A Model for Improving Knowledge Generation in Design Science Research through Reflective Practice

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Abstract: Epistemology refers to the philosophy of knowledge and aims to address central questions of how we create new knowledge. All research paradigms can be distinguished in terms of epistemological assumptions, that is, assumptions of how knowledge is produced in the respective paradigms. Design science research (DSR) is a research paradigm often used in technical disciplines for the creation of artefacts. DSR has roots in pragmatism, where beliefs and theories are evaluated based on the success of its practical application. New knowledge is produced in DSR when original artefacts are created to solve a problem. The epistemological assumption of DSR can then shortly be defined as 'knowledge through making'. At its core, DSR is goal-orientated and its practical approaches are focused on delivering the product according to straight-forward processes - without being affected by human factors. This process of acquiring new knowledge is efficient but not necessarily effective in terms of capturing all aspects of the experience of the practitioner. Frameworks exist for the creation of artefacts in DSR, but the process of knowledge generation is not explicit. The aim of the paper is to guide explicit knowledge generation in DSR. The research question is "How can we make the process of obtaining knowledge in DSR more explicit?" DSR Frameworks are iterative in nature and focus on the creation and evaluation of artefacts. There is an implicit assumption that reflection takes place in these iterations. Schön, author of The Reflective Practitioner, writes that new knowledge is produced through reflection during and after an event has occurred. He also states that you can only have a complete understanding of a problem through the dual process of reflection-in-action and reflection-on-action. We argue that this also holds true for artefact design and development in DSR. A reflective DSR practitioner can explicitly indicate how knowledge is produced in the design science research cycle. The effective use of reflective practice changes each individual phase of a DSR framework from goal-orientated to problem-orientated. Epistemologically, knowledge is then produced through 'learning by doing', which gives DSR a worldview that supports reflective practice. The paper promotes the incorporation of reflective practice in DSR and provides a demonstration thereof in an example on the preparation of IT students for their chosen career.

Keywords: Design science research, reflective practice, epistemology, knowledge generation

1. An introduction to the epistemological assumptions of design science research

All paradigms have ontological, epistemological and axial assumptions which guide the research process (Vaishnavi & Kuechler, 2004; Oates, 2006; Scotland, 2012). Even though these terms motivate assumptions about reality, knowledge and value for any intellectual effort, they are implicit for most people, including researchers (Vaishnavi, Kuechler & Petter, 2017). Researchers may conduct investigations for the duration of their professional careers without realising the philosophical implications of their research approaches (Kuhn, 1996). One of these terms, epistemology, refers to the theory of knowledge and is concerned with understanding the limitations, the validity and the scope of knowledge (Myers, 2009). An epistemological assumption is concerned with exploring the creation of knowledge and the manner in which individuals learn about their supposed reality i.e. what does knowledge depend on, how can we be sure that what we know is correct. Epistemology explains how knowledge is created, how knowledge is attained, how knowledge is articulated and how knowledge is communicated (Scotland, 2012).

In design science research (DSR), new knowledge is created by designing innovative artefacts as a solution to a relevant human problem (Hevner & Chatterjee, 2010). Vaishnavi and Kuechler (2004) support this definition by stating that DSR alters the world through the creation of innovative artefacts. An artefact can include, but is not limited to, constructs, models, methods, and instantiations (March & Smith, 1995), as well as frameworks, architectures, design principles and design theories (Purao, 2002; March & Smith, 1995; Gregor & Jones, 2007; Gregor & Hevner, 2013).

In DSR, a piece of information is factual and the meaning of the information is made clear through circumscription. An artefact is developed, and the interaction between its components results in its behaviour.

Descriptions of these interactions become information, and the level to which the behaviour is predictable makes the information factual. DSR is dependent on an artefact that functions in a predictable manner. The functionality the artefact delivers comprises of what the meaning of the artefact is – which supports the epistemological stance of 'knowing through making' (Vaishnavi et al, 2017). The theoretical standpoint of DSR may change as it iterates through phases of artefact development, changing from a positivist whilst recording behaviour, to an action researcher when interpreting the observations and planning subsequent interventions.

DSR practitioners have more success when they move between pragmatic and critical realist standpoints, directed by a pragmatic evaluation of development in the DSR cycle (Bunge, 1984). "The design science researcher arrives at an interpretation (understanding) of the phenomenon and the design of the artefact simultaneously" (Purao, 2013).

The aim of design science research then is to contribute new design science knowledge that is "a body of intellectually tough, analytic, partly formalizable, partly empirical teachable doctrine about the design process" (Simon, 1996). The design science researcher can then be seen as a pragmatist (Peirce, 1931).

2. Design science research process

This section provides an overview on the role of knowledge in DSR and how knowledge is generated.

2.1 Role of knowledge

"Knowledge is generated and accumulated through action. Doing something and judging the results is the general model… the process is shown as a cycle in which knowledge is used to construct works, and works are evaluated to build knowledge" (Owen, 1997). A graphical representation of this can be seen in Figure 1. The process to build knowledge through creation is not unstructured, although sometimes thought to lack rigour (Vaishnavi et al, 2017). The channels in the diagram below are the "systems of conventions and rules under which the discipline operates. They embody the measures and values that have been empirically developed as "ways of knowing" as the discipline has matured. They may borrow from or emulate aspects of other disciplines' channels, but, in the end, they are special to the discipline and are products of its evolution" (Owen, 1997). In short, the creation of artefacts produces new knowledge as part of the knowledge building process. Researchers then delve into the knowledge base to inform designs of new artefacts. This then becomes an iterative process where knowledge is added to the knowledge base through creation, and improved artefacts are created due to the existing knowledge base.

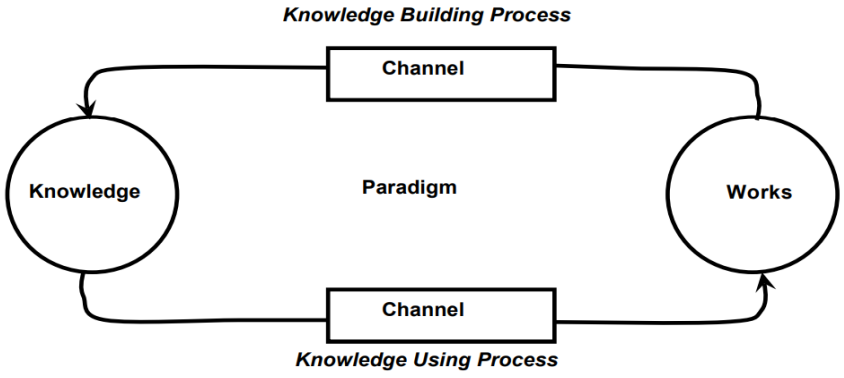

Figure 1: A general model for generating and accumulating knowledge (Owen, 1997)

Different types of contributions can be made to the knowledge base of design science research. Levels of abstraction are explained where contributions to DSR can start with the creation of artefacts, evolve into design principles for artefacts and further be defined into design theories (Purao, 2002).

Design science research is categorised into two groups of knowledge, descriptive and prescriptive knowledge. Descriptive knowledge (omega knowledge) is concerned with the 'what' and prescriptive knowledge (lambda knowledge) is concerned with the 'how' knowledge of created artefacts (Gregor & Hevner, 2013). Examples of descriptive knowledge include phenomena (such as observations, measurements and classifications) and sense-making (principles, theories, patterns etc.) Examples of prescriptive knowledge include artefact creation such as constructs, models, methods, instantiations and design theory.

2.2 Knowledge generation

Within the context of DSR there are different research approaches available. Vaishnavi and Kuechler (2017) established an original framework for design science research in 2004, which was later adopted by Hevner and Chatterjee (2010) (Figure 2). The framework was an adaptation of the model for a computable design process (Takeda, 1990). The phases in the design process and the design science research are similar, but the activities that take place in each phase are significantly different. The biggest difference is that the DSR process requires that the contribution of new knowledge be a key focus of its approach. This framework is still applicable in their latest research. The DSR framework iterates through five phases. The researcher first becomes aware of a problem, suggests a possible solution to the problem, the suggested solution is then developed and evaluated until the research process can naturally conclude. The DSR framework is goal-orientated. Knowledge is generated through circumscription of the process followed to reach the conclusion. This contribution of knowledge is known as Design Science Knowledge. Notably, Peffers, Tuunanen, Rothenberger, and Chatterjee (2008) also created a model for DSR called the DSRM (design science research methodology) model. Peffers et al (2008) appear to present this model as an evolved version of the DSR framework by Vaishnavi and Kuechler (2004) by iterating through six clearly defined phases that follow the same logical flow of events. When comparing the DSR framework and the DSRM model, both approaches suggest that reflection and abstraction take place in their final phases only.

Knowledge is explicitly generated during the last phase of the DSRM model, by suggesting that the results should be communicated through scholarly and professional publications.

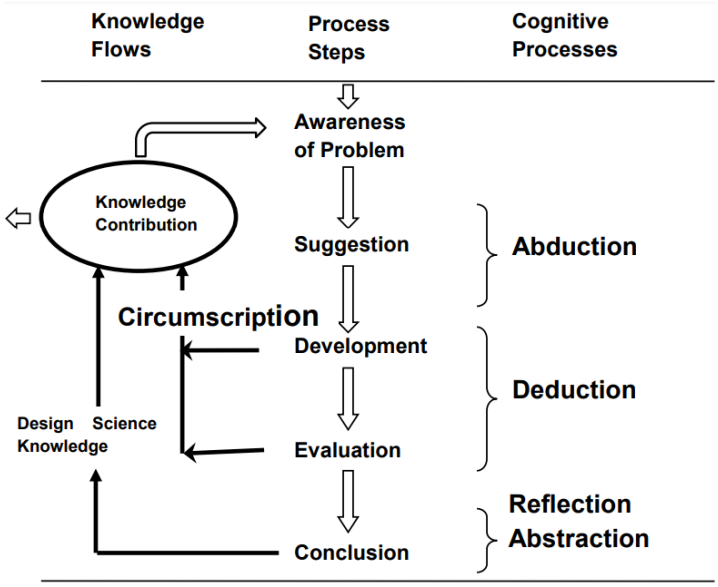

Figure 2: Cognition in the DSR framework (Vaishnavi et al, 2017)

There is an implicit assumption that reflection takes place in both approaches. The presentation of the models however, only explicitly suggests that reflection takes place in the last phases when the project is concluded and communicated. The cycle for cognition in DSR (Figure 2) illustrates the cognitive process followed by indicating the type of knowledge that is produced in each phase of the DSR framework. The DSR framework goes through cycles of abduction, deduction, abstraction and reflection. The creative intellectual process of reflection is used in the conclusion phase to contribute to design science knowledge. In the DSR framework, the overall contribution to advance knowledge needs to be argued at the conclusion of the project (Vaishnavi et al, 2017).

2.3 Limitations in DSR knowledge generation

The aim of the paper is to report on how the process of knowledge generation could be made more explicit if reflective practice is applied throughout the framework, and not only when concluding a project as suggested in Figure 2. The premise of the research implies that there are limitations in the knowledge generation process of the design science research framework.

Knowledge generation in DSR is not explicit. DSR frameworks are iterative in nature and focus on the creation and evaluation of artefacts. Knowledge generation is a result of circumscription of the process followed. The contribution of the knowledge then adds to the knowledge base of design science knowledge. There is an implicit assumption that reflection takes place in these iterations but it is only explicitly stated as part of the conclusion phases of the approaches.

A body of knowledge already exists on the foundation of learning by doing. The epistemological assumption of DSR which is "knowing through making" is limited when compared to the epistemological assumption of reflective practice which is "learning by doing". Even in scientific professions, when practitioners address unique problems, it is an artistic process in which reflective practice takes place (Schön, 1983). Reflective practice is a professional learning and development strategy focused on improved practices, based on assumptions that cause-effect relationships shape behaviour (Osterman, 1998).

Reflective practice is a continuous process. Building on the first limitation listed, the DSR framework only explicitly states that reflection/ abstraction takes place when the cycle has concluded. Reflective practice is intuitively similar to DSR but incorporates known scientific methods for explicitly stating how knowledge is generated. Using reflective practice should be a continuous process throughout the phases of the DSR framework and should not be limited to the conclusion of the artefact.

A model formulated for the use of explicit knowledge generation in design science research would thus require continuous integration of reflective practice approaches embedded in its iterative phases.

3. Explicit knowledge generation in reflective practice

This section provides a shared understanding of reflective practice, and the known scientific methods for knowledge generation within its process.

Reflection is an action of self-deliberation that involves using prior experience and contextual awareness. It is an essential skill that enables one to formulate a philosophy of sharing knowledge and can be used as a standard to observe and measure other professionals' practices (Atkinson & Irving 2013). Reflective practice comprises carefully considering our personal experiences when knowledge is applied to practice (Schön, 1983).

A reflective practitioner should continuously reflect on his or her experiences and draw knowledge from these practices. Reflective practice is the dual process of immediate reflection during a situation (reflection-in-action) and also reflecting on the situation after it has been resolved in order to better resolve similar scenarios in the future (reflection-on-action) (Schön, 1983). Reflective practice has been defined by numerous academics as the process of learning from and through one's experiences with the aim of acquiring a new understanding of practice ((Boud et al, 1985; Boyd & Fales, 1983; Mezirow, 1981, Jarvis, 1992)). The academic evolution of reflective practice has produced a number of explicitly stated processes for knowledge generation.

Reflective practice is rooted in experiential learning, where the process of learning is most effective when it starts with a problematic experience. The four stages of learning according to Kolb (1984) gives experiential learning as a cyclical process that starts with an experience, continues with reflective observation, leads to an abstract conceptualisation of the problem and results in active experimentation to address the problem. The last stage may result in a different experience which prompts the continuation of reflective observation and so on (Figure 3).

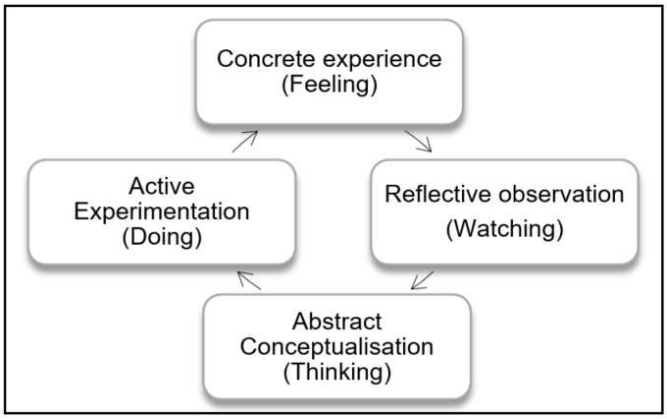

Figure 3: The four stages of learning (Kolb, 1984)

Osterman and Kottkamp (1993) explain that while the experiential learning cycle is a process for using experience as the foundation of learning, that learning cannot take place without reflection, and reflection should be integral to the process of action-taking. Reflective practice, summarised, is the "dialog of thinking and doing through which I become more skilful" (Schön, 1987). Figure 4 provides a summary of what is expected in each phase of the cycle.

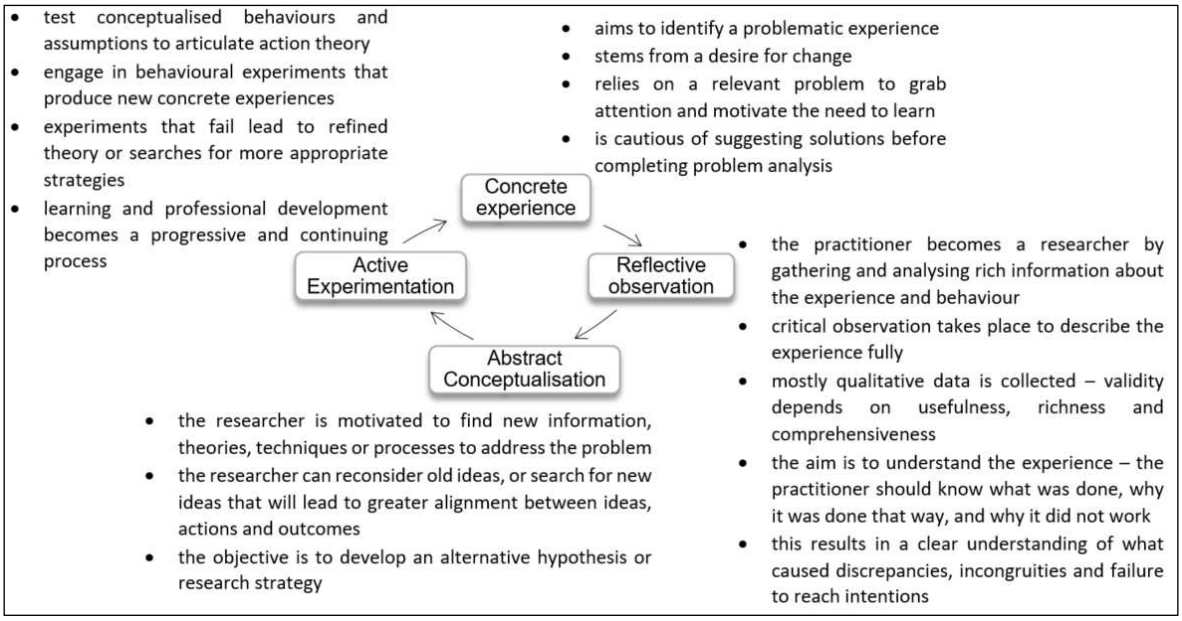

Figure 4: An adaptation of experiential learning explained (Osterman & Kottkamp, 1993)

During the abstract conceptualisation phase, the practitioner is motivated to search for new and unique theories, techniques, processes or ideas to solve the problem (Osterman & Kottkamp, 1993). This stage of the experiential learning cycle deals with abstraction of new concepts and provides a known strategy for knowledge generation. The principle of abstraction and generalization given by Klein and Myers (1999), provides an explicit reasoning to knowledge generation for this reflective practice process. They explain that theoretical abstractions should be carefully conveyed by the researcher as it was experienced and collected, so that the reader can understand how the theoretical insights were reached. Building on the work of Walsham (1993), the validity of drawn inferences and conclusions should not depend on the ability to present the information statistically, but rather on the credibility and impact of the logical reasoning used to describe the results.

