The teaching of creativity in Information Systems programmes at South African Higher Education Institutions[1]

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Abstract

The development of problem solving skills is a shared goal in science, engineering, mathematics and technology education. In the applied sciences, problems are often open-ended and complex, requiring a multidisciplinary approach as well as new designs. In such cases, problem solving requires not only analytical capabilities, but also creativity and the ability to innovate. The development of an information system entails problem solving by means of design, hence creativity is integral to the task of an Information Systems (IS) professional. However, it appears that the teaching of creativity in IS programmes is under-researched and possibly neglected. This study investigates what is being done to foster creative ability of South African undergraduate IS students. At the same time, a theoretical framework for creativity teaching is developed. We find that the fostering of creative ability involves more than just the teaching of creativity techniques, and that creativity can be indirectly nurtured in multiple ways.

Keywords: Creativity, Problem solving, information systems, creativity teaching, enhancing creative ability

Introduction

The development of problem solving skills is a shared goal in science, engineering, mathematics and technology education (Govender, 2007; NCTM, 2000; Topi,Valacich & Wright (2010); Wolmarans & Collier-Reed, 2010). In mathematics, problem solving is integral: a goal as well as a major means of learning mathematics (NCTM, 2000). In computer science, "to program is… to solve a problem" (Govender, 2007, p. 40). Within engineering, problem solving is regarded as a "defining feature of engineering practice" (Wolmarans & Collier-Reed, 2010). In the field of IS, the design and development of an information system is fundamentally a problem-solving effort within a specific domain (Li, Yang, Klein, & Chen, 2011), and problem solving is regarded as "omnipresent in the life of an IS professional" (Topi et al., 2010).

In the applied sciences, problem solving needs to extend beyond analytical ability. In a study by Wolmarans and Collier-Reed (2010), engineering lecturers identify a number of characteristics of problem solving in engineering practice. According to the lecturers, problem solving in engineering has a constructive or design element: "how to design something to make it work better". Further, engineering problem solving is regarded as open-ended since incomplete information is supplied and the integration of multiple disciplines is often

[1] Appeared in African Journal of Research in Mathematics, Science and Technology Education, 19 (3): 278 – 288.

required. Wolmarans and Collier-Reed conclude that open-ended problem solving requires not only the application of discipline-specific rules, but also *the ability to think creatively in order to come up with novel solutions*. Drohan, Stapleton and Stack (2006) performed a study among IS graduates, to compare the problem solving skills they require in practice with the problem solving skills they have learned during their studies. The majority of respondents indicated that problem solving is crucial in their work environments. However, the problems they are required to solve during their undergraduate studies do not reflect the complexity and the multidisciplinary nature of problems they have to deal with in practice. Among others, "they lacked proficient working knowledge of problem solving processes and *were not trained to think outside the box*" (Drohan et al., 2006, p. 6). In the field of Operations Research (OR), Evans (1992) argues that the complexity and ill-defined nature of most real-world OR problems require a larger solution space than can be provided by analytical reasoning; *the solution space needs to be enlarged by the use of creativity*. From the above studies, one can see a common emphasis on the importance of creativity and innovation for problem solving in the applied sciences.

In the field of IS, the IS 2010 curriculum unpacks problem solving skills for the information systems graduate to include analytical skills as well as creativity and the ability to innovate (Topi et al., 2010). While the teaching of creativity is acknowledged as important in international curriculum guidelines, our perception from practice is that it appears to be neglected at undergraduate level. Soft skill subjects have to compete for time with a very wide range of essential functional subjects. Furthermore, it has been established that creativity and creativity teaching is under-researched in the field of IS overall (Seidel, Muller-Wienbergen & Becker, 2010; Couger, Higgins & McIntyre, 1993). This article explores the fostering of creative ability of undergraduate IS students at South African HEIs. The article is structured as follows. First, the topic of creativity is introduced. Following this, the teaching of creativity in IS is investigated. The article then proceeds to the empirical study, which involves two rounds of data collection and the development of a theoretical framework. The article concludes by reflecting on the implications of the study.

Defining and Understanding Creativity

There are many ways to define and describe creativity (Couger et al., 1993; Dinicaa, Dineswcua & Miron, 2010; Tsai, 2012; Seidel et al., 2010). Some definitions describe the intelligent behavioural qualities and skills of a person, while other focus on the novelty of an idea or product. One such definition is that "*Creativity is the ability to see a challenge or problem in a new light and thus to find solutions that have not been obvious before*" (Dinicaa et al., 2010, p. 3732). Some definitions focus on creating new ideas by combining familiar concepts (e.g. Tsai, 2012).

