for example an industry analysis or competition assessment). Teams are then asked to present their piece to the class, thus assembling the "jigsaw". Teams can then be asked to carry out the next stage of the case process in class. Preparation can be done pre-class or in-class.
- **Use a random draw to select groups for presentations:** The instructor can ask several teams to analyse the same case and to come to class prepared to present their arguments. At the start of the class, the instructor can select one or more of the teams who will be the only team(s) to present that particular case response. Other teams could be given time after the presentation to discuss their major points of agreement or disagreement with the first group's arguments.
- **Have teams prepare video presentations for viewing outside of class:** This is an attractive approach for students, can ease assessment, and students can review the work of others, if permissions are properly structured,

CONCLUSION

Case-based teaching can be an important element of experiential learning and can be applied successfully in large undergraduate classes. However, instructors need to go beyond the traditional MBA-style case approach and consider more creative and simpler methods that can be adopted in the large class environment. Many of the well-established techniques for active and experiential learning in large classes can be applied or modified for the case situation. Doing so will enhance the student and the instructor experience.

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BIOGRAPHIES

Dr. Kenneth A. Grant is the Chair of the Department of Entrepreneurship & Strategy within the Ted Rogers School of Management at Ryerson University and was formerly the School's first Faculty Teaching Chair. He holds a DBA from Henley Business School in innovation and knowledge management, University of Reading an MBA from the Schulich School, York University and a BA from the Open University, Prior to becoming an academic he was a partner in two major consulting firms and holds the CMC designation. He is an expert in case teaching and case research.

Michael Moorhouse is a PhD candidate at Ivey Business School, Western University. He holds an MBA from the Ted Rogers School of Management at Ryerson University and an Honours BBA from Wilfred Laurier University. His research focuses on consumer financial decision making, service evaluations, and trust, particularly within the novel peer-to-peer sharing economy. Michael has held marketing management positions at Procter & Gamble, Walmart Corp., and Viacom International Media Networks.

Dr Candace T, Grant is a consultant specialising in project management, education and social enterprises Previously she was Associate Dean of Business and Justice Studies at Utica College and an Assistant Professor in the Ted Rogers School of Management at Ryerson University and was a consultant in training development, project management and methodologies. She holds a PhD from De Montfort University in business & technology ethics an EMBA from Royal Roads University and a BA from Queens University. She also holds the PMP designation.