When reviewing the DSR framework, it is notable that ideas and recommendations are given in the *Suggestion* phase. The knowledge generated from this phase cannot be assumed to be abstraction, as it relies more often on a plan that is driven by instinct or intuition, and not on explicit methods. Abstraction is an explicit process

for theory building and through the use of reflective practice the knowledge generated could contribute to the prescriptive knowledge of DSR.

To summarise, the following advantages of using reflective practice for improved knowledge generation in design science research are noted:

- Knowledge generation in reflective practice is explicit.
- Knowledge generation in reflective practice fits into known scientific methods.
- Knowledge generation in reflective practice is intuitively similar to that of design science research when following a cyclical model for creating ideas.
- Knowledge generation through reflective practice puts a stronger focus on the creation of prescriptive knowledge in design science research.

From the perspective of reflective practice, a model for explicit knowledge generation in DSR should include:

- Engaging in reflective practice to gain a deeper understanding of the problem experienced.
- Reflection that takes place during each phase of the DSR framework while iterating through the phases.
- Reflection that takes place after each phase of the DSR framework has been completed to better improve future similar scenarios.
- Reflection that takes place in context of observation and abstraction during each phase of the framework with the aim of understanding which type of knowledge was generated.
- Embedding continuous reflection to deliver explicit DSR knowledge during active experimentation of suggestions made toward addressing the problem experienced.

The next section provides an overview of how these advantages, and suggested elements for a DSR model that produces explicit knowledge generation, motivate the use of reflective practice to enrich design science research knowledge generation.

4. Improving knowledge generation in DSR through reflective practice

New knowledge in DSR is produced through the process of creation. The creation of artefacts is a practical approach to knowledge building. The practical nature of DSR has roots in pragmatism, where approaches and theories are evaluated based on their practical application. DSR and pragmatism both lend toward goal-orientated approaches, which is why knowledge generation through reflection typically only takes place when the project has concluded. This process of acquiring new knowledge is efficient but not necessarily effective in terms of capturing all aspects of the experience of the practitioner.

For example, the DSR framework iterates through five phases, the first of which is becoming aware of a problem. An individual wishing to do research on a specific problem area has already employed some form of reflective practice by researching a phenomenon that cannot be addressed by tacit knowledge or knowing-in-action. During the suggestion phase the researcher could offer a solution from his existing knowledge but it would be better practice to include other researchers to jointly reflect on possible solutions for the problem.

During the development phase the research will reflect on the initial design of the artefact and choose to conduct evaluation methods to better understand the context of the artefact. During the evaluation phase the researcher will include users or experts to assess the artefact. This is a deeply reflective practice as the feedback obtained creates a richer picture of the solution than the researcher could have suggested on his own. During the conclusion phase the researcher reflects on the methods he used and determines whether the artefact is an appropriate solution to the original problem. He also determines whether new problems may arise which may need suggested solutions and so on. This also is a deeply reflective practice as the researcher cannot conclude the study if he believes that other researchers will not accept the results. The DSR framework in its entirety can then be seen as following a process of reflective practice, even though researchers only propose reflection in its conclusion phase (Vaishnavi et al, 2017).

A reflective DSR practitioner has the ability to explicitly indicate how knowledge is produced in the design science research cycle. The effective use of reflective practice changes each individual phase of a DSR framework from goal-orientated to problem-orientated. Epistemologically, knowledge is then produced through 'learning by doing', which gives DSR a worldview that supports reflective practice. Reflective practice

focuses on the user's ability to reflect on situations as they occur but also after they have occurred to improve future practices.

Within the context of design science research, reflective practice is a valuable approach for knowledge generation in a project. The reflective practice process of experiential learning can be used in the DSR framework for improved knowledge generation. The DSR framework is iterative in nature and can move forwards or backwards in any of its phases. It can then be suggested that the cycle of experiential learning should take place during phases to promote abstraction and explicit knowledge generation. Furthermore, the process of moving forward in the DSR framework is typically when reflection-in-action takes place e.g. 'What do I currently need to move forward to the next phase?' The process of moving backwards in the DSR framework is when reflection-on-action takes place e.g. 'How can I improve future iterations under similar circumstances?' Figure 5 provides a graphical representation of a DSR framework enriched with reflective practice for improved knowledge generation.

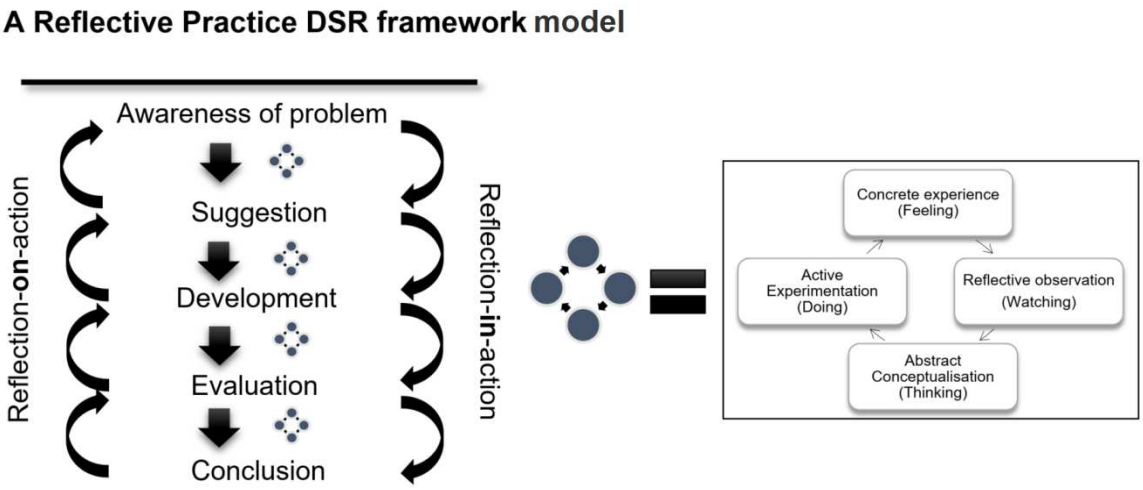

Figure 5: A reflective practice DSR framework model

The use of the DSR framework enriched with reflective practice can be used to explicitly indicate knowledge generated for all types of artefacts. As depicted in Figure 5, the reflective practice cycle is incorporated in each phase of the DSR framework, allowing a reflective process of abstraction to take place for knowledge generation before continuing to the next phase. This method of reflective practice provides a scientific approach for knowledge generation throughout the DSR framework, and not only when concluding a developed artefact as depicted in Figure 2. To further explain the process of embedding reflective practice in the DSR framework, Table 1 provides an in-depth overview of how experiential learning can generate explicit DSR knowledge.

Table 1: An overview of how reflective practice can generate explicit knowledge in the DSR framework

DSR phase	RP cycle	Addressing a problem experienced in related fields to higher education, information technology and engineering	Explicit knowledge generation
Awareness of problem	Concrete experience	A specific problem is experienced in a specific context, for example, information technology, engineering or higher education (amongst others). There is a desire for change to improve the problem experienced. The problem experienced is *currently* relevant, and when researched indicate existing gaps in the literature that require further development. A critical reflection and analysis of the problem in context is required ***before*** attempting to suggest solutions.	Strategies are researched and evaluated for its appropriateness in addressing

DSR phase	RP cycle	Addressing a problem experienced in related fields to higher education, information technology and engineering	Explicit knowledge generation
	Reflective observation	The aim of reflective observation in the DSR *awareness of problem* phase is to fully *understand* the problem experienced by reflecting on what worked, what did not work, why the problem was addressed in a specific manner, to determine inconsistencies, incompatibilities and actions that lead to failure. For this reason, it is necessary to gather and understand as much information that is available on the problem experienced as possible. At this stage, formal research methods are not recommended as the objective is first to fully understand the problem experienced. When formal research methods are employed such as recorded interviews or questionnaires – participants may be reluctant to share sensitive or profound details of the problem experienced. Initially, informal contact will deliver more honest responses that will improve the direction of the research. Reaching an understanding of the problem experienced can be achieved by: • Conducting academic literature reviews through journal articles, conference papers or books. The research can be supplemented by information found from informal platforms such as websites, word of mouth or media outlets. • From initial research, stakeholders or central role players should be identified. Stakeholders can also be determined through strategies such as stakeholder theory (Donaldson & Preston, 1995) or using the boundary questions for critical systems heuristics (Ulrich, 1983). • Initial interaction with stakeholders or role players should be conducted via informal contact methods to increase the honesty of responses. Obtaining honest responses at the start of a research process is crucial, as this will guide the direction and duration of the research. • The information received from stakeholders should provide rich usable data. As informal research methods are adopted that do not provide a back-up of data collected, recommended methods that the researcher can employ to retain the qualitative feedback include autoethnography (Ellis, Adams & Bochner, 2011) or reflective journaling (Dunlap, 2006).	the problem. Explicit knowledge is generated in the form of proposed strategies that could suit a specific problem.
	Abstract conceptualisation	Abstract conceptualisation can commence on the condition that the researcher has a clear understanding of the problem experienced. If there is any uncertainty whether the problem was completely understood the research process should circle back to reflective observation. The objective of this phase is to evaluate all existing information gathered and to find new techniques or processes that can address the problem. Old theories can be reconsidered and applied in a different context. New theories from other disciplines can be considered for implementation in the problem context. The aim is to conceptualise a new research strategy that is suitable for the problem. Typical research strategies could include: • Self-directed learning (Garrison, 1997), project-based learning (Thomas, 2000), or computational thinking strategies (Wing, 2008) – for higher education • TOGAF (The Open Group Architectural Framework) (Buckl, Ernst, Matthes, Ramacher & Schweda, 2009), DoDAF (Department of Defense Architecture Framework)(Zeigler & Mittal, 2005), or foundational architectures (Goertzel & Wang, 2007) – for IT and engineering projects	

DSR phase	RP cycle	Addressing a problem experienced in related fields to higher education, information technology and engineering	Explicit knowledge generation
	Active experimentation	The identified research strategies should be informally discussed with the stakeholders. Suggesting suitable research strategies that are accepted by the stakeholders indicate that the researcher has a clear understanding of the problem. Reactions and behaviours should be observed when the research strategies are suggested. If all stakeholders do not agree with the suggested research strategies, it implies that the problem was not completely understood and this will lead to refined theories and approaches.	
Suggestion	Concrete experience	The *suggestion* phase of the DSR framework can only commence when suggested research strategies resulted in a positive experience for the stakeholders. A negative experience indicates that the problem was not completely understood and that the research process should circle back to the *awareness of problem* DSR phase. Identified research strategies can then be further researched for their possible effectiveness in solving the problem. The suggested research strategies should explicitly bring about change to the problem experienced.	Gaps in literature are identified. New information is added to the knowledge base in order to address the gap.
	Reflective observation	The objective of reflective observation in the *suggestion* phase is to promote a deeper understanding through research of the strategies or approaches that were well received by the stakeholders. Once the researcher has achieved a deeper understanding, the stakeholders are informally updated on new information regarding suitable strategies and approaches that were suggested. Stakeholders should actively be informed of new developments to ensure that the identified research is still addressing the problem experienced and does not stray from the initial issue.	
	Abstract conceptualisation	Abstract conceptualisation in the suggestion DSR phase aims to consolidate information gathered from academic research with informal discussions or conversations held with stakeholders. This action should lead to identifiable gaps in the research that emphasise the possibility of new suitable approaches toward addressing the problem experienced. When identifying appropriate strategies or approaches to address that gap in research, it is important to reflect on how, and which type of, knowledge will be generated when these methods are implemented.	
	Active experimentation	During active experimentation in the *suggestion* DSR phase, new strategies and approaches identified to address the gap should be presented to the stakeholders during informal discussions. The suitability of the new approaches will rely largely on acceptance from the stakeholders. Strategies or approaches that are questionable need further research and development, and the research process may need to circle back to reflective observation for refinement.	
Development	Concrete experience	A concrete positive experience results from the suggested new strategies and approaches. A feasible suggestion is agreed upon by all stakeholders for implementation toward solving the problem experienced. A needs analysis or requirements analysis (Potts, Takahashi & Anton, 1994) may be required before development of the strategy can commence in order to fully comprehend how the suggested strategy will address the problem experienced. The development phase can be guided by methods used for implementation which can be extended to suit the context of a problem experienced in higher education, IT or engineering such as design thinking (Brown & Wyatt, 2010), prototyping (Zalzal, Gava, Kelouwani & Cohen, 2009), or agile methodologies (Maruping, Venkatesh & Agarwal, 2009).	Specific strategies are adopted for the problem experienced based on research and feedback. Formal research methods are employed

DSR phase	RP cycle	Addressing a problem experienced in related fields to higher education, information technology and engineering	Explicit knowledge generation
	Reflective observation	The development of the strategy in context of the problem experienced has commenced. Continuous feedback is required from stakeholders to ensure that the development of the suggested strategy remains relevant to the problem experienced. At this stage of the research it is recommended to start using formal research methods for data gathering and analysis such as interviews and questionnaires (Zhang, Kuchinke, Woud, Velten, & Margraf, 2017), or participatory design (Bratteteig & Wagner, 2016). The qualitative feedback received from stakeholders should provide rich usable data. Scientific guidelines for data analysis can be followed to improve the integrity of the findings. Example approaches for data validation include the principles for conducting and evaluating interpretive field studies in information systems (Klein & Myers, 1999) and the qualitative analysis of content (Zhang & Wildemuth, 2009). Tools for qualitative data analysis may include traditional spreadsheets or advanced software such as Atlas.ti.	that deliver scientific findings which add value to the knowledge base. Limitations to chosen strategies are identified. Suggestions to address the limitations are presented.
	Abstract conceptualisation	Formal qualitative data analysis methods will deliver scientific findings that can inform the development of the strategy at an academic level. Research remains a continuous process, and as the data analysis provides insights into the development of the strategy, new knowledge is generated and added to the knowledge base. Formal research is produced, and can be consolidated with existing strategies to further refine the research process and suggested approaches.	
	Active experimentation	During the development of the strategy, challenges will occur. Stakeholders may react differently than expected, and behaviours should be observed to understand the context of the concerns identified. Challenges result in new experiences that guide the research process and determines which actions should be taken. Iterative development is emphasised for improved outcomes as learning is a continuous process. If the initial strategy fails, the feedback from stakeholders leads to refined theory. If the developed strategy is considered acceptable, the research process continues to evaluation.	
Evaluation	Concrete experience	Depending on the type of experience that resulted from the previous DSR phase, the developed strategy is subject to evaluation. Evaluation will highlight additional shortcomings not identified through data analysis. In context of higher education, IT or engineering, evaluation may include formal research methods such as TAM (Technology Acceptance Model) (Legir, Ingham & Collerette, 2003), UX (user experience) evaluation (Law & Abrahão, 2014), or extending traditional data gathering methods that include stakeholder feedback.	Different evaluation methods are researched that will deliver the best possible feedback for the strategy developed. Evaluation of the strategy contributes knowledge on successful and unsuccessful approaches. Academic literature is added to the knowledge base.
	Reflective observation	In the *evaluation* phase, reflective observation refers to the researcher's ability to identify suitable methods to assess the progress of the developed strategy. As there are numerous methods of evaluation, it is crucial that a suitable option is used in context of the problem experienced in order to produce the best possible feedback. When an optimal evaluation method is applied, the findings will result in a clear understanding of which development processes lead to discrepancies, incongruities or failure to reach the intended outcome.	
	Abstract conceptualisation	When a clear understanding can be achieved of which specific parts of the collective whole were successful and unsuccessful the research process naturally becomes easier to guide. Targeted research can be conducted to find information that addresses the discrepancies. All research previously undertaken can be reconsidered if there is evidence that it can address the problem. The objective is to refine specific elements of the developed strategy that were identified as substandard, in order to improve the general success of the strategy as a whole.	