Creativity has been studied from a number of perspectives. From a socio-psychological stance, Amabile (1988) focuses on the creativity of the individual in order to understand creativity and innovation in organisations. She considers domain-relevant skills, creativity-relevant skills and intrinsic task motivation the three essential components necessary for the creativity of the individual. According to the creativity-relevant (also called the domain-general) perspective, all people have the ability to express themselves creatively in some way and potentially over many domains, for example through art, music and writing. Flexible cognitive style, willingness to take risks, openness to new experiences and resilience are considered examples of such skills. However, if someone needs to be creative in solving complex problems that relate to a specific field of study like science, engineering or technology, then that person needs the knowledge and skills of the particular field in order to be a creative problem solver. This perspective refers to *domain-relevant* creativity and the focus is more on the product (idea, design, object, etc.) that needs to be developed to help solve the problem. Both views of creativity (domain-relevant and creativity-relevant skills) are important if we want to understand, evaluate, and cultivate creativity (Baer, 2010). This is in line with Wolmarans and Collier-Reed's (2010) finding that open-ended problem solving requires the application of discipline-specific rules, as well as the ability to think creatively. Amabile (1988) considers the third component, intrinsic task motivation, an essential determinant of creativity. Intrinsic task motivation refers to the individual's perceived value of engaging in a task. In contrast, she found that extrinsic motivation (rewards, evaluation, incentives etc.) might prove detrimental to creativity. The psycho-social model proposed by Amabile has been accepted by scholars as a valuable conceptualisation of individual creativity (for example, Cooper, 2000; Woodman, Sawyer and Griffin, 1993). Apart from the three intra-individual components discussed above, Amabile (1988) adds one external component, the social environment. She shows that the social environment can influence domain- and creativity-relevant skills by for example training and experience provided. The social environment though, has a greater effect on the motivational component (Amabile & Pillemer, 2012). By allowing freedom and a sense of control over one's own work, good project management, providing sufficient resources, giving a challenge but also recognition, both intrinsic and extrinsic motivation are supported.

The perspective of Amabile above reflects the characteristics and surroundings of the creative individual. As was mentioned earlier, exploring the definition of creativity opens up different avenues. For example, creativity might be defined by focusing on the product of creative efforts rather than the individual him/herself (Amabile, 1988). By trying to find a definition of creativity, Rhodes (1961) came up with four strands of definitions of creativity and classified it as the four Ps of creativity, i.e. Person, Process, Press and Products. Person refers to the individual, process to the mental processes in the creative process, press to the ecological/environmental influence on the person and products to the idea or artefact that results from the creative effort. The 4Ps model has been used by IS researchers as a useful broad conceptualisation of creativity (Mûller & Ulrich, 2013; Couger et al., 1993; Seidel et al., 2010).

The importance of creativity within organisations and the fact that work is often done in groups, led to an academic interest in group creativity. Woodman et al. (1993) developed an interactionist theory of organisational creativity. They show, from a systemic perspective, how the interaction between the individual, group and organisational environment is working towards a creative product. They consider factors conducive to the creativity of groups such as democratic leadership style, diversity within the group, the cohesiveness of the group, group norms, creative problem-solving approaches as well as the structure of the task. The ideal organisational climate enabling creative work includes elements that support individual creativity (providing enough resources and enough freedom to take risks), as well as group creativity. Cooper (2000) adapts this model to consider factors affecting creative IT requirements and logical design in IS development.

The Teaching of Creativity in IS Education

Creativity experts and practitioners believe that domain general creativity can be taught and enhanced through structured creativity development (Couger et al., 1993; De Bono, 1995; Joo, McLean & Yang, 2013). Well known structured methods exist of which the six thinking hats method of De Bono (1995) is a popular example. Couger et al. (1993), in an attempt to enhance creativity in IS organisations, trained employees to use well-established structured creativity enhancement techniques with good results. These techniques included progressive abstraction, force field analysis, wishful thinking and metaphors.

The need for formal teaching in creativity was already recognised by the IS industry in the early 1990s. The subject of creativity is currently seen as a foundational skill in the IS 2010 curriculum, as part of problem solving skills (Topi et al., 2010). The IS 2010 curriculum provides guiding assumptions about the IS profession and requires a student to understand that the IS professional "demonstrates persistence, flexibility, curiosity, creativity, risk taking, and a tolerance of these abilities in others." (Topi et al., 2010, p. 370). It however leaves the question of how these skills are to be developed in undergraduate IS students. Very few studies exist that demonstrate how creativity theory can inform teaching practices. The study by Nguyen and Cybulski (2008) is one of the few where creativity theory is incorporated into an intervention. They use a novel approach to teach Requirements Engineering (RE) by integrating different dimensions of constructivist learning and creativity education theory to support creative problem solving. They pointed out to students where domain-general and domain-specific creativity skills are needed in the RE life cycle while guiding them through the process. Another example is given by Steyn, Matthee and Turpin (2013) where first year IS students had to use structured creativity approaches to solve an authentic problem. The final product was a video which had to illustrate the technique they chose, the process of reaching the solution as well as the proposed solution.

A number of studies in IS education introduce innovative teaching approaches to address aspects that are related to creativity, but these studies are usually not explicitly based on creativity theory. Often the terms experiential learning, problem based learning, or game based learning are used to describe these interventions. One such an example is where Schatzberg (2002) applies experiential learning to give students the opportunity to relate to the role of the systems analyst in industry. Students follow the role-play of a 'development team' and an 'assembly team'. The development team must solve a problem by designing and building an executive toy, give it a name, and write the instructions of how to assemble the toy on a piece of paper. The dissembled toy with the instructions is then given to the assembly team who must rebuild the toy according to the instructions. The development team will then evaluate the toy built by the assembly team, who will in return evaluate the quality of the instructions given. In addition, the importance of solving real life problems is illustrated by the use of case studies and capstone projects in IS teaching. In this context, case studies refer to a "narrative" which presents the student with a real life or future problem for which the students must find solutions. The importance of this way of teaching in IS, is underlined by the existence of journals like "The Journal of Information Technology Teaching Cases" which solely aims to publish case studies (real examples) in a form that can be used in IS teaching. Finally, a capstone project is a multifaceted project where students can work in groups to apply their skills and knowledge to deliver a project for industry. Usually, the main purpose of a capstone project is to bring the theory and practice together by applying the full design cycle. This helps students to understand on a practical level how their skills will be applied in industry (Tappert & Stix, 2012; Gill & Ritzhaupt, 2013).

The discussion above shows that research on the explicit inclusion of creativity in IS curricula, specifically for systems analysis and design, is scarce (Nguyen & Cybulski, 2008). In particular, there is no comprehensive framework for developing the creative ability of undergraduate IS students. This article wants to explore how the development of creative ability is approached by IS lecturers at South African HEIs. We wanted to ascertain what teaching approaches they reportedly use to promote creative practices.

Teaching of Creativity in IS at Various South African HEIs

Research Design

The empirical study consisted of two phases. The first was a familiarisation phase, where 19 South African HEIs that were known by the authors to offer IS or related degrees were approached to find out what they were doing in terms of creativity teaching, in particular in their Systems Analysis and Design modules. Since South African HEIs do not have a uniform structure for their IS departments, this study targeted IS as well as IT departments offering systems analysis, and focused on design courses as well as programming courses. Lecturers from 11 HEIs agreed to share what they and the colleagues in their departments were doing in terms of creativity teaching. Often, the initial contact person referred the researcher to someone who was more knowledgeable on the topic. As mentioned, this was a familiarisation exercise that explored whether and how the various lecturers included creativity in their teaching. Data were collected during an informal survey by means of email and telephone interviews. These data were analysed for recurring keywords and themes related to the teaching of creativity. The analysis strategy was informed by the literature on creativity and creativity teaching, in order to draft a theoretical framework for the development of creative ability of undergraduate IS students.

In order to confirm the appropriateness of the framework for undergraduate IS students in South Africa, we wanted to test it with colleagues who were experienced and knowledgeable about teaching of creativity skills. In the second empirical phase, a sub-set of six IS lecturers were approached who were identified during the familiarisation phase as being especially knowledgeable in the teaching of creativity and four of these were available. They were associated with four different institutions. In-depth interviews were held with these four lecturers individually to obtain their comments and inputs on the theoretical framework. We received their inputs on whether they agreed with the framework's categories and components, and whether some components stood out to be more important than others. We also asked them about implementing these components in practice - whether they themselves were currently doing it, and how to go about it especially in the South African context. The second phase included an ethical clearance application and the collection of informed consent.

Information collection Phase 1: Familiarisation

As mentioned, Phase 1 was a familiarisation exercise that explored whether and how the various lecturers included creativity in their teaching. At this stage, it needs to be noted that most participants responded that problem solving was central to their teaching, but they did not necessarily have modules on problem solving and even less on creativity. Lecturers who explicitly employed methods to teach creativity were the exception.

Figure 1 provides a comparative summary of teaching approaches that emerged from the data, being different ways in which creativity was directly or indirectly addressed. A 'yes' indicates the number of IS departments that made use of a specific approach (as identified in the data) in their curriculum. Some participants provided information about unique projects that they believed indirectly fostered creativity, for example linking system design to charity projects. These projects are categorised under “other” and not discussed further.