DSR phase	RP cycle	Addressing a problem experienced in related fields to higher education, information technology and engineering	Explicit knowledge generation
	Active experimentation	The refined strategy can be evaluated by stakeholders using formal data gathering methods to test their behaviours and observe the assumptions made. Explicit knowledge is generated and should be shared with other researchers via publications to encourage peer-review of the suggested strategy. Findings from the data collection methods with stakeholders should be included in the publications to encourage other researchers to also critically reflect on the problem experienced as a whole. Consolidating feedback from stakeholders and peers lead to refined theories and may guide the research process back to reflective observation in any of the DSR phases.	
Conclusion	Concrete experience	After a number of iterations the developed strategy may or may not be final. Feedback received from peers and stakeholders will determine the level of completeness. The problem experienced was current and relevant and the final artefact should be shared for academic reflective practice.	Successes and failures of the overall artefact can be documented to contribute to the related fields, as well as the knowledge base of reflective practice and design science research.
	Reflective observation	Academic findings should also be shared with stakeholders for improved feedback and may highlight significant elements that were overlooked. A final round of formal data collection methods with stakeholders are recommended to ensure that the findings were valid and rigorous.	
	Abstract conceptualisation	The research process followed a DSR framework enriched with reflective practice to encourage explicit knowledge generation. The research gap, development and evaluation processes of the artefact should be highlighted in academic publications. Suitable methods for reporting on DSR studies include developmental research for curriculum design (Mckenny & Van Den Akker, 2005), the DSR framework (Vaishnavi et al., 2017), the DSR process model (Peffers et al., 2008), and the DSR checklist for rigourous artefact development (Hevner & Chatterjee, 2010). The objective is to determine whether the explicit knowledge generated is accepted by other academics and researchers pending peer-review.	
	Active experimentation	Feedback received from peers may lead to refined theory building for the problem experienced. Depending on the experiences of different stakeholders, additional research may be required that could circle back to any of the phases of the DSR framework. Failed strategies also result in research outputs that highlight methods or approaches that were not suitable for addressing the problem experienced. Active experimentation in the *conclusion* phase of the DSR framework includes applying generated theory to similar problems experienced in other disciplines. Engaging in reflective practice for professional development is encouraged and research findings should be shared continuously to highlight successes and failures.	

A demonstration of the application of embedding reflective practice in the DSR framework is explained in the next section.

5. Demonstration

The paper aims to improve knowledge generation in DSR through reflective practice. An example thereof is provided in context of the preparation of IT students for their chosen career.

There is an increasing concern that information technology (IT) graduates lack certain skills expected by industry when they enter the workforce.

Reflecting from a traditional DSR perspective, the researchers became *aware of the problem* and *suggested* a possible solution. An artefact in the form of guidelines for bridging the gap between IT theory at university

level, and IT practice at industry level, could provide insight on improved practices. The process naturally lent itself to the phases of the DSR framework for artefact creation, and limitations in its knowledge generation process for the guidelines were identified. Following the original DSR framework resulted in guidelines that were only truly reflected on towards the end of the project. When the guidelines went through another iteration of application in context, more gaps were noted than guidelines originally produced. This led the researchers to believe that the DSR framework is a well-structured process for developing a prototype version of an artefact, but it lacks a scientific approach to knowledge management. The DSR framework is intended for experimental creation but does not explicitly indicate how to generate knowledge and how to retain and improve the knowledge generated before a project is concluded.

In order to provide some context for the demonstration, the following sections provide an overview of the research questions and objective, participants and data analysis methods used for the problem experienced.

5.1 Research questions and objective

In Table 2, during the first reflective practice cycle of the *awareness of problem* DSR phase, the initial problem experienced is described. From this experience, the following research questions were identified:

- Which industry related skills does an IT graduate need and typically lack?
- Can project-based learning be implemented in an IT degree to introduce industry-related IT skills?
- Can a set of guidelines be derived for bridging the IT theory-practice gap in order to improve the skills of IT graduates required by industry?
- How can reflective practice support the development of these guidelines (a design science research artefact) by generating explicit knowledge?

The primary objective of the research used in this demonstration was then to develop guidelines for bridging the gap between IT theory (standard IT teaching practices at university) and IT practice (the required industry-related skills).

5.2 Participants

The central participants of the study were entry-level and exit-level students in their undergraduate IT degree. Other role players of the study included members from the IT industry and IT educators. The problem experienced started with exit-level IT students during 2017 when a skills gap was noticed between IT theory and IT practice. Industry was subsequently asked to provide feedback on skills IT graduates typically lack (Janse van Rensburg & Goede, 2019). The research described in this demonstration is still ongoing at the time of this publication.

5.3 Data analysis

Qualitative methods were used to gather data from participants. Interpretive content analysis was used to analyse qualitative data in order to identify themes in the data. Findings from literature and identified themes were used to build guidelines for bridging the IT theory-practice gap.

Research conducted provided evidence on the validity of experiential learning through reflective practice with the focus on abstraction for improved knowledge generation. Following the process for reflective practice in the phases of the DSR framework added value to the knowledge generation process and resulted in guidelines for how to reflect-in-action, and reflect-on-action. Using the guidelines provided in Table 1 (and building on the model presented in Figure 5), Table 2 provides an overview of how reflective practice was embedded in the DSR framework in context of the problem experienced, resulting in guidelines for bridging the IT theory-practice gap.

Table 2: A demonstration of reflective practice embedded in DSR to address a problem experienced

DSR phase	RP cycle	Problem in context
Awareness of problem	Concrete experience	A gap between IT theory (higher education) and IT practice (industry) was noted. Recent IT graduates lacked certain skills expected by industry when they entered the workforce. There was a need to better prepare IT students during higher education to bridge the gap between university and industry. This raised the question of what higher education can improve on or do additionally to better prepare IT students for industry. Before solutions toward bridging the identified gap could be proposed, it was necessary to complete a comprehensive problem analysis to ensure that the problem was fully understood.
	Reflective observation	In order to understand the context of the problem experienced through analysis, it was necessary to first do informal research to determine whether similar problems have been experienced by other academics. The objective of the informal research was to understand the context of the problem, who was involved, and which approaches were recommended toward solving the problem. From this research, stakeholders could be identified that were central to the current problem experienced. In context of the problem experienced, the stakeholders identified were IT students, members of the IT industry and IT educators. From an initial perspective, feedback from all stakeholders was required to fully comprehend the problem experienced. Informal discussions were held with IT students, educators and members from the IT industry to understand the problem experienced from their different perspectives. As the aim of an informal conversation is first to understand the problem from these different perspectives, no formal method of data gathering and analysis was adopted. The conversations however did lead to qualitative feedback that needed to be retained in some manner. The researcher opted for autoethnography, where all important ideas and issues raised during informal conversations were noted on an available medium, for example, a note book, a research journal or the 'notes' application on a mobile phone. Interactions took place during informal settings, such as coffee with colleagues (IT educators), conversations with IT industry members while attending hackathons or discussing possibilities for collaboration, and casual feedback sessions with IT students on their experiences and expectations. The action of autoethnography lead to a clearer understanding of the problem experienced. During this process, the researcher was able to explain the experiences relative to the individual perspectives of all stakeholders. A deeper understanding of the problem was achieved through this process of reflective practice during which the researcher identified areas for improvement. In short, IT students wanted more industry exposure, and members of IT industry highlighted specific skills that needed to be better developed in IT graduates. From the perspective of the researcher, it was assessed that IT educators did not provide valuable feedback on areas for improvement. The reasoning behind this decision was that there was a notable gap between industry expectations and curriculum that was being taught. Some information was outdated, and some educators had very little interest in doing market research or collaborating with their colleagues or industry. For this reason, IT educators were not considered a central stakeholder in providing feedback on what needs to change – they were solely considered as the vehicle for providing updated and *current* education that should adjust their approaches accordingly.

DSR phase	RP cycle	Problem in context
	Abstract conceptualisation	Having had a better understanding of the problem, the researcher was motivated to start looking for information, theories or methods that could assist in addressing the problem experienced. Existing strategies being used were reflected on, and notes were made regarding their effectiveness toward supporting the feedback obtained (still via autoethnography). For example, projects are often included in the assessments of IT students, but are most often compiled by the IT educator. Through reflection and research, this approach could be improved on by managing the scope of the project through the use of industry projects (rather than *thumb-sucking* the scope), or topics that provide value and meaning to the student (i.e. community projects). Before identifying any specific methods that could deliver a positive experience, new strategies were also researched, reflecting on their appropriateness for the problem experienced and the feedback obtained. Some of the strategies researched and reviewed in context of IT higher education, for example, included problem-based learning, self-directed learning, blended learning, computational thinking and project-based learning.
	Active experimentation	By identifying possible strategies from literature, the researcher could use these examples for discussion with the relevant stakeholders. Informal discussions with IT students and members from the IT industry were held to suggest the strategies and their expectations thereof. Perceptions and opinions were still noted via autoethnography methods. Not all possible strategies were equally welcomed, but a general approval of project-based learning (PBL) instruction was voiced. The reasoning behind this was that IT industry comprises of project-based environments and research indicates that PBL settings promote the early acquisition of diverse 21st century competencies. Project-based learning also has the ability to address the other approaches – as it can include methods for problem-based learning, self-directed learning, blended learning, and improving computational thinking. PBL was initially introduced in an exit-level IT module using industry scopes to understand whether this approach would address the problem experienced. The researcher wanted to understand why some methods were preferred as other proposed approaches also had relevant advantages for the problem experienced. After additional research was conducted, it was noted that the different approaches could still be used to achieve the same goal. This highlighted that the various teaching and learning approaches were not necessarily the concern but rather how they were implemented.
Suggestion	Concrete experience	A lack of generic rules for the manner in which these approaches are implemented highlighted the need for guidelines that indicate how these teaching and learning strategies, including PBL, could be used to address skills shortages in IT students. Guidelines were required that facilitate the manner in which these approaches should be implemented so that they are industry focused and share the same goal – improving 21st century competencies. Additional research was required before suggestions could be made to understand what the contribution of the guidelines needed to be.
	Reflective observation	Research was conducted to find existing guidelines that can address the problem experienced. The existing literature was critically reviewed to determine whether all suggested strategies, including PBL instruction, were addressed by all existing guidelines. The researcher continued to make notes on the qualitative data through autoethnography, reviewing guidelines that were repeated, understanding why and how they were formulated, and understanding the value and context of their application. Appropriate guidelines found in existing literature were presented to students and industry during informal discussions, and their perceptions and ideas were noted.

DSR phase	RP cycle	Problem in context
	Abstract conceptualisation	During the process of research and informal discussions, gaps in the existing guidelines were identified. Guidelines that were partially applicable were reconsidered and adjusted to better address the problem experienced. New techniques and processes in the form of guidelines needed to be developed to address the missing information not covered in existing literature. The objective was to consolidate existing guidelines with new suggested guidelines in order to provide a single set of guidelines that can be followed to address the skills shortages and improve 21st century competencies of IT students.
	Active experimentation	In order for the guidelines to be considered, they needed to be refined based on their acceptance by the relevant stakeholders and their successful application in an IT curriculum. Existing and suggested additional guidelines were proposed during informal discussions with students and industry to determine whether they saturate the current need for skills development to address 21st century competencies. Guidelines that were questioned were further refined, and an initial set of guidelines were confirmed for implementation in a first instance of IT higher education.
Development	Concrete experience	The problem experienced started with exit-level IT students, and the initial set of guidelines were applied in context of their education. The aim of applying the guidelines was to understand whether a positive experience in terms of their career awareness and skills development could be achieved. The guidelines were applied in context of relevant teaching and learning strategies such as PBL to simulate an IT working environment which motivated their desire to learn. While following the proposed guidelines it was noted that some guidelines did not have the expected outcomes. Additional research was required to understand why these guidelines did not have the intended impact.
	Reflective observation	The researcher became aware that addressing these guidelines at exit-level of a curriculum is too late in some instances to successfully prepare the soon to be IT graduate. As the first research cycle where the guidelines were applied had started, it was necessary to establish formal research methods for data gathering and analysis to address the problem experienced. The researcher asked IT students that formed part of an exit-level IT module in which the guidelines were applied to complete an interpretive questionnaire. The feedback included their perceptions of the strategy taken and provided suggestions to further improve the approaches taken that did not meet their expectations. The feedback was analysed in Atlas.ti using open coding to identify themes in the data. The themes identified indicated advantages of the strategy taken, highlighted approaches that raised career awareness and improved their 21st century competencies, and provided additional suggestions that they would find beneficial. From the additional suggestions, it was realised that certain guidelines would have a greater impact if they were applied earlier in the IT degree and not only at exit-level.

DSR phase	RP cycle	Problem in context
	Abstract conceptualisation	A conceptual framework was formed that following the guidelines at an earlier stage of the curriculum can prepare the future IT graduate in a systematic manner. Guidelines that were suitable to follow earlier in the IT degree needed to be identified. For example, PBL instruction could also be implemented at IT extended level. Additional guidelines were required that would suit the needs of the IT extended students. The objective was to reflect on the initial set of guidelines and suggest improvements that would assist the future IT graduates earlier in their degrees.
	Active experimentation	Guidelines that could be followed in an IT extended degree were identified and implemented at entry-level of the curriculum. The impact of the guidelines was informally observed and noted. Certain guidelines were challenging to implement at entry-level and additional research was required.
Evaluation	Concrete experience	A problem was experienced when following the guidelines at entry-level of the curriculum. It was noted that the guidelines cannot be applied in the exact same manner for entry- and exit-level IT students. For example, it is noted that the student groups require different motivation for completing projects. Exit-level students were more focused on their careers and wanted to participate in industry scope projects. Entry-level students were more focused on their studies, and engaged better in projects that were relevant to their current context. The researcher was cautious of adjusting guidelines without additional research and feedback to better understand the problem experienced.
	Reflective observation	In order to understand the challenges experienced while implementing guidelines at entry-level of the curriculum, IT extended students were asked to reflect on their experiences. The data was gathered using guided reflective sheets that contained questions relating to their experiences, preferred teaching and learning methods and self-reflection on improved 21st century competencies. The feedback was analysed using a combination of basic descriptive statistics for the quantitative data, as well as open coding for the qualitative data. The aim was to understand why only certain approaches were successful following the initial set of guidelines. From the data analysis an understanding was achieved as to which approaches were valuable and which approaches required further research and development.
	Abstract conceptualisation	The approaches contained in guidelines that were found lacking needed further research for possible solutions as to how they could be applied at different year levels. The existing guidelines were evaluated to understand the extent of adjustments required so that they would address the problem experienced. The objective was to find strategies for applying similar guidelines at different year levels with the common goal of improving the 21st century skills of IT students.

DSR phase	RP cycle	Problem in context
	Active experimentation	The appropriate guidelines were applied at entry-level and exit-level, but the scope was adjusted to suit the context of the student. When a new approach was implemented within a guideline, students were informed of how this would improve their 21st century competencies. While the identified guidelines seemed to support the problem experienced, the scope was continuously reevaluated and adjusted as necessary. The learning process was continuous for entry-level and exit-level students, as well as the researcher, who articulated her ideas noted through autoethnography via research publications to share explicit knowledge on best practices using formal methods of data analysis.
Conclusion	Concrete experience	The set of guidelines were not finalised after a limited number of iterations had been concluded. This implied that the guidelines should continuously be evaluated and reflected on for relevance and applicability. Where it was experienced that guidelines were not sufficient, more research was required in order to attempt to saturate the information.
	Reflective observation	In order to understand whether the guidelines were sufficient, feedback was required from members of the IT industry that had recently employed IT students that had been subject to the guidelines. Formal interviews were held with members from the IT industry, and the qualitative data was analysed in Atlas.ti using open coding to identify themes in the data. The objective of the data analysis was to determine whether members of industry could notice improvements in the 21st century competencies of IT students based on the initial feedback received during informal conversations at the start of the research process. Guidelines were discussed, and where additional concerns were voiced, supplementary research was suggested to further understand the problem experienced. At this stage of the research, it was important to publish research papers on the study to assist with providing clarity on the problem experienced and addressing the gaps in literature.
	Abstract conceptualisation	In the conclusion phase of the DSR framework, it is not only important to provide research contributions on the literature gap identified, but also to report on the DSR process followed to conduct the research. The objective of this type of research publication is to provide explicit knowledge generated when following a DSR framework or approach. As the set of guidelines is also considered as an artefact that was created by following a DSR approach, it was necessary to use a formal DSR reporting method such as the DSR checklist of Hevner and Chatterjee (2010).

DSR phase	RP cycle	Problem in context
	Active experimentation	Preparing future IT graduates is an iterative and reflective process. As change occurs, guidelines should be updated to remain current and relevant. Guidelines should continuously be applied at all levels, contextual to the environment of the student, to ensure a well-rounded work-ready student. Reflective practice is central to the learning process of the student and the researcher, and should continuously be implemented as part of the development process. The DSR framework was enriched with reflective practice for explicit knowledge generation, and in this example, resulted in the formulation of guidelines for bridging the IT theory-practice gap. This method of explicit knowledge generation can also be applied in context of other disciplines to structure the research in a professional and academic manner.

In the context of this example, explicit knowledge was generated in the following ways:

- Suitable strategies toward addressing the problem experienced was identified and highlighted in research publications.
- A gap in academic literature was identified for the creation of guidelines toward bridging the IT theory-practice gap.
- Through formal research of data gathering and analysis, specific strategies could be identified that would address the problem experienced and was highlighted in research publications.
- Through the process of development and iteration, shortcomings were identified in the strategies that could be refined for further research.
- Targeted evaluation methods that suited the development process of the problem experienced were highlighted in research publications.
- Results and findings from evaluation methods employed contributed to the academic knowledge base.
- Contributions to the knowledge base of design science research and reflective practice resulted in explicit discussions that address the problem experienced, while highlighting the elements of the research processes that were successful and unsuccessful.

6. Summary

The DSR framework is an excellent tool for prototyping artefact creation, but it is limited in its explicit methods for knowledge generation. When following the DSR framework, the researcher will iterate through the phases and produce an artefact that concluded as a *prototype* that addresses the *current* requirements of the problem. DSR more often results in outstanding artefacts, which can be implement and used for the specified problem, but that is not easily adaptable to a changing environment. In DSR, when the problem changes, a new artefact needs to be created and the DSR framework has to restart in the first phase. The goal-orientated nature of DSR is effective for immediate results, but not efficient in anticipating problems in a holistic manner.

Abstraction for tried and tested approaches is only reflected on in the concluding phase, which provides limited knowledge generation for the knowledge base of DSR. It is notable that following a DSR framework enriched with reflective practice results in a more rounded artefact, due to the reflective cycle that takes place between phases. The cyclical process of reflection allows the practitioner to address the current problem as well as anticipate and prepare for future variations of the problem. This allows the practitioner to holistically apply the DSR framework, and conclude the artefact without having to restart at phase one when problems are identified. This process of reflection results in improved knowledge generation for design science research.

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Activity Theory used as an Analytical Lens for Business Research

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Abstract: Activity Theory is used in this paper to demonstrate the process of critical analysis of qualitative data from two case studies. The paper explains the elements of an activity system (the subject, object, outcome, mediating tools, rules, community and division of labour). Thereafter, practical examples from the work of two recent PhD students are used to show the importance of identifying and analysing activities that are found either in the introduction or the current use of information systems in business organisations. These examples highlight the applicability of Activity Theory in analysing data from projects of interest to Business Management whose topics and contexts are very different. The first focusses on the introduction of an Accounting Information System to microbusinesses in a low-income community in South Africa and the second focusses on Information Security Management in Mobile Network Organisations in Uganda. The examples illustrate the value of Activity Theory as a lens and as a way of stimulating critical analysis. Activity Theory is known for its ability to identify reasons for failure or disappointing performance in existing situations by highlighting contradictions either between different activities, between an earlier version of an activity and a later version as the activity evolves, or within an activity (between the elements of that activity). However, as shown in the first example, it can also be seen as a useful tool when proposing a new project as a predictor of success. Despite the fact that data is typically qualitative, the analytical process related to Activity Theory can be structured, which assists novice researchers or those unaccustomed to interpretivist analysis to uncover insights that are not immediately obvious. Activity Theory is said to act as a lens in data analysis and is particularly useful in organisational sciences for the theorization of technology-mediated organizational change.

Keywords: Activity Theory, contradictions, analysis of qualitative data, technology-mediated organisational change, Accounting Information Systems, Information Security Management, participative action research, case study

1. Introduction

This paper explains how Activity Theory (AT) can be used as a research methodology in organisational and management sciences research particularly related to organisational change. It is of particular value in research that focusses on the introduction or use of a tool or artefact to mediate a business activity or a series of activities, and to trigger organisational change related to the introduction of information and communication technology (ICT)(i.e. technology-mediated organisational change). As will be explained in the literature review, the tool need not be a physical instrument or related to ICT. However, in this paper both examples involve the introduction and use of ICT in different ways. The two examples (case studies) come from recently completed research and are used to highlight differences in the way that AT can be used and how AT adds value. It is important to note, therefore, that the paper does not focus on the findings of these studies but rather uses them to illustrate the use of AT as a supporting research methodology and, in particular, as an analytical lens. The first case study involved the facilitated adoption of an Accounting Information System by three microbusinesses operating in a so-called 'township' (low-income suburb) within a large city in South Africa. The second case study undertook a critical analysis of the management of information security of existing mobile money systems in mobile network organisations in Uganda. The literature review explains the theory and its value to Business Management research which involves the adoption and use of ICT. References have been limited to the classic papers of major contributors to AT and to recent papers.

The primary objective for this paper is to explain Activity Theory (AT) can be used as a research methodology in organisational and management sciences research.

Secondary objectives are to demonstrate how AT can:

- facilitate critical analysis of qualitative data
- provide insights into organisational change resulting from the introduction of a tool or artefact to mediate a business activity or a series of activities
- be of value in projects whose topics and contexts are very different

- be used in conjunction with participative action research but also in a descriptive case study

2. Literature review

2.1 Overview

AT was initially developed in the Soviet Union in the 1920's and 1930's by Russian psychologists Vygotsky, Rubinshtein and Leont'ev as an approach to psychology that unites human consciousness and human activity (Hasan and Kazlauskas, 2014). Vygotsky should be recognised as the founder of AT, not just because he identified artefact- (or tool-) mediated action as the main unit of activity, but because his concept of artefact-mediation allowed him to develop a theory in which the object-concept is an important and deliberate outcome of each activity (Barab, Evans and Baek, 2004). In other words, the basic element of AT, the activity, is purposeful and is carried out as meaningful and deliberate actions by the subject in order to achieve the object and outcome using physical or psychological tools, including language, in a social environment (Hasan and Kazlauskas, 2014). Hashim and Jones (2007, p. 2) define AT as "…a theoretical framework for analysis and understanding of human interaction through their use of tools and artefacts." An activity both facilitates, and is facilitated by the tool used. AT is also described as being a philosophical and cross-disciplinary framework that is useful for studying both the individual and social levels, which are interlinked in different forms of human practices as developmental processes (Kuutti, 1996). Nardi (1996) describes AT as "a powerful and clarifying descriptive tool", providing a set of basic theoretical concepts to help understand the relationship between the human mind (consciousness) and activity (what people do). Activity is holistic, high level, collaborative and constructive, for example, undertaking a work project (Spinuzzi, 2014; Stuart, 2014; White and Cicmil, 2016).

2.2 The activity system

AT has an associated framework that assists researchers in analysing, studying, designing, describing and understanding how and why activities happened. This theory-based conceptual framework has a basic set of principles (see Section 2.6) and allows the researcher to inquire about and to explain phenomena and human activities that are of interest. It provides a cultural, historical and theoretical focus on human activity and, hence, Cultural Historical Activity Theory (CHAT) is an alternative name for Activity Theory (Hasan and Kazlauskas, 2014).

Barab, Evans and Baek (2004) explain that Vygotsky (1978) introduced the initial concept of mediated action as having three elements, namely, the subject, tool and object. The subject is engaged in an activity and this is mediated by tools to achieve a certain object. The focus of the activity is the object and the purpose of the subject is to engage in an activity (Hasan and Kazlauskas, 2014). In addition, Vygotsky saw human activity as quite distinct from that of non-human entities in that it is mediated by tools, the most significant of which is language.

"Activities are object-oriented, meaning that the most important element of the activity is the object." (Karanasios and Allen, 2018, p. 136). These same authors describe the object as the problem situation, the 'thing' that people are working on to transform or as the focus of the activity. Since the objects are so important, an activity is meaningless on its own. The object is turned into an outcome by the work process of the activity (White and Cicmil, 2016). In AT, the subject (human doer) and the object (things being transformed) form the core of the activity and the eventual outcome of the activity can be either intended or unintended (Hasan and Kazlauskas, 2014).

People are innovative and hence constantly change the objects and create new objects. A social understanding of the changing character of these objects, which is facilitated by AT, enables it to be particularly relevant and strengthens its ability to contribute to the community in which it is located. The new objects are normally a consequence of unplanned and multiple activities and the transformed object will in turn often bring about changes in the behaviour of the subject. However, it is not only the subject, but the environment and even the tool that is modified through mediated activity (Engeström, 1999).

Despite the fact that activities are object-oriented, the role of tools in an activity system is central to AT. Tools are artefacts or systems (such as language) that are created as a result of a social process and previous activities. In research, particularly that involving the introduction or use of ICT or information systems, AT recognises that cultural characteristics are 'designed into' tools and hence the social and the technical aspects

are combined. However, unfortunately in many studies an emphasis is placed on technology for its ability to transform an activity (Karanasios, 2014a).

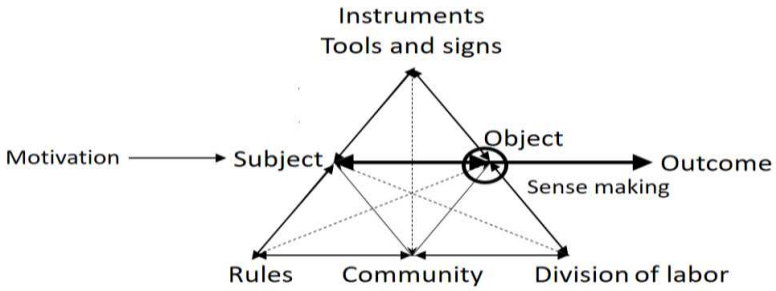

Figure 1: The main elements of the activity system (Adapted from Engeström (2010))

Engeström proposed an extended Activity Systems model (See Figure 1) that emphasizes the collective nature of a human activity as he recognised that human work is done in a social and cultural context (Engeström, 2010). Hence, the extended model adds a community component, rules (an accumulation of knowledge about how to do something) and the division of labour. Karanasios and Allen (2018) propose that motivation be added to the model as a concept feeding into the subject element (See Figure 1). There are relationships between each of the elements. Hence, an activity system is made up of tightly related elements; it is holistic rather than a collection of independent parts.

Rules and norms govern the use of tools. However, tools (including technology) may influence and transform the rules and norms resulting in dynamic activity systems. Since, over time the object of the system may change and manifest itself in different ways, new ways of working are introduced which may create new divisions of labour with new efficiencies and new types of labour. A division of labour naturally implies differences of status (Engeström, 1987 cited by Kizito, 2015). This may be caused by physiological factors, cultural conflicts or increases in population, by-laws, or any of many other factors. The division of labour means that activities do not occur in isolation and thus need to be understood within their environmental context.

2.3 Hierarchical structure of activity, actions and operations

A separate addition to AT is a three-level model for structuring an activity (Barab, Evans and Baek, 2004). Since some studies require a more detailed investigation than at the level of an activity, a hierarchical structure was proposed in which the top level, the activity, is motive driven and is composed of goal-directed actions and the actions themselves are composed of operations (Barab, Evans and Baek, 2004 citing Leont'ev, 1978). The motive of the individual activity is to transform the object in order to achieve an anticipated outcome. At the action level, the aim is contained in the object itself and is to achieve a certain goal. It is difficult to clearly define an object, meaning that it might be interpreted differently by different people or might change.

Lektorsky (2009) argues that the values and norms of an activity should be taken into account in order to understand collective activity in terms of its actions, operations, motives, goals and tasks. However, the distinction between an action and an activity can become blurred. An operation is generally regarded as a process whereby incoming resources are transformed into out-going products / services by a series of activities or sub-processes.

2.4 The work activity

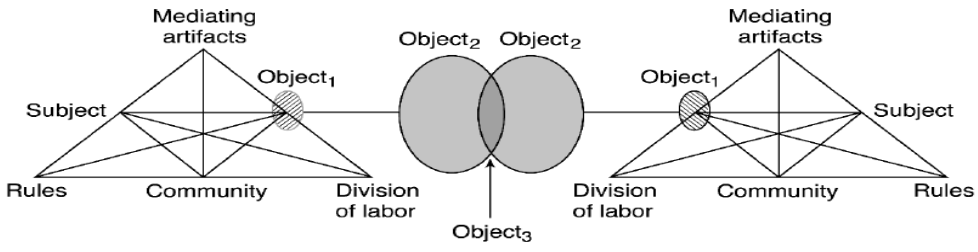

Figure 2: Third Generation of Activity (Engeström, 2001)

The third generation of the Activity Theory entails joint activity or practice being the unit of analysis rather than an individual activity as there may be several systems exhibiting patterns of contradiction and tension at the same time (Engeström, 1999). Figure 2 is a minimal representation of two concurrent activity systems (as provided by Engeström (2001)), however the objects (labelled Object 1 and Object 2 for both activity systems in Figure 2) need not be identical for the two activities, although in some cases they are. The model also takes into account that several subjects can have common interests (Object 3 in Figure 2). Adopting this approach, an activity is best understood when it is seen in the context of other individuals' (subjects') actions, as these may impact on one another and may coincide to some extent. Each activity has its owner or subject. In addition, the outcome of one activity is often intended for some other activity; the outcome in one activity may become an object, or actor in a subsequent activity (Korpela, Mursu and Soriyan, 2002). Hence, activities are independent but un-isolated units that are influenced by the environment and other activities and this may cause contradictions (Adams, Edmond and Hofstede, 2003; Engeström, 2010) (Engeström, 2010).

For a collective activity there is a collective subject, and for an individual activity there is an individual subject. Although a collective activity cannot happen without more than one individual participating as part of the subject, the collective activity does not completely determine individual actions - each individual is a free agent with his or her own goals and ideas. Hence, individuals can resist new or existing norms and rules in order to form other ones, which makes it difficult to predict their behaviour (Lektorsky, 2009). Korpela et al. (2002) identify a "work activity" as a form of a collective activity, which comprises of people working in an organised way. The motives for a collective work activity may vary for each of the participants but all intend to transform the shared object so as to produce the collective outcome (Karanasios and Allen, 2018). The actors do not need to be working at the same time or place and play different roles (at the lower level of the hierarchy of activity-action-operation and, hence, these are "individual actions") in transforming the object to the outcome (Korpela, Mursu and Soriyan, 2002).

For the individual action to succeed within a work activity, coordination and communication between the separate actions is required. Since the individual subject is within a community, there have to be shared rules governing the multiple relationships between the elements of the whole activity system. This view makes AT particularly relevant to organisational sciences and business management.

2.5 Contradictions

An activity system has several levels of contradictions that must be identified and analysed in order to better understand how, when, and why an activity system develops. The primary contradiction is the basic source of instability and development and is found *within* any of the nodes or elements of an activity system (Barab, Evans and Baek, 2004; Foot, 2014). Secondary contradictions refer to a conflict between two *different* nodes of the activity system (Barab, Evans and Baek, 2004; Foot, 2014). Other contradictions may occur between the object and outcome of a single activity system and between separate activity systems (Mursu, Soriyan and Korpela, 2003; Mursu *et al.*, 2007).

Contradictions shape and change the way things are done (Karanasios, 2014a). They generate disturbances and conflicts, but also generate innovation. Activity systems are constantly working through contradictions and, hence, are virtual disturbance- and innovation-producing machines. In activity systems, equilibrium is an exception and tensions, disturbances, and local innovations are the engine of change.

2.6 Summary of AT

Engestrom (2001) formulated five principles of Activity Theory. Firstly, the main unit of analysis in Activity Theory is the activity system. Secondly, 'multi-voicedness' is a cause of contradictions. Thirdly, the principle of historicity argues that the history of an activity system helps researchers to understand the problems as well as the potentials because "parts of older phases of activities stay often embedded in them as they develop".

Fourthly, contradictions can result in tensions but also transformation in activity systems. This links with the second principle, as the multi-voicedness is often the source of the contradictions. In a context of a mobile health system, for example, Allen, Brown, Karanasios and Norman (2013, p. 844) found "a major contradiction between the subject of the system (the paramedics/ambulance crew) and the division of labor relating to the delivery of the drug". Finally, expansive learning relates to the possibility of major transformations in activity systems through re-conceptualisation of the object and the motive of activity embracing a radically wider horizon of possibilities than in the previous mode of the activity.

Although research using AT is best understood as a developing body of knowledge, there are some basic characteristics of activity systems and research using AT that are recognised. Hardman (2005) draws primarily from Cole and Engestrom (1993) and Russell (2002) in order to elaborate these ideas.

1. Human activity is collective and human behaviour originates within the social realm.
2. Tools, which carry socio-historical meanings, mediate activities.
3. AT studies development and change, which is understood to include historical change, organisational change, individual development and moment-to-moment change.
4. AT assumes that people are active and knowing agents but that they act in sites that are not necessarily of their choosing with tools that constrain and afford their actions.
5. Methodologically, AT emphasises the emergent nature of activity and acknowledges a central role for interpretation, i.e. interpretivism, in its explanatory framework. Consequently, activity theorists make use of contextualist methodologies.
6. Activity systems are constantly subject to change and AT sees these changes as driven by contradictions. Contradictions can arise within and between systems.

2.7 AT in Research

AT has been used extensively in education research as well as in social science, anthropology and work science. Today it is recognised as a multidisciplinary research approach, which is increasingly oriented toward the study of technological and human aspects within organisations and social systems (Nardi, 1996; Barab, Evans and Baek, 2004; White and Cicmil, 2016). Recent examples of use reported in organisational and business sciences and published in various 'business journals' include its use for business intelligence (Kekwaletswe and Lesole, 2016), knowledge acquisition through process mapping (White and Cicmil, 2016) and the creation and evolution of new business ventures (Jones and Holt, 2008). The value of integrating AT into organisation studies, particularly those relating to organisational change and technology-mediated change has been noted (Harrington and Kearney, 2011; Kang and Hovav, 2018).

Karanasios (2018) refers to Blackler (2009) when saying, "In the context of organizational research rather than the organizational being taken as the unit of analysis and organizational objectives prioritized, activity theory takes the activity system as the core unit and prioritizes 'objects' of organizational activities. This invites a situated analysis of the activity 'which is often overlooked in more abstract studies of organizations' (Blackler, 2009, p. 27)."

However, in many cases the tools used to mediate in the activity system are information systems or ICT tools and hence Information Systems (IS) journals are often selected as places to publish these papers, even when the authors are from business schools. Examples of multidisciplinary AT use related to IS and published in IS journals include those described by Weeger and Haase (2016), Clemmensen Kaptelinin and Nardi (2016), Forsgren and Byström (2018), Kelly (2018) Mursu and various co-authors (2002; 2004; 2007), Simeonova (2018) and Karanasios and Allen with co-authors (Allen *et al.*, 2013; Karanasios and Allen, 2013; Karanasios, 2014b). Despite this, relatively few IS researchers have used AT (Malaurent and Avison, 2016).