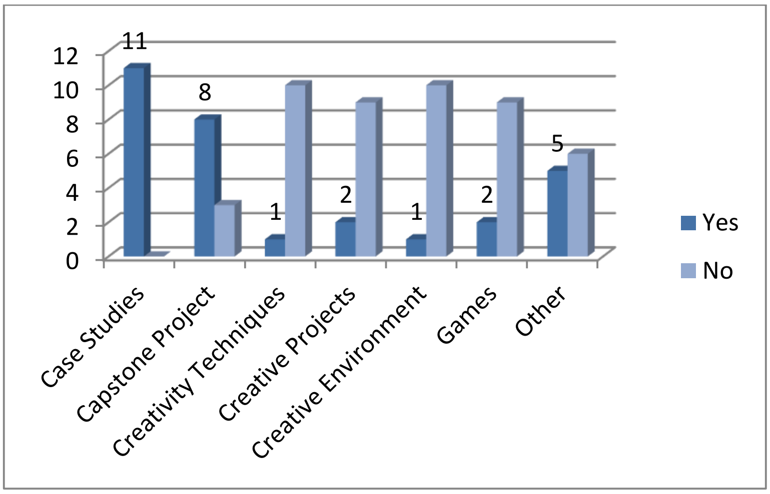

Figure 1. Teaching approaches used by participating HEIs

Discussion of findings: Phase 1

All participating IS departments mentioned the use of case studies or scenarios to present a problem to students in class. In the second year or third year of studies the case studies generally become more complex. Some departments were involved with organisations that provide them with their real-world problems as a case study. Eight of the participating departments run a capstone project: a final, multifaceted project where students can work in groups to apply their skills and knowledge to deliver a project for industry. The other three departments do not have the required resources to run capstone projects.

One of the participating departments teaches creativity techniques (such as idea association, mental provocation, Triz and Six Thinking Hats) as part of their undergraduate IS curriculum.

Creative projects refer to any official project or assignment that involves a specific creative component, such as music, art, or drama. Two participating departments had creative projects in their curriculum. One of these included the design of a poster as part of their IT project management module where students have to use art and be creative in how they present their projects in a poster format. The second department included the making of a 5 minute video as a problem-solving project for their first year IS students.

A creative environment involves something that a lecturer does to the physical, social or cultural environment in class or after class with projects or assignments to encourage creative problem solving. All participating departments had group assignments for problem solving, with the potential to create a social and cultural environment to boost creative effort. However, only one department was found to actively influence all three environments (physical, social and cultural) by having a creative room with round tables where students can have group discussions, play problem solving games, and participate in problem solving group assignments.

Two participating departments included games as part of their IS curricula. At one of these, the lecturer has built a room for her IS students where they sit at round tables and play problem solving games such as puzzles, Lazer Maze, Tangram, Lego Mindstorms, etc. During this game session, technical concepts are introduced to students while collaborative learning takes place and the lecturer only becomes the facilitator of the learning experience. Games are specially selected to enhance creative problem solving skills students need in order to do their practical programming class in the computer labs. The practical programming class follows directly after the two hour gaming and learning session. This was the only university out of the 11 participating HEIs who explicitly and successfully integrated a creative learning environment with technical concepts through play. The lecturer explained that these problem solving games also help to bridge the cultural differences and educational gaps that students might have. Another participating university also introduced Lego Mindstorms in the first year IS module to help enhance problem solving skills at introductory level.

Towards a theoretical framework for the development of creative ability in IS students

The data collected during the familiarisation phase made it clear that the participating IS lecturers recognised many facets to the teaching of creativity. To a few participants, it was important to use creativity techniques or games in the process of problem solving. Many participants believed that exposing students to real world problem solving situations (through capstone projects) also nurtured their creativity skills. To some participants the use of carefully selected case studies was important to nurture problem solving skills that included creative thinking. In order to make sense of the variety of responses received, the literature on creativity was revisited along with the findings of Phase 1 to develop a theoretical framework for the development of creative ability in undergraduate IS students. The phrase “developing creative ability” is used to emphasise that the focus is on the development of creativity skills – creativity as the end rather than the means, although developing creative ability may include the utilising of a creative means or environment.