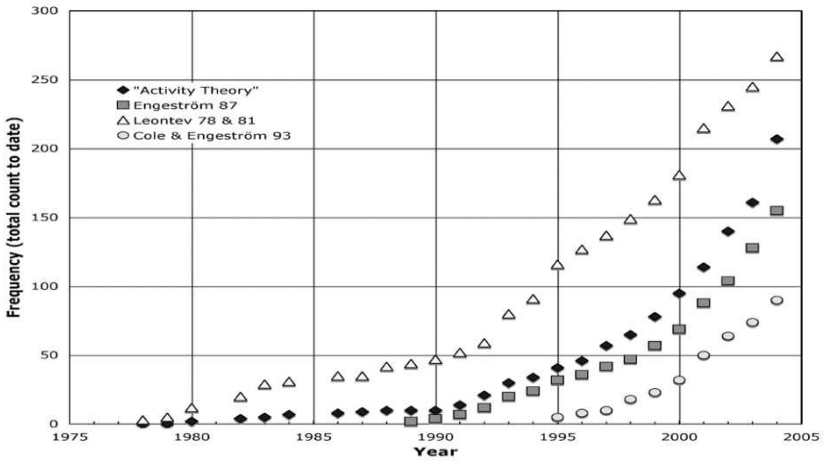

Figure 3: Indication of the Growth of Activity Theory (Roth and Lee, 2007)

Figure 3 depicts four indicators of the increasing interest shown in Activity Theory over three decades (up to 2005), based on citation frequencies in the Institute for Scientific Information's citation database.

2.8 Benefits of using AT as a theoretical lens

Although there are several frameworks that use human activity systems as units of analysis (Zott and Amit, 2017; see for example Sadok and Welch, 2019), they may fail to provide a holistic analysis of real-life situations because they focus on isolated individual actions (Kuutti, 1996). AT can help to uncover contradictions and congruencies and this helps to uncover the relationships and links that are existent in a deep social system (Karanasios and Allen, 2018, p. 44). Identifying contradictions can assist researchers in explaining why a technology has not achieved its desired and expected outcomes. Contradictions help activity systems to evolve from time to time.

2.9 Shortcomings in existing research using AT

In a comprehensive assessment of AT and argument for its extension and use, Karanasios (2018) points out aspects of AT in IS research that generally receive insufficient attention. This subsection relies heavily on that set of recommendations.

2.9.1 Can AT be used for research for technologies that are no longer simply tools?

The shift in IS research continues to inspire new perspectives on the role of technology, as technology is thought to have surpassed its initial role as merely a tool as envisaged in the traditional AT (Karanasios, 2018; Karanasios and Allen, 2018). Hence the evolution of social-media to becoming a tool-community hybrid and indeed that technologies in general are "increasingly taking hold of all the aspects of the activity system" (Karanasios and Allen, 2018, p. 138). This links in some respects with the view that IS and ICT related AT research may still be over-emphasizing the role of technology (Simeonova, 2018). A few examples of papers in which AT is used to study social media do exist (see Bagarukayo *et al.*, 2016; Forsgren and Byström, 2018).

2.9.2 A multi-layered lens for understanding activities

As noted in Section 2.3, using the AT framework, activities can be analysed at three levels, namely, activity, action and operation. The division helps the researcher in shifting the focus from the greater activity to finer grained actions and operations or sub-tasks. Karanasios and Allen (2018) argue that AT has the ability to "address the challenge of studying the interaction between technology and actors" (p. 439), however, these same authors note that few IS studies go to this more detailed level.

2.9.3 The complexity and hidden nature of cultural-historical contradictions

Karanasios (2018) says that although the concept of contradictions is fundamental in AT it is often understated. Simeonova (2018) supports this view saying that AT is often used in a simplistic way. In addition, it is often difficult to uncover such contradictions as established norm and existing power structures often resist change. Using various sources of data (multi-voicedness), various data collection methods (although qualitative data remains predominant the common sources of data used in case studies are needed), and longitudinal studies are appropriate for AT research (Malaurent & Avison, 2016; Marcandella & Guèye, 2018; Weeger & Haase, 2016). As will be seen in Section 3, this was a major focus for both of the studies used as examples in the current paper. Karanasios (2018, p. 141) citing Engestrom and Sannino (2011) raises another major concern when claiming that "few scholars articulate their analytical approach to identifying contradictions". Table 1 gives some practical advice in this regard and the examples that follow in Section 3 are also intended to assist in making the analytical approach clear (Karanasios, 2018).

2.9.4 Research methodology must include taking action

A critical research philosophy is closely aligned with the intentions of AT as a theoretical framework and hence needs to be followed before and during data collection (Karanasios, 2018). Critical realism has also been used in conjunction with AT (Allen *et al.*, 2013; Simeonova, 2018).

It is, therefore, not sufficient simply to identify contradictions; the research identify and carry out actions to address these contradictions (Karanasios, 2018). AT is a practice-based theory (Karanasios and Allen, 2018; Simeonova, 2018) and research often is undertaken in the natural (work) setting as a longitudinal case study (for example, Malaurent and Avison, 2016; Weeger and Haase, 2016; Marcandella and Guèye, 2018). Hence, research using AT may embrace a participative action research (PAR) model or canonical action research

(Malaurent and Avison, 2016) with the iterative design that is required by PAR or may use a Design Science research methodology (see Kang and Hovav, 2018).

3. Examples of data analysis using AT as a lens

3.1 Common factors

Both case studies come from recent post-graduate work and both adopted the interpretivist paradigm but they were very different. The studies were exploratory but offered explanations and critique regarding the data collected. The section on Case 1 goes into some detail regarding the techniques used to analyse the data. Then Case 2 is described; the analysis was also done using thematic analysis using AT principles as was the case in Case 1). Finally a table is used assess how well these two case studies remain true to the requirements for AT research as described in the summary in the literature review.

3.2 Case 1:

Title: "A Facilitated Approach to Accounting Information Systems Adoption: A Case of South African Township Microenterprises"
Overview:
Research question: "How should AIS be introduced into township microenterprises to improve its chances of adoption**?"**
Research approach: The case study paid special attention to the social context in which it took place. The Subject, Community and Division of Labour shown in Figure 4 indicate the participants for the first activity only.
Data collection: The researcher described historical context, the entrepreneurs, microenterprises and the community that participated in the study. In order to add to the rich picture of the social context, the researcher included an As-Is synopsis and a high-level SWOT analysis of each microenterprise before the participative action research started. The entrepreneurs were also asked questions about themselves in individual interviews and profiles about them were presented in the study.
Data Analysis using AT as a lens: The researcher identified two key human activities in the facilitated adoption of AIS by entrepreneurs of microenterprises in the township. These were the learning and implementation of AIS within the microenterprises and included iterative cycles within and between the activities. The second of these activities is shown in Figure 4.

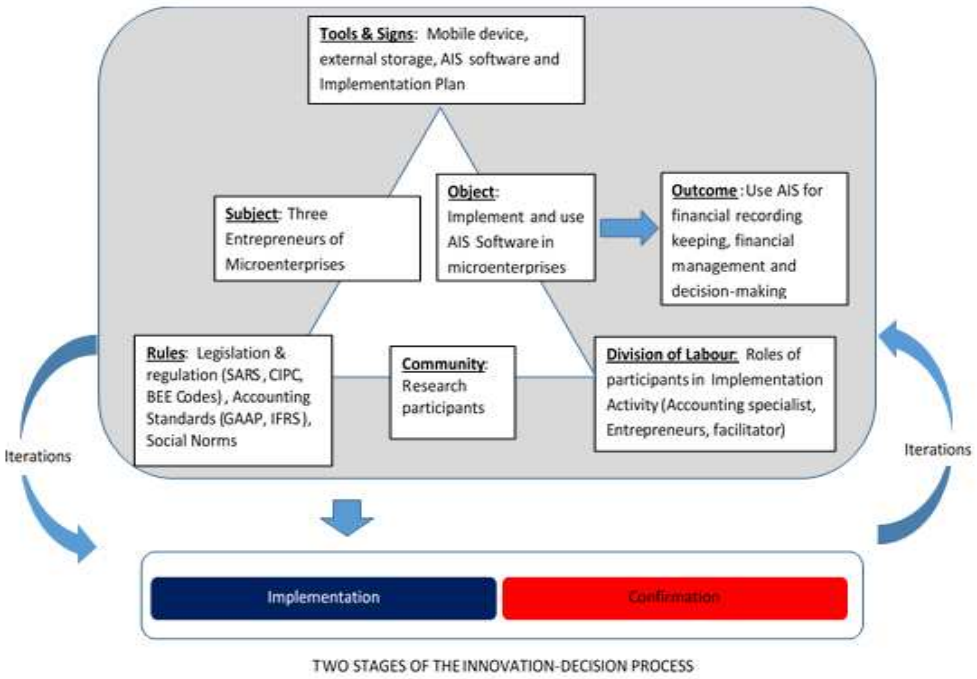

Figure 4: Analysis of the Implementation Activity System

The research was designed around these two human activities. The researcher recorded interviews using a mobile phone as well as written notes. At the end of each iteration of the activity, the researcher identified meaningful units of data and coded it according to the elements of the activity system as shown. The activities were analysed separately and then together. In the analysis, contradictions were identified and captured in comparison matrices (See Table 2). Each activity system had a comparison matrix and therefore three matrices were completed (for the Learning Activity System, for the Implementation Activity System and the third for the comparison between the two activity systems). The researcher and participants attempted to resolve the contradictions identified in order to facilitate the adoption of AIS. The same matrix was subsequently used for identifying strengths as in addition to the contradictions, particularly strong relationships between the elements of the implementation activity system were identified.

Table 2: Comparison (Analysis) Matrix of the AIS Implementation Activity

	Subject	**Tools and Signs**	**Object**	**Division of labour**	**Community**	**Rules**
Who or what	3 entrepreneurs of microenterprises	Mobile device, external storage, AIS software and implementation plan	Implementing and using AIS	Roles in the implementation activity	Research participants	Legislation, regulations, practices and norms
Subject		Strength	Contradiction		Strength	Contradiction Strength
Tools & Signs						
Object				Contradiction		Contradiction
Division of Labour					Contradiction No strength	
Community						No strength
Rules						

Contradictions were identified in the Implementation Activity for each of the pairs of action system elements. However, in this paper only some examples that illustrate particular points have been selected and are shown as blue blocks in Table 2. These are described together with the steps taken to address them.

- **Subject-Object Contradiction:** Entrepreneurs were not always able to capture transactions in the AIS as they occurred and they would forget to capture transactions later. They also did not stick to the backup schedule. Old habits were difficult to overcome.
- **Resolution:** The researcher and accounting specialist re-enforced the message that entrepreneurs needed to have the discipline and commitment to capture transactions and back up data according to the schedule.
- **Subject-Rule Contradiction:** a) The entrepreneurs were not completely comfortable with revealing their financial data. They were not completely transparent to the accounting specialist and facilitator.
- **Resolution:** The entrepreneur has to be encouraged to be more transparent since there was an ethical (non-disclosure) undertaking to keep their information private in the research.
- **Contradiction:** b) The entrepreneurs continued informal practices like borrowing money from Mashonisas (informal money-lenders).
- **No resolution: T**he entrepreneurs could not get credit from banks.
- **Object-Division of Labour Contradiction:** The entrepreneurs preferred personal support to online support of AIS software.
- **No resolution:** This could not be resolved as the technical support for the free, open-source software was only available online. Over time, partly through necessity and partly through increased trust, they were expected to use the Internet.

- **Object-Rule Contradiction:** The implementation of AIS did not immediately change the participants' social norms and practices. Some informal practices persisted
- **Resolution:** Implementation of the AIS will only have an effect on the entrepreneurs' social norms after some time.
- **Division of Labour-Community Contradiction:** The entrepreneurs wanted to focus on business and maybe accounting, compliance and support but they could not afford it.
- **Resolution:** The objective of the study was to empower and encourage the entrepreneurs to do the basic bookkeeping themselves until they could afford professional services.

Strengths could *not* be identified for every one of the pairs of action system elements in the Implementation Activity. However, examples that illustrate particular points have been selected and are shown as yellow blocks in Table 2. These are described together with the positive effect of these strengths on the project.

- **Subject-Tool Strength Identified***:* The entrepreneurs were already familiar with and had fully adopted mobile devices and applications before the study. This made the AIS implementation faster and easier.
- **Subject-Community Strength Identified:** The accounting specialist came from same community as the entrepreneurs. Hence, the entrepreneurs were able to identify with her. The entrepreneurs are more likely to trust one of their own.
- **Subject-Rules Strength Identified:** The entrepreneurs were well-versed in the norms and business practices in the community of Alexandra.
- **Division of Labour-Community Strength Identified** No strength identified. This is weakness because there is a lack expertise or professionals to assist small businesses in the township.
- **Community-Rules**: No Strength identified. Small business in the township community mostly ignore regulations and proper business practices

3.3 Case 2:

Title: " Information Security Management Framework for Mobile Money Systems in Uganda"
Overview: Mobile money systems are generally accepted in Uganda as an easy way to make emergency payments and do electronic money transfers but there are a number of oversight information security management issues (insufficient information security policies, procedures and practices) that need to be addressed. Previous studies have focused on objective security (technical applications and solutions) but have not paid attention to the subjective aspects of information security management. Technical solutions alone cannot fully solve this problem.

Research objective*: T*o develop an information security management framework that will help to minimize the identified information security management problems in mobile money systems in Uganda (More details can be found in Kanobe, Alexander and Bwalya, 2017)

Research approach*: T*his study adopted the interpretivist paradigm in order to explore the topic and get an in-depth understanding of the information security management problem in mobile money systems using Uganda as a case study. Data collection occurred between August and November 2017.

Data collection and analysis: In order to better understand the information security management of mobile money systems in Uganda, a qualitative case study was undertaken involving three Mobile Network Operators (MNOs). The mobile money information security management framework was developed and validated. Key data methods employed were internal documents review and semi-structured interviews involving managers across various departments involved in mobile money information security management such as, IT, internal audit, legal affairs, human resource, security and compliance, legal affairs and many more. Participants with expertise knowledge in the area of study were needed, therefore, the study participants were purposively selected.

Data Analysis using AT as a lens: Information security management involves several activities and, hence, Activity Theory (AT) was utilized to underpin the study through all its research process. The contradictions were identified during the analysis and interpretation of the data and review of related literature.

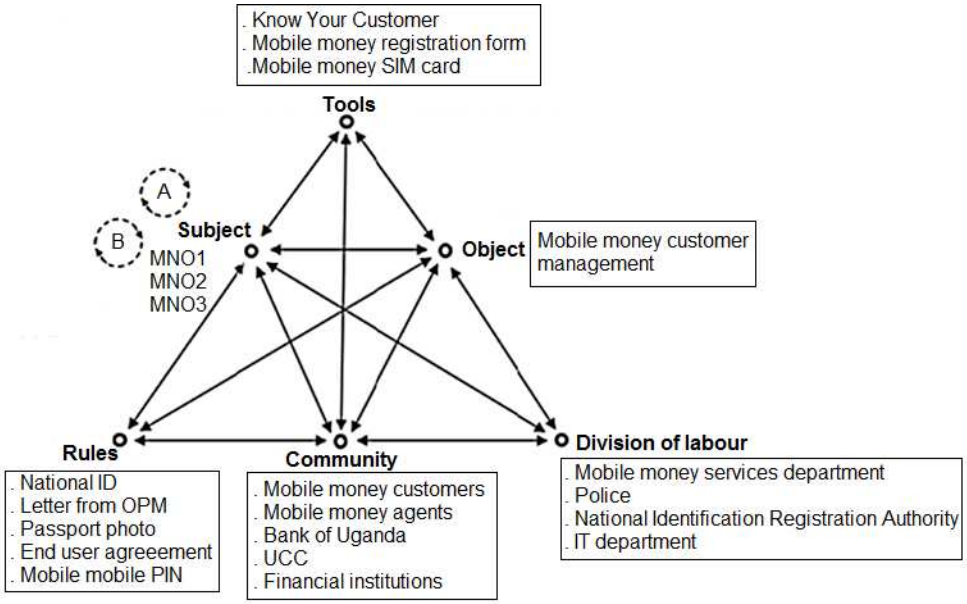

Figure 5: Primary information security management contradictions in the Mobile Network Operators' activity system (Source: data)

Explanations of the primary contradictions, labelled A and B in Figure 5, are presented in Table 3.

Table 3: Description of the primary contradictions

Contradiction	Description
A	The MNOs' mobile money application administrators are also end-users of the mobile money system they are administering. Operating as system administrators and users of the same system requires tight policies to minimise system abuse **(subject vs. subject)**
B	Mobile money system administrators report mobile money abuse to MNO management. However, mobile money system administrators are also end-users of the system so reporting themselves remains a challenge and increases risks of mobile money abuse by MNOs. **(subject vs. subject)**

The secondary contradictions develop between different mobile money activities nodes are shown in Figure 6. They are labelled alphabetically and described in Table 4.

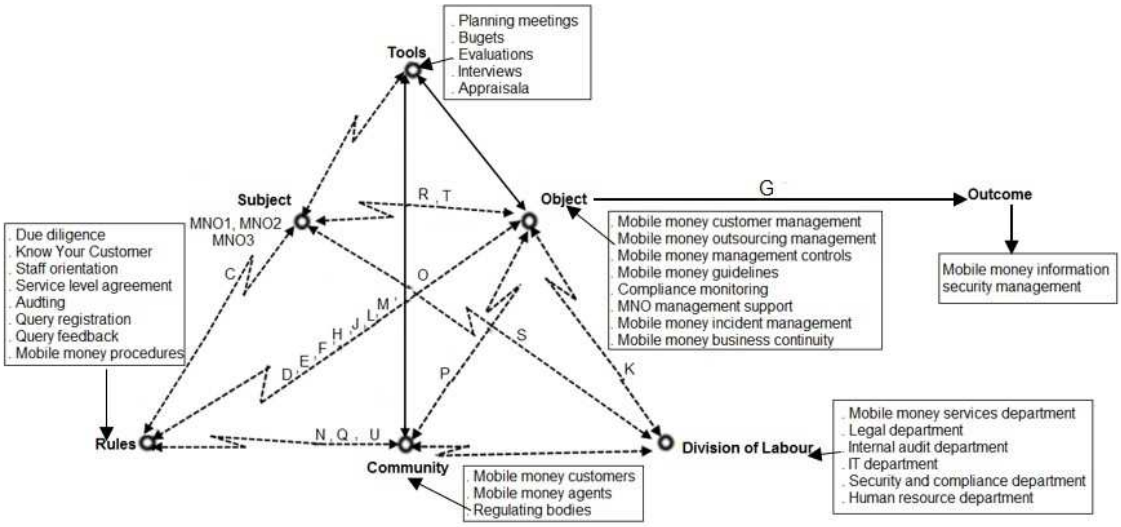

Figure 6: Secondary information security management contradictions in the Mobile Network Operators' activity system (Source: data)

Table 4: Descriptions of the secondary contradictions in the mobile money activity system

Contradiction	Description
C	The mobile money customers' registration is mandatory for all users of mobile money systems but at the same time the mobile money system still has an option for unregistered mobile money users. Leaving the unregistered option in the mobile money system provides an opportunity for unregistered mobile money users to access the system. **(Tools vs. Rules**).
D	The rules followed to appoint outsourced mobile money agents are insufficient to ensure the maximum possible safety of mobile money information in the hands of third parties. The mobile money due diligence rules include providing a bank statement, business registration certificate, physical address, bank account with financial institution and National ID. **(Rules vs. Object).**
E	The mobile money agents' service level contracts are not comprehensive enough to address information security management concerns in mobile money systems. **(Rules vs. Object).**
F	There was evidence of inadequate *rules* to be followed to raise information security awareness (object). Information security awareness activity is confined to PIN sensitization, occasional email alerts and SMS, leaving out many other rules. **(Rules vs. Object).**
G	Information security management has not been integrated into the mission and vision of the MNOs. The absence of explicit references to information security in the MNOs' strategic goals reflects a low priority given to information security management of mobile money systems among MNOs. **(Object vs. Outcome).**
H	There was evidence of insufficient management information security controls which are expected of a system that involves many money transactions. **(Rules vs. Object).**
I	The development of Mobile Money Guidelines lacks division of labour. The guidelines were developed only by Bank of Uganda without participation of other mobile money regulating bodies. **(Community vs. Division of labour).**
J	There was a lack of a comprehensive information security policy that defines the 'dos and don'ts' of mobile money information security and repercussions for failing to comply with the expected guidelines. **(Rules vs. Object).** The Uganda mobile money guidelines 2013 are short of sanctions.
K	One of the rules for mobile money agents as per the Mobile Money Guidelines is providing qualified supportive staff at their centers. However, this rule is not followed by MNOs during mobile money agents' recruitment. **(Division of labour vs. Object).**
L	One of the rules for mobile money agents is being a registered limited company. However, the scope of the company and area of specialty for the limited company are not defined. This opens a door for any registered limited company, irrespective of its scope of activities, to qualify as a mobile money agent. **(Rule vs. Object)**.
M	Some aspects of the due diligence conducted regarding mobile money agents are not specific and there is a risk of mobile money information with entities that lack expertise in mobile money business. For example, the requirement for proving qualified staff. Qualification is a multi-dimension factor which entails types and levels of qualifications. Therefore, without specifying the type and level of qualification makes it open to any qualified staff from any field, yet mobile money requires specific qualifications related to Information Technology and e-business. **(Rule vs. Object).**
N	MNOs follow rules to assign roles and responsibilities. Mobile money roles are allocated according to qualification, implying division of labour. However, there is limited segregation of duties. For example, in MNO1, the IT manager also executes the duties of information security personnel which can lead to system compromise. **(Rules vs. Division of labour**).
O	Study findings revealed that a single outsourced mobile money application developer does all the tasks around mobile money application development. This discloses insufficient controls, auditing and monitoring of the mobile money application development processes and hence increases opportunities for system comprise.
P	There was evidence of inadequate compliance monitoring of the outsourced mobile money agents. Mobile money agents are third parties who get access to mobile money customers' information right from account opening to mobile money transactions, hence it requires tight monitoring to minimise system abuse. The insufficient monitoring of the mobile money agents' activities leaves mobile money customers' information susceptible to information security abuse. ***(Object vs. Community)***

Contradiction	Description
Q	There was evidence of attempts to manage mobile money systems using old Mobile Money Guidelines. The current Mobile Money Guidelines were developed in 2013 (five years before this study) and there was no evidence of plans or a schedule for reviewing those guidelines, yet information security management is a dynamic field that calls for careful review of approaches and strategies. The old regulation guidelines may not be effective for dramatically new trends in technology and corresponding changes in information security management. **(Rules vs. Community).**
R	There was evidence of insufficient management support from MNOs for information security awareness. Information security awareness by information security experts is taken to be the first defensive wall for information security management. When people are aware of the consequences of their actions they tend to be careful and avoid making mistakes that can lead to system compromise. **(Subject vs. Object).**
S	There was evidence of inadequate management of mobile money security incidents among the MNOs. One, general, hot-line was used for reporting mobile money incidents (both operational issues and security cases) resulting in long response times and, hence, increasing the severity of risks related to mobile money security management issues. **(Subject vs. Division of labour).**
T	Study findings revealed that continuity business plans and recovery programs exist among MNOs. However, these lack adequate support in terms of training, awareness, resources and reviews, rendering them inadequate for the current needs of mobile money service continuity and safety of mobile money information. **(Subject vs. object)**.
U	The study disclosed that the MNO internal policy development process was dominated by a limited number of departments, namely Law and Internal Audit. Not involving other departments is tantamount to a lack of policy ownership and accountability among the excluded departments. **(Rules vs. Division of labour).**

The study concludes that the rules, tools, community and division of labour employed by the subjects (MNOs) to attain improve the objects are wanting and necessitate continuous review and update because mobile money systems like any other technology are dynamic. The PDCA (Plan, Do, Check, Act) approach to mobile money information security management activities is recommended in order to address update information security concerns for MNOs.

4. Discussion

Table 5 is used to illustrate the different ways in which AT was used in these two case studies and whether the studies were aligned to the principles and guidelines proposed by proposed by Engestrom (2001), Hardman (2005) and Karanasios (2018) and others as discussed in the literature review (Section 2).

Table 5: Comparison of cases

	Case 1	Case 2
Multi-voicedness	Yes, The voices of the researcher who acted as facilitator and advocate, the accounting teacher, and 3 entrepreneurs were given equal standing.	Yes to some extent: A variety of stakeholders employed by the 3 mobile network operators (MNOs) who managed the mobile money applications and data were interviewed. However, clients and the mobile money (MM) agents with whom clients interacted were not interviewed or surveyed. This was beyond the scope of the thesis which focussed in information security management (ISM) policies rather than operation of the MM system.
Longitudinal case study	Yes	No, this was a descriptive case study which used the literature, including information about ISM policies and management in other countries in central Africa, to critically analyse the existing situation (described during interviews).

	Case 1	**Case 2**
A holistic analysis of real-life situations	Yes, historical, cultural, social, economic and business aspects were included in detail	Yes to some extent as the MNOs had been in operation for several years. Issues regarding rural communities and their vulnerability to financial data mismanagement were also discussed.
Combining active participation and action research	Yes,	No. As a descriptive case study this was not possible. Although there was a need for information from interviewees the impression was that they held back confidential organisational information.
Uncovered contradictions	Yes, contradiction between elements, activities and over time were identified.	Yes, contradiction between elements and activities over time were identified using the corresponding activities identified in the literature.
The outcome of one activity is often intended for some other activity. The outcome in one activity may become an object, or actor in another activity (Korpela, Mursu and Soriyan, 2002).	The learning activity was followed by the implementation activity. Iterations occurred with amended activities.	The activities identified occurred continuously and hence contemporaneously.
Can AT be used for research for technologies that are no longer simply tools?	The technology was considered only to be a tool.	The technology was considered only to be a tool.
A multi-layered lens for understanding activities	Inspection at the level of actions and operations was not done. However, the contradictions generally identified operational level challenges and hence amendments were at a level of detail.	Inspection at the level of actions and operations was not done explicitly. However, the contradictions generally identified operational level.
The complexity and hidden nature of cultural-historical contradictions	Yes. A critical approach was evident (although critical realism was the espoused epistemology). The intention was to empower the entrepreneurs.	The data collection process was limited by organisational confidentiality.
Research methodology must include taking action	Yes, the iterations undertaken were specifically intended to address the contradictions that were identified.	As a descriptive case study this was limited to providing the organisations with the recommendations together with explanations in this regard.
Uncovered congruencies	Strong relationships (congruencies) were considered as important - these are the strengths that were uncovered that are predictors of sustained change.	In the case of the MNOs it was found that there were comprehensive similarities. In this case these were seen as a sign of lack of innovation and were judged to be limiting competitive advantage.
Human activity is collective and human behaviour originates within the social realm.	Yes	Yes
Tools, which carry cultural-historical meanings, mediate activities.	The tools challenged the existing cultural-historical meanings (social norms) regarding revelation of financial information.	Mobile money systems are indeed tools carrying socio-historical meaning and the research does allude to this. The central issue of personal financial data may also be considered a socio-historical tool in the MM system. However in the ISM this is not the case.

	Case 1	Case 2
Studies development and change (including historical, organisational, and moment-to-moment change) & individual development.	Change was the objective of the facilitated adoption of AIS but the need for deeper changes to existing rules and norms emerged. This was particularly pertinent in this case study where the history of the country and its impact on the socio-economic context of the micro-enterprises received a lot of attention and had shaped the current rules and norms.	This was limited by the fact that this was not Action Research but the recommendations were change oriented.
People are active and knowing agents but they act in sites that are not necessarily of their choosing with tools that constrain and afford their actions.	The agency and economic circumstances of the entrepreneur were a focus of the study.	This was constrained by the organisational view of the study. A future study focussing on the user of a mobile money system and the agents who facilitate such a system 'on the ground' would make this insight from AT more visible.
Methodologically, AT rejects positivism in favour interpretivism, and makes use of contextualist methodologies.	Qualitative data was interpreted. The study took place in the community although not on the premises of the micro-enterprises.	The analysis was interpretivist and focussed on work activities. It used Uganda as the broader context where the country's existing laws and regulations had a large influence on ISM.
Changes as driven by contradictions which can arise within and between systems.	Contradiction, as well as strengths were the focus of the analysis.	Recommendations arose from the contradictions that were uncovered.

5. Conclusion

The primary strength of Activity Theory as a lens for analysis of qualitative data is its ability to highlight reasons for failure or disappointing performance and to encourage change or innovation. The contradictions or tensions may occur either between different activities, between an earlier version of an activity and a later version as the activity evolves, or within an activity (between the elements of that activity). However, the converse is also true. Evidence of strong relationships between activities or between the elements of an activity in a new system or pilot project can indicate that the activity or the sequence of activities (as in Case 1) or a number of activities carried out at the same time (as in Case 2), is likely to accomplish the desired object.

However, the presence of several particularly strong relationships within a group of activity systems can lead to stagnation. There was evidence from Case 2 that, where almost all the competitors in a particular sector are involved in activities that are largely the same, little improvement in the product or service offered will be evident. Such stagnation and lack of competitive advantage may occur if rules and regulations constrain the activity systems, if all the subjects use virtually the same technologies or if the environment has limited skills available, thereby causing division of labour to be similar for all competitor. However, the motive of the Subject (in Case 2 this was the MNOs) may be to keep things unchanged. It is therefore a conclusion from this paper that contradictions as well as strengths, together with the underlying motives encouraging or hindering innovation, need to be examined.

A more methodological advantage is that the analytical process related to AT can be structured using the activity system model but nevertheless, by focussing on the cultural and historical aspects while recognising the major role played by tools and the object, it can produce insights that are not obvious using other theoretical lenses or methodologies. This structure aids researchers who are uncertain how to analyse qualitative data effectively.

The question can be asked as to how AT differs from other approaches, e.g. a comprehensive process analysis, that will also take due account of differing cultures, behaviour, skills and so. This is an interesting question and is addressed here only briefly. There certainly are commonalities as several of these take the context into account. As noted earlier other approaches have been criticized on the grounds that they have too narrow a

focus (fail to provide a holistic analysis of real-life situations). That they do not 'dig' sufficiently deeply into a social system, and are that deliberately seeking out contradictions is unique to AT.

The disciplinary origins of the approaches differ and thus the underlying world views are different. AT has origins in the humanities while process flow analysis or business reengineering developed as tools for business analysts and for business process redesign. The areas of interest highlighted by the methodologies are therefore also different and might focus more often on the different hierarchical levels identified in AT, namely, the activity, the action and the operation. An in-depth comparison between these would make an interesting follow up paper, with a co-author who is well-versed in process flow analysis or business reengineering. Activity Theory and Business Reengineering.

AT's strength lies in its ability to transform human activity through a mediated approach. As such AT can provide a theoretical framework which can possibly be utilised in business process reengineering and practice improvement in a business environment. The case studies reported on in this paper both focussed on activities rather than actions or operations, but a critique of those studies is that in many cases data collected really referred to actions and operations. However, the distinction between an action and an activity can become blurred. An operation is generally regarded as a process whereby incoming resources are transformed into out-going products / services by a series of activities or sub-processes. A clear understanding of the different levels may lead to a conclusion that AT analysis could be complemented by a comprehensive process analysis and that such a combination would be of value.

The primary objective for this paper was achieved in the discussion of the exiting literature and the discussion of the two case studies. The secondary objectives were demonstrated using the case studies both of which successfully did a critical analysis of qualitative data. It is believed that in both cases insights were obtained regarding the organisational changes resulting from the introduction of ICT-related tools and other artefacts to mediate a business activity or a series of activities even though the organisations were at different ends of the spectrum in terms of size. AT proved valuable in a study at macro-organisational level (across three large organisations in the same sector) and at micro-level. The research methodologies were also very different. In Case 1, participative action research was carried out whereas Case 2 was a descriptive case study.

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Charting a Clear Course Through the Methodological Jungle: Lessons About PAR from and for Simulation-Based Educational Research

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Abstract: Many argue that technology brought about by the Fourth Industrial Revolution offers new opportunities for student learning. In order for educators to use technology with wisdom, in-depth longitudinal research using rigorous methodological approaches is needed to understand the opportunities and challenges of including these technologies in management education. Therefore, educational researchers are challenged to design research projects to collect data from multiple sites over several years using various methodologies. This article examines strategies used by the researchers to design and implement a research project employing a Participatory Action Research (PAR) approach that combined qualitative and quantitative data from two universities across several years. The research project was specifically designed to study learning using a business simulation. The article describes the research project including the various data collection points and analysis methods. The purpose of this article is to bridge the theory-implementation gap enabling educational researchers to consider the design of a comprehensive research project as well as identifying key challenges and practical suggestions for using PAR.

Keywords: Participatory Action Research (PAR), business simulation, education, qualitative research, quantitative research, methodology

1. Introduction

The tension between what is and what could be presents a scenario that either overwhelms causing inertia or inspires action. The very idea of creative tension as the gap between an idealised vision and current reality is not new, but its many iterations in countless situations do spark interesting and often novel questions and approaches (Senge, 1990). One established set of concepts that are an expression of this tension is the gap between theory and practice, whether real or perceived the conversation and considerations brought to bear by this perceived gap demand attention from academia. In a microcosm of the larger question about the gap between theory and practice the authors zoom in on the gap between methodology as theory and the actual implementation of a research project as practice. Of course the implementation of the project is not so distant or far removed from the theory that describes it, as to call the gap a dichotomy but the difference is real enough when the theory is clear and crisp and the implementation can be complex and messy. This has been the experience of the researchers that dutifully embarked on an educational research project with the best intentions and a grasp of the theoretical concepts. This article elaborates on the challenges and benefits that cannot be fully grasped by reading about them in a book but that results from experiencing the reality, which of course comes not only with challenges but also benefits!

Embarking on a comprehensive longitudinal educational research project goes beyond dealing with the theory versus practice debate. The opportunities for dynamic tension between concepts demanding a resolution of some kind appeared abundant. In the search to answer questions about teaching and learning efficacy were the educators going to fully embrace the view proposed by Drucker that, "you can't manage what you can't measure" (Merinen, 2013)? It is a well enough accepted axiom in management, but if a methodological lens is applied to this statement then surely only quantitative measures would suffice? What about the sentiments of the sociologist, Bruce Cameron that "not everything that counts can be counted, and not everything that can be counted counts" (Cullis, 2017)? Embracing this view necessitates a more nuanced approach, surely there are some salient behavioural or attitudinal aspects that cannot be reduced to numbers but that have an important bearing on lecturer efficacy and student learning? It is a desire to grapple with this dynamic tension to consider both lived experiences and data driven outcomes that specifically contributed to the decision to pursue complementary mixed methods, nested in a Participatory Action Research project. The theoretical considerations and practical realities that emerged during the project will be discussed in this article.

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2. Background

Computer based simulations and their incorporation into the classroom have grown in popularity. There are various computer based simulations available but simulations that cater for management education share certain commonalities. The simulation creates a virtual marketplace where students compete against peers or virtual companies sometimes on their own but most often in teams. This competition creates an interactive and immersive learning experience as students have to make decisions to manage their virtual companies. The simulated environment offers the opportunity to compress "years" of business performance into rounds where algorithms calculate the quality of decisions relative to market demands and competitor actions. This feature enables students to make "annual" decisions in areas such as marketing, production, research and development and finance, these annual decisions are processed as a round and students receive their feedback in the form of financial statements (Capsim, 2019). Students are responsible for their respective companies for several rounds, creating a unique opportunity to reflect on their actions and outcomes, learn deep lessons and make adjustments based on feedback loops. Simulation based learning offers a unique opportunity to grasp the cause and effect of their decisions and to develop a deep understanding of the drivers of profitability. It must also be mentioned that these virtual companies allow students to explore and deal with the outcomes of their actions, poor results must be addressed and corrected in subsequent decision making. In this way the simulation itself is iterative in the same way a longitudinal PAR project is.

The research agenda to explore this pedagogy has taken shape seeking to address and uncover the key elements that contribute to effectiveness (Adobor & Daneshfor, 2006). The mere mention of measuring 'effectiveness' raises a whole gamut of important considerations, what does effectiveness mean, what should be measured and how? McKenney and Reeves (2018) summarise the decades long evolution of the effectiveness conundrum by explaining that educational researchers have either emphasised rigour or impact, but that ideally synergy should be sought between these concepts. This insight is both useful and daunting to educational researchers, Anderson and Lawton (2009) put the challenge into perspective by noting how unlikely it is that one article will conclusively speak to the efficacy of a given pedagogical approach. Rather, to achieve clarity and insight, research itself must be regarded as an iterative process requiring countless small but purposeful steps in the right direction. Interestingly, determining the 'right direction' for research and ensuring sufficient interest by scholars in that direction is easier said than done. Arbaugh and Hwang (2015) point out that while trends continue to abound and garner interest, more established areas, such as experiential learning have not benefitted fully from renewed interest and that multi and transdisciplinary research is suffering due to a lack of cross disciplinary research dialogue. Interestingly, the business disciplines benefiting the most from the surge in articles and citations is rather uneven with a focus on entrepreneurship education, online education or critique of business schools (Arbaugh & Hwang, 2015). It is precisely out of the critique that business schools receive, that a cry for the reinvention of management education emerges (Steyaert, Beyes & Parker, 2016).

The right method to use in a research project should always be dictated by the research question. Borrowing from the field of architecture where form follows function, it can be said that in research, 'methodology follows question'. In pursuit of the 'right direction' and reimagining management education, the researchers started with multiple questions, what is the ideal group size, should lecturers allocate roles to students, are students deeply engaging in the strategic planning process when they make decisions in the simulation, are they developing leadership skills in their group interactions? These questions were not all entirely synergistic but research questions could be grouped according to thematic categories such as 'team work', 'leadership development', 'ethical decision making' and 'strategic planning and decision making', to name a few. In addressing the variety of research questions that emerged the researchers agreed that the overarching primary objective of the research was to measurably increase the impact of simulation based modules, both in terms of teaching strategies employed and in terms of learning outcomes achieved by students, without burdening students with additional work. The variety of questions that were posed also necessitated the collection of different data points, and therefor different data analysis methods were employed, each time ensuring that the right lens was utilised for the right question and that appropriate rigour was applied to the research process and management of data.

3. Review of the literature

3.1 Participatory Action Research as a method

Action Research involves systematically collecting and analysing data with the overarching goal of effecting change by taking action (Gillis & Jackson, 2002). Newton and Burgess (2016) allude to the fact that there are many opposing views of the different types of Action Research. For the purposes of this paper Action Research is categorised into four types or modes (see Table 1).

Table 1: Four types of Action Research

Type	Author	Description
Technical Action Research	Denscombe, 2003	Aiming to improve effectiveness of practice Practitioners co-opted and greatly dependent on researcher as facilitator
Practical Action Research	Creswell, 2005 Denscombe, 2003	Studying local practices Involving individual or team-based inquiry Focusing on self-development Implementing a plan of action Leading to practitioner as researcher In addition to effectiveness, aims at practitioner's understanding and professional development Researcher role: to encourage practical deliberation and self-reflection of practitioners
Participatory Action Research	Chambers, 2004 Creswell, 2005 Wadworth, 2005	Studying social issues that constrain individual lives Emphasising 'equal' collaboration – research participants involved as integral part of design Focusing on life-enhancing changes resulting in the emancipated researcher
Emancipatory Action Research	Denscombe, 2003	In addition to effectiveness, understanding and improvement, it aims at transformation and change within the existing boundaries and conditions Focus on changing the system itself

Source: Adapted from Maree (2007)

The research objectives of the particular study in question aligns with Participatory Action Research. As a subset of Action Research, PAR, in essence, aims to effect social change by means of specific actions (McNiff & Whitehead, 2006). Participatory Action Research (PAR) offers an opportunity to build a relationship between theory and practice (Kemmis & McTaggart, 2005). An important criterion for successful PAR is both the Action Researcher and community members who want to see an improvement in their situation. PAR is an iterative process of action and reflection cycles which includes those being researched in a dialogue, creating knowledge to enable action. This methodology is well suited to research in education, adult education, community development and organisational development (Young, 2006). PAR is a particularly useful method for educators as it enables the researcher to implement lessons learnt throughout the research process in order to benefit and encourage better learning in a series of iterative feedback loops. PAR allows the qualitative features of participants' views, patterns and even feelings to be revealed without the researcher manipulating or controlling (Leininger, 1985; MacDonald, 2012). Importantly, knowledge creation is regarded as an active process (McNiff & Whitehead, 2006). Thus far, action research has assumed a reality which can be uncovered and then altered in some way or improved upon for emancipatory purposes. This however begs key questions about where our ideas of what counts as 'improvement' come from. How can the researcher both 'observe' reality as well as being part of it and thus be implicated in its continual creation and recreation? These issues are much more complex than action research has acknowledged so far. Ideally researchers need to move beyond the notion of the 'reflective practitioner' to encompass post-structuralism which attends more to the way in which we construct reality (Brown & Jones, 2001).

The work of Kurt Lewin (1944) is widely acknowledged as the origin of PAR as he is considered the father of Action Research (Gillis & Jackson, 2002). At its core PAR is founded on Lewin's life experiences and the philosophy that people would be more motivated to accomplish their work if they felt involved and valued in decision making processes (McNiff & Whitehead, 2006). Another key contribution by Lewin in the process of popularising Action Research was the presentation of this methodology as an approach to not only study a social system but also work to simultaneously effect changes (Gillis & Jackson, 2002). Lewin's original advice to researchers about how to structure and report on their research is a cycle that is still in use today, moving

from observing, to reflecting, acting and evaluation to modifying (McNiff & Whitehead, 2006). Schön (1995) posits that new paradigms of scholarship, which works to include research, teaching, application and integration should be firmly based on reflection. With this original focus on reflection well and truly intact it should not be a surprise that the roots of PAR also wind their way to Paulo Freire, who was a believer in the value of critical reflection (as part of a wider process) for personal and social change (Maguire, 1987). Freire also espoused the empowerment possibilities of PAR by emphasizing the importance of critical consciousness on social change (Freire, 1970).

Promisingly, PAR provides an alternative to traditional social research by changing the narrative from the linear 'cause and effect' to a framework involving participation and considering the context of participants' lives (Kelly, 2005; Young, 2006). One of the criticisms from a more traditional perspective is that PAR is a 'soft' and open-ended research design (Young, 2006). The open ended nature of this approach can, however, be tremendously beneficial for complex contextual problems. In light of this, PAR as a method acknowledges the need for participants to become co-creators, forming part of the research process, from design to dissemination (Vollman, Anderson & McFarlane, 2004). The purpose of the research agenda then is to enable capacity development, empowerment, social justice and of course, participation instead of passivity (Vollman *et al.*, 2004).

PAR entails a cyclical process that iterates between research and fact finding, taking action and reflecting on the process and distilling insights before further research takes place (Marshall & Rossman, 2006). It also requires individuals to be self-reflective with the ultimate goal of improving the situation (Koch, Selim & Kralik, 2006). Interestingly, Selenger (1997) highlighted that an important component of PAR is that it has the ability to make participants aware of the resources under their control that they can utilise for self-reliant development. Therefore, PAR is very well aligned with the goal of educators to encourage self-directed learning in their students. The stages of the PAR project that the researchers progressed through as well as the measurements utilised are depicted in Table 2.

Table 2: Stages of the PAR process in the simulation-based learning research project

Questions to be addressed	Previous studies	Variable elements to be measured	Local measurements	Form of analysis
How to increase the impact of a business simulation course?	Abdullah et al. (2013) Tiwari et al. (2014) Vos (2015) Lu et al. (2014) Kohler et al. (2015) Avramenko (2012)	▪ team work ▪ leadership development ▪ ethical decision making ▪ strategic planning and decision making ▪ strategic thinking ▪ business management skills	Participant observation Validated measurement instruments conducted via surveys Student and lecturer reflections Student performance Focus groups	Thematic analysis Statistical analysis

Source: Adapted from James (2008)

3.2 The value of employing a Methodological mix in the context of PAR

Scoles et al. (2014) agree that mixed methods are particularly appropriate to address problems in complex environments, such as presented in the field of education. Ideally, mixed methods are valuable when quantitative and qualitative data can be analysed together and the insights from one method can complement the use of the other method (Scoles et al., 2014). Usefully, PAR is very flexible when it comes to methods that can be employed to collect data. The reason for this flexibility is that in each context the researcher and participants collaboratively define the research problem and then consequently select the appropriate methods to collect the required data (McNiff & Whitehead, 2006). According to Creswell (2009) a mixed methods research project must be carefully designed taking cognisance of four key aspects, being i) Timing –

consider whether qualitative and quantitative data should be collected sequentially or concurrently; ii) Weighting – the research question should dictate the appropriate weighting or priority assigned to qualitative or quantitative research in a particular study. Weighting should differ for each specific study; in some cases it is most appropriate that the weightings are equal, in others there should be a greater emphasis on either qualitative or quantitative; iii) Mixing – qualitative and quantitative data may be mixed at various stages of the research project for example collection of data, analysis of data and/or data interpretation, and in some instances during all three stages; finally iv) Theorising – considering what theoretical frameworks might need to guide the design of the research project. The use of both qualitative and quantitative methods provide a specific opportunity to measure performance, consider behaviours and triangulate research findings. Some of the methodologies utilised in this research project are:

- *Participant observation* which involves the systematic noting and recording of behaviours, events and objects which the researcher obtains by having access to research subjects in the context of a social setting, providing a rich source of data (Marshall & Rossman, 2006). Students and lecturers (the researchers) have many interactions ranging from lectures to consultations and even e-mailed queries that provide rich and diverse opportunities for observation.
- *Student and lecturer reflections.* Students are given the opportunity to reflect on a weekly basis with probing questions that have been developed to encourage the appropriate depth of reflection by students who very often have not been required to reflect before and may not be familiar with how to reflect on their experiences, actions and insights. The researchers keep a record of their reflections as lecturers in an electronic reflection diary which is normally updated after lectures and after interactions or events that spark insights.
- *Validated measurement instruments* conducted via surveys. Surveys are made available to students every so often using the weekly hyperlinks for reflections.
- *Student performance during the simulation,* marks, and assurance of learning reports provide a quantitative view. The simulation records student engagement in the form of logins, decisions made, results for each round and peer evaluation results. These quantitative measures provide a wealth of data that can be analysed to triangulate findings.
- *Focus groups,* are a type of small group interview benefiting from the interactions between research participants, who have characteristics relevant to the study in common, as a source of data (Marshall & Rossman, 2006). Focus groups are habitually conducted at the end of the semester to consolidate student learning, as a form of revision for the summative assessment and to distil insights for future improvements to the class.

3.3 The value of a systems thinking perspective

The discussion at the beginning of the article was launched by probing the value of creative tension gaps in inspiring action (Senge, 1990). This links strongly to the systems thinking approach (Senge, 1990) which advocates for a holistic view of the system in question with the goal of creating learning organisations. Part of this holistic perspective involves identifying connections between sub-parts of the system that are not obvious and understanding why they are behaving the way they are (Arnold & Wade, 2017). According to Arnold and Wade (2015) systems thinking can be defined as a "system of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects".

Educational research projects are clearly situated in a larger system where institutional realities and individual student proclivities all affect and are in turn affected by the system they are a part of. Kastens and Manduca (2017) agree that a systems thinking perspective can be valuable in planning and executing educational reform projects. The group learning that is advocated for in organisations that seek to employ systems thinking (Senge, 1990) dovetails well with PAR as a methodological approach and specifically in this case where different methodological tools are used to collect data about the learning process in question. Interestingly there are two clear interfaces between a systems thinking approach and this research project, firstly the iterative nature of PAR itself as a methodology and secondly the iterative nature of the simulation utilised as a teaching tool. The iterative nature of both the simulation and the PAR project create multiple feedback loops that both the students and researchers can benefit from in their development as increasingly reflective practitioners.

The systems thinking approach is valuable precisely because it recognises that educational improvements are rarely as simple as changing a single action and measuring a single effect, it more likely means that multiple contributory causes are likely to be involved in achieving a single desirable outcome (Kastens & Manduca, 2017). This resonates with the researchers as multiple interventions may converge to improve, for example, the teamwork skills of students. Feedback loops play an important role in systems thinking in terms of garnering growth and ensuring large impacts from limited resources (Arnold & Wade, 2017; Karstens & Manduca, 2017). For example a negative feedback loop governs departures from goals and serves to balance efforts before the escalation becomes overly negative. In the simulation for example if a team over produces without regard for their customers preferences their finances will suffer, often in the form of an emergency loan that serves to reel in their decision making in subsequent decision rounds as they solicit guidance and work to become profitable again. Positive feedback loops encourage participants towards alignment with project goals that are deemed to be effective. For example the researchers noted that pointed reflection questions were answered more holistically and provided more opportunities for the kind of reflection that was envisaged so all reflection questions were revamped to take advantage of this insight. The discussion on feedback loops highlights succinctly the two facets or skill areas in systems thinking that must be mastered, namely, gaining insight which involves improving systemic insight of a particular system and secondly, using insight which involves application of the systemic insight gained (Arnold & Wade, 2017). It is no wonder that the systems thinking approach offers the potential for an ambitious educational interventional to amount to more than the sum of its parts (Kastens & Manduca, 2017).

4. Charting a clear course in the Simulation research project

4.1 Sample

Data has been collected from modules at two South African universities from 2015 – 2018 and should continue until 2020. Both modules centre on a computer based business simulation and have similar learning outcomes.

At University 1 the module is part of a Strategic Management Honours degree, at University 2 it serves as a capstone module for a Bachelor of Business Science degree. The data collection instruments and questions were identical across both university modules for the purpose of comparability. The total sample consisted of 438 participants during the period 2015-2018 (see Table 3).

Table 3: Sample size per year

Year	University 1	University 2	Total
2015	44	26	70
2016	68	17	85
2017	60	29	89
2018	47	147	194
Sub-total	**219**	**219**	**438**

Source: Authors own

4.2 Methods of data collection and instruments used

The project uses a systematic Participatory Action Research approach as the researchers and students are participating in the research project collectively engaging in finding solutions to increase student learning. The researchers are also responsible for lecturing the modules and Figure 1 provides an overview of the research process. This means that the researchers are also moving through the participating, acting and research phases with the participants. Students are seen as part of the research team as their actions and reflections enable a collaborative process.

A key research tool used in the project is reflection. Both the researchers' reflection, as well as students' reflection, are used as data collection methods as can be seen in Figure 1. The researchers write a reflective journal and make notes of their experiences and observations during the course of the semester. Students are expected to reflect every week as part of the experiential learning cycle (Kolb, 1993, 2007). In this way, the reflection assists student learning but also serves as a data collection method, complying with one of the project goals, namely not to overwhelm or burden students with extra work. Reflection is prompted by carefully selected prompting questions based on the learning experiences within the curriculum in the specific week. A combination of open-ended questions (for example: *What do you hope to learn from participating in*

the simulation?) and short answer questions (for example: *Which option best describes your team's success at forecasting, in terms of the gap between your decisions, forecast results and actual results*) are utilised.

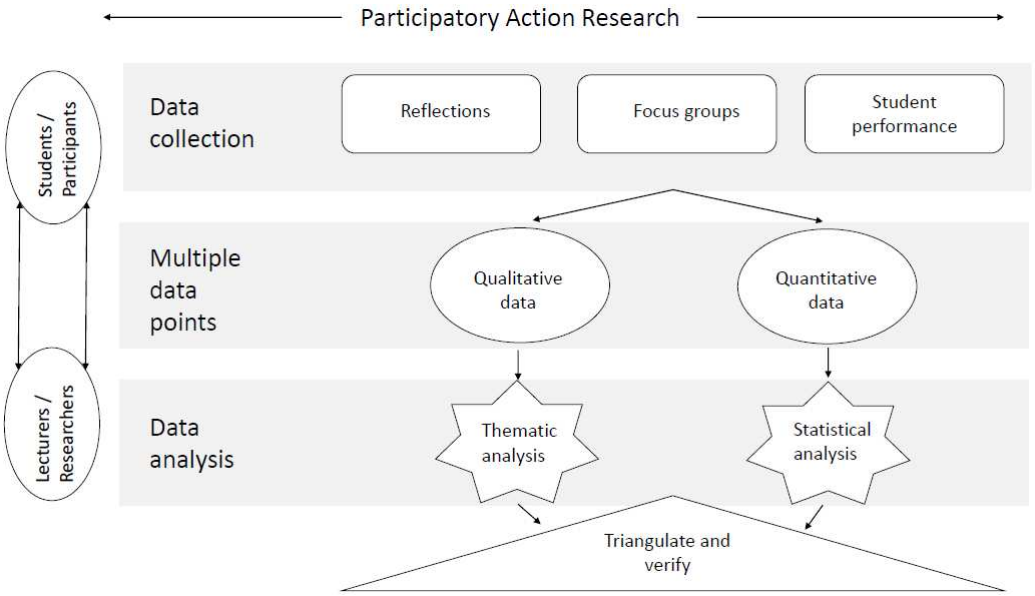

Figure 1: Conceptual model of the methodological mix utilised in the simulation research project

Source: Authors own

Validated measurement instruments are also included to measure constructs such as group efficacy and group conflict resolution using likert scales. While the measurement scales were not developed in South Africa, the researchers reviewed the language of each item within the scale to account for any contextual differences. Google forms are used so that students can submit their reflections online at their convenience during the week. As lessons are learnt during the PAR process, the researchers have adapted some questions and added others where appropriate.

Peer evaluations of team members are done twice during the semester. This data is collected via the simulation platform and provides quantitative data. Focus groups are also used at the end of the semester. Students are prompted to discuss issues such as the most important lessons learnt, what they would change about the module in the future, etc. The focus groups are recorded and transcribed in order to be analysed.

Student performance during the semester is another important source of data which is used to develop a holistic view of student learning. Student performance data is collected using their simulation results, marks and assurance of learning reports. Performance during the simulation is measured using a balanced scorecard (Kaplan & Norton, 1996) containing the four standard categories namely 'financial', 'internal business processes', 'learning and growth', and finally 'customer'. The assignments completed for which marks were captured include reflections and peer evaluation, simulation marks as per the balanced scorecard, business report, end of semester presentation and exam marks. The assurance of learning report includes marks for analytical skills, critical thinking skills and functional knowledge skills, providing additional quantitative data. Demographic information, such as gender, age and university, of the participants are collected using Google Forms.

4.3 Analysis of data

Thematic analysis is used to extract themes from the qualitative data as indicated in Figure 1. The researchers used the six steps described by Nowell et al. (2017) during thematic analysis. (1) The researchers familiarised themselves with the data – this involved immersion in the data, the qualitative data was read and re-read several times on Nvivo to search for meanings and patterns. (2) Generation of Codes – the researchers identified initial codes in order to simplify the core characteristics of the data. (3) The researchers searched for themes – in this phase the initial codes were collated into thematic categories. (4) Thereafter, the themes identified in the previous phase were reviewed to ensure relevance to the topic under investigation, being

increasing the impact of simulation-based modules. (5) Themes were defined and named through detailed analysis of each theme that was identified. (6) A thematic analysis report was written as part of the final analysis to ensure logical interpretation of the data. The quantitative data is analysed using SPSS in order to arrange and summarise the data based on descriptive measures (Selvanathan, Selvanathan & Keller, 2011).

A key characteristic of the methodological approach used in this research project, which is also an inherent trait of PAR, is its iterative nature. Any insights gleaned by the researchers are undergoing a two tier process of member checking with students to ensure clarity and accuracy in the discussion and insight and then also peer debriefing between the researchers. Peer debriefing involves collaboration between researchers in pursuit of ensuring that valid information is collected. While it is ideal in debriefing for the said colleague to be impartial and have some distance from the study, the researchers find that working for different institutions and with different cohorts of students provides perspective. Once insight has been clarified and distilled not only does it permit for the triangulation and confirmation of findings but it also feeds back into the data collection process as questions and processes are updated and tweaked.

4.4 Findings and changes to the project to date

The modules are continuously improved as the researchers and students reflect and learn during and from the research process which means that some findings result from the iterative nature of the project and educator reflections, and not only from the more formal thematic or quantitative analysis approaches. For example, initially the module design included two practice rounds spanning two weeks. After the first PAR cycle, students reflected that they would benefit from playing four rounds in the two preparatory weeks in order to 'see how their strategies play out', this was then implemented from 2016. Another example of how the student participants influenced the module was uncovered during the focus groups where students raised a concern regarding the workload of the weekly reflections. The educators decided that the value of the reflective pieces towards their final mark should be increased in order to more accurately align their effort and time with the assessment weighting. Revision sessions were also adapted on the advice of the student participants to include practice financial questions. Students' reflections at the end of the semester on what they would do differently if they could turn back time and start the semester over pointed towards the importance of reading the simulation guide early in the semester. Although the modules at that time already did specify that the students should read the guide in the first week, the educators decided to add an in class quiz using technologies like Socrative and Kahoot to test their understanding of the guide in the second week. The main idea was that the exercise could expose and highlight the importance of reading the guide earlier in the semester.

Continuous improvement is important as the central goal of any educational research should be to improve learning. The lessons learnt by the researchers lead to actions that benefit both current and future students. The educators are learning important lessons regarding the module design as well as for the research project.

In terms of the module design, changes made include adding class activities to address a need identified within the research process. For example, a strategic decision making technique was included to assist the students to assess their proposed decisions using various lenses to consider the issues at hand. A simulated team survival activity was introduced to show the importance of team work. Students are challenged to rethink the value of historical empirical evidence with an activity based on Hume's theory of causation. This activity was specifically introduced as the educators' reflections showed that students tend to believe that historical financial data produced by the simulation is an absolute predictor of the future rounds, resulting in them being blindsided by unanticipated actions by competitors for example. Other improvements made to the module design was the inclusion and refocusing on theory in the classroom sessions. This was as a result of the educators' reflection on the type of questions asked by the students during the semester. Theory on ethics, strategy, financial statements and ratios as well as the practice of reflection was included.

In terms of changes made as a result of the research project, a good example is that initially the researchers asked more open ended reflection questions, such as "What was the most important thing you learnt this week?" or "How have you experienced the simulation?". However, the researchers noticed that the student participants gave vague answers that did not indicate the required depth of reflection. Therefore, the researchers redesigned the reflection questions in order to prompt more depth of reflection focused on key experiences within the semester. Some example questions include:" What did you learn about ethical decision making that could be useful to you in future?" Another important lesson regarding data management was that

in the first year of the project the researchers used their institutions Learning Management Systems to capture the students' reflections. However, later it became apparent that the data would be lost as the educators lose access to the module page after a year and even if data was downloaded it was not in an 'analysis friendly' format. The search for alternative solutions led the researchers to use Google Forms to collect the reflections and merely post the links on the respective Learning Management Systems (LMS).

4.5 Data management choices

Good data management ensures that each researcher knows what to do, why it is being done, when and how the data should be stored so that the data can be consistent throughout the research project which in turn ensures high quality data that increases the odds of trustworthy and useful findings (Taylor, 2017). The number of participants increase each year and so the demands of ensuring rigour and consistency grows with each subsequent semester, consequently the researchers found themselves relying more and more on technology as a tool to manage data. Google forms were used to capture student reflections and responses to validated measurement instruments. Google drive was used as cloud based storage to centralise and organise the records pertaining to informed consent, student performance, voice recordings of focus groups and storage of transcripts. A lesson learnt was that LMS's only store data for the duration of a semester and if not saved timeously, data can be lost. The challenge with downloading data from LMS's at two different institutions also meant that formatting and creating synchronicity became both a timeous and tedious exercise. Using Google forms ensures uniformity between campuses and across years.

Deciding how to organise the captured data also presented interesting challenges, particularly for qualitative components of the project where the boundaries between research themes are not so clear cut. Word documents were created for analysis in Nvivo and organised according to questions asked and answered, campus and year of the responding cohort, with care to ensure that relevant answers (even to seemingly unrelated reflection questions) were included in the appropriate thematic grouping at face value.

5. Ethical considerations

Flick (2018) reminds researchers that careful consideration should be taken at every point during the research process, as each step highlights different nuanced ethical dimensions. Careful consideration should be taken regarding the scientific quality of the study and the welfare of the participants while at all times respecting the dignity and rights of any and all participants (Flick, 2018). The researchers went to great lengths to assure the scientific quality of the research project by studying the existing literature in order to ensure that the questions posed weren't a mere duplication of previous studies. This included doing an extensive systematic review of teaching approaches associated with simulation-based modules in the most prominent business databases. The Human Research Ethics Committees of both institutions involved in the project reviewed any potential ethical risks and approved that the project adhered to high ethical standards before the study commenced. This process included a full review of the purpose of the project, the research questions and aims, identification of the sample, the data collection, analysis and finally reporting of the findings. The researchers ensure that participants are adequately informed in order to give consent by firstly doing a presentation on participatory Action Research, what the research project involves, the time commitment and any potential inconvenience for participants as well as their right to withdraw from the research at any time.

Secondly, each participant receives an explanatory letter elaborating on the presentation that has been developed for this purpose:

- The scope of the research, and how the sample was selected
- What informed consent means and how to withdraw from the research
- Any potential benefit, risks and inconvenience to the participants
- Confidentiality and storage of data
- Contact information of researchers
- How the participants may request a report of the research results

Ethical principles that relate specifically to PAR that were adhered to include that the all participants must be afforded the opportunity to influence the study, those who choose not to participate must be respected and finally, it is the researchers' responsibility to maintain confidentially throughout the research process (O' Brien, 2001).

6. Validity, reliability and trustworthiness

Rigorous criteria and methodological standards are key to ensure the needed validity and reliability of any research project (Lub, 2015). Achieving rigour, minimising bias and ensuring the credibility of findings is the goal of the research project in question (Noble & Smith, 2015). While different terminology is used to describe the ideas of validity and reliability in qualitative research the objective remains similar. In pursuit of trustworthiness in qualitative research, credibility, transferability, confirmability and dependability are the criteria that have to be applied (Anney, 2014). Strategies that were utilised during the research project were informed by Noble and Smith (2015):

1. Acknowledge and work to minimise personal biases which could influence findings
2. Ongoing critical reflection of methods employed to ensure appropriate depth and relevance of data collection and analysis
3. Meticulous record keeping, ensuring interpretations of data are consistent and transparent
4. Seeking out both similarities and differences across responses to ensure different perspectives are represented
5. Inclusion of rich and thick verbatim descriptions by participants to support findings
6. Systematic and clear thought processes during data analysis and interpretations
7. Engaging with other researchers to reduce bias
8. Respondent validation- which aligns well with the principles of PAR
9. Data triangulation-different methods and perspectives work to ensure comprehensive findings

The considerations of validity, reliability and trustworthiness were incorporated during research design and carried through during implementation. The research project can be conceptualised as a wheel, see Figure 2. The outside rim of the wheel is PAR which is supported in turn by each of the spokes.

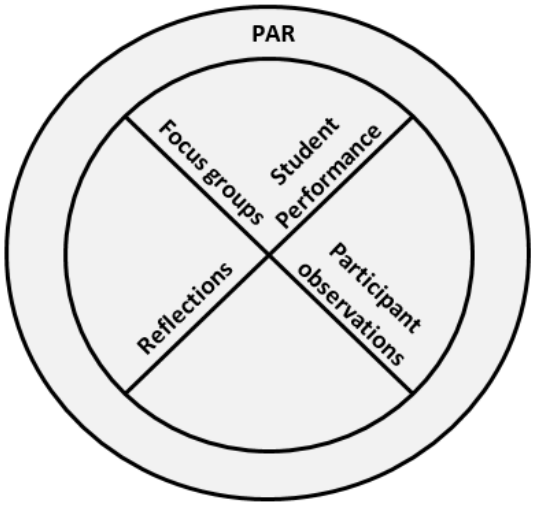

Figure 2: The PAR Wheel

Source: Author's own construction

None of the spokes are more or less important than any other, however if any of the spokes "fail" a quality test it jeopardises the quality of PAR, if not the given article or spoke in particular. Therefore, the quality of the project is mutually an interdependently reliant on the quality of each other spoke. In a similar way the comprehensiveness of the project is dependent on the presence of "enough" spokes to support the rim, this can be interpreted as saturation via findings or of methods. While we will not contend that there is a predetermined number of spokes that is ideal here we do advocate for the triangulation of findings using at least two data collection methods and ideally a mixed methods approach. The opportunity here is in the potential robustness of results, while strong advocates of either qualitative or quantitative approaches to answering research questions may not be easily coaxed out of their respective corners the authors contend that educational research could only benefit from approaches that incorporate mixed methods and by

implication, multiple perspectives. This again comes from the founding reason for the research project which was a call for more empirical data to support claims of teaching efficacy.

7. Implications for practice

The researchers have learnt a great many lessons throughout the research project, from an operational point of view a valuable lesson was to manage, store and file the data clearly and consistently! Akin to undertaking a building project, each phase has brought its own insights and challenges.

7.1 Challenges

7.1.1 Administrative load of the research project

A research project of this nature presents a challenge in terms of the administrative workload. The researchers noticed that a lot of valuable time is spent just managing the project. Administrative actions such as checking that the Google Forms links work every semester and relinking each questionnaire on the Learning Management System takes time. Another example is that for each cohort the researchers must collect and capture consent forms as part of the ethical clearance process, then at the end of the semester the data of students that did not give consent must be removed from the data set. The capturing and reconciling of the data across multiple weeks and campuses can get so time consuming that this presents a daunting challenge that may cause researchers not to get to the analysis phase. A potential solution might be to look for funding to assist with the administrative functions inherent in such a project.

7.1.2 Keeping the data clean

As the research project collects data from two universities' cohorts at the same time, it is often a challenge to ensure that the data remains clean. Each questionnaire begins with a question asking the student to identify at which campus they are studying, an incorrect selection here complicates accurate data capturing. This means that a great deal of time is taken to clean the data after each collection cycle and to consolidate all the data points. This challenge relates to the administrative load described above.

7.1.3 Quantity of qualitative data

The vast amount of qualitative data collected in the described PAR research project presents both an opportunity and a challenge. Collecting a high volume of qualitative data often assists the researchers to reach saturation when doing qualitative data analysis and ensures the trustworthiness of the research findings. However, this also complicates data analysis making thematic analysis a cumbersome process which can become overwhelming.

7.1.4 Requires close collaboration between researchers

The involvement of multiple researchers means that they have to work in close collaboration with one another as it is very important that the students experience similar learning stimuli to ensure quality data. Open communication and sharing of ideas and lessons is key to the success of this research project which requires high levels of trust. As deep reflection is the engine of the PAR process, the researchers must make time for reflection and discussion throughout the project.

7.1.5 Messy non-linear cycles of PAR

While theoretical descriptions of PAR describe the cyclical nature of the methodology as a linear process, in practise the researchers experience a much more complex and tangled affair. At times the researchers would move back and forth from diagnosis to action until a suitable solution was found that delivered the desired results. This was particularly noticeable in the early stages of the research project, and admittedly became less as the project matured. The challenge described here is in line with other practitioners' experiences (c.f. James et al. 2008).

7.2 Benefits

7.2.1 Transforming teaching practices

A well-established benefit of using PAR within an educational setting is that the educator can implement lessons learnt to the benefit of students as soon as a new understanding is uncovered. As this research project is spread over five years, this is a particularly important benefit for the researchers meaning that the entire project does not need to be complete for the students to benefit from it. For example after the researchers

wrote their first journal article a decision making technique was added to equip students with the tools to look at problems and associated decisions through different lenses.

7.2.2 Creating a research pipeline

Designing and implementing a research project of this scale with one overarching research question and multiple secondary questions, allows the researchers to zoom into specific secondary questions in turn and provides many research avenues. Of course, not all of the avenues are equally useful or fruitful to contribute to the body of knowledge, but it puts the researcher at an advantage as they can conceptualise several articles and write as time and resources allow.

7.2.3 Discovering helpful technologies

As this article described, the research project entailed collecting several data points at different intervals. At times this presented data collection and storage challenges, especially initially. The researchers met this challenge through using and experimenting with different technologies, such as Google Forms, Today's Meet, Nvivo and Kahoot. Therefore, an added benefit of a research project of this size using PAR is discovering and learning to use new and innovative solutions, often employing technology.

8. Conclusion

Often a gulf exists between the theoretical understanding of methodology and the practical implementation of a sound research project. This article reflected on a research project showing the interplay between theory and practice by disclosing in detail how the research project was conceptualised and implemented by highlighting some of the practical reasons for decisions that were made. The nature of Participatory Action Research, combining qualitative and quantitative data, the systems thinking approach, ethical considerations, reliability and validity considerations are some of the theoretical roots that were discussed. From a practical point of view, the article explained how the stages of PAR were implemented and the conceptual model of the research project was shared. The article also highlights how insights and lessons learned from the PAR process so far have informed changes to the two modules that are under investigation, revealing that valuable insights are not only limited to the end of the project but that improvements to teaching and learning can be made throughout. The practicalities of ensuring reliability, validity and trustworthiness were discussed and, finally the researchers reflected on the main challenges and benefits of engaging in a research project of this nature.

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