The theoretical framework is largely informed by the work of Cooper (2000). In an attempt to improve the understanding of creativity during IT requirements and logical design phases, he devised a creativity model using ideas from organisational (Woodman et al., 1993) and creativity literature (see Amabile & Pillemer, 2012). This resulted in Cooper’s perspective that “organisational creativity results from individuals working together in a complex social system on a heuristic, rather than algorithmic, task with an outcome consisting of a useful and novel product, service, procedure or process” (Cooper, 2000, p. 248). From the interviews in phase 1 of this study, it became clear that a number of interventions mentioned by the interviewees are meant to create as closely as possible such a collaborative creative environment. For this reason, Cooper’s model seemed appropriate to use as foundation of the proposed theoretical framework.

Our framework proposesthat in order to facilitate creative ability of IS students, the individual student, the team and the teaching environment should be considered. These aspects were discussed in the section on creativity theory and are given as categories with components in Table 1 below. We decided to add an additional category called “the nature of the problem” – something that is a given in an organisational context but pliable in a teaching context. Thus we emphasise the important role of the IS lecturer to manipulate the problem space such that it requires creative effort to solve the problem. In particular, from the interviews and literature, the inclusion of capstone projects seems to be an important factor in the fostering of creative ability of IS students.

Table 1. A theoretical framework for developing the creative ability of IS students

Framework category	Component	Supporting references
1. Development of a student's creative ability while focusing on ***the individual student,*** during IT/IS course or project.	• Domain knowledge (incl. process/task knowledge)	• Cooper (2000), Adams (2006), Amabile (1988)
	• Creativity skills	• Cooper (2000), Adams (2006), Amabile (1988), Couger et al. (1993)
	• Fostering of intrinsic motivation (perception by individual that activity is meaningful)	• Cooper (2000), Adams (2006), Amabile (1988), Zhou (2012)
2. Development of a student's creative ability while focusing on ***the team level,*** during IT/IS course or project.	• Structuring of task and process	• Cooper (2000), Woodman et al. (1993), Adams (2006), Amabile (1988)
	• Team diversity: functional as well as socio-cultural	• Cooper (2000), Woodman et al. (1993), Adams (2006)
	• Group level problem solving and creativity skills	• Cooper (2000), Couger et al. (1993)
	• Group internal dynamics (e.g. shared norms)	• Cooper (2000), Woodman et al. (1993), Adams (2006), Tiwana and Mclean (2005)
3. Development of a student's creative ability while focusing on the ***teaching environment*** creativity skills during IT/IS course or project	• Freedom to take risks	• Cooper (2000), Romeike (2007), Adams (2006), Amabile (1988)
	• Reward system (moderate extrinsic motivation)	• Cooper (2000), Woodman et al. (1993), Amabile (1988)
	• Availability of resources/ infrastructure to perform task	• Cooper (2000), Adams (2006), Amabile (1988)
4. Development of a student's creative ability while focusing on ***the nature of the problems*** presented during IT/IS course or project	• Open-ended problems, requiring "heuristic" rather than algorithmic approach	• Cooper (2000), Amabile (1988), Adams (2006), Romeike (2007), Zhou (2012)
	• Capstone projects	• Gill & Ritzhaupt (2013)

Information collection Phase 2: Feedback on Framework

Four lecturers were asked for their views on several aspects of the framework resulting from the data of Phase 1. They commented on the whether they agreed with the framework categories and components, and whether some components seemed more important than others. They also commented on the possible implementation of these components in the South African context. The responses of the four lecturers are discussed below, grouped according to the framework's categories. The lecturers are referred to as R1 to R4.

Responses on framework category 1: The individual student

The four lecturers all agreed that this category was relevant. Further, each stated that domain knowledge was "essential" (R1) or "very important" (R4) for being creative. Stating the reverse, R3 commented that "students are not creative because they are not comfortable with the technology". No one denied the importance of creativity skills, but there was a general sense that in practice, in a resource constrained environment where it was a challenge to get students to master the domain content, spending time on teaching creativity skills was not a priority. The respondents again agreed that intrinsic motivation was "very, very important" (R4), but they were careful about how to stimulate intrinsic motivation by noting "one tries to talk to them" (R2) and "I hope I inspire them" (R1).

An aspect at the level of the individual student that was not in our framework and that was mentioned by more than one lecturer, was that of entrepreneurship, even to the extent that "IS students should have a course in entrepreneurship" (R1). Enterpreneurship is seen as a character trait of students "who are willing to try out and generate options and hence be more creative" (R3).

Responses on framework category 2: The team

There was agreement in the lecturers' responses that since systems design is done in teams, a student's team contribution is important. Of the four framework components in this category, lecturers generally placed more emphasis on the structuring of the task and on the team's internal dynamics. There were strong opinions on task structuring: two lecturers reported that intensive tutoring and appropriate assessment should form part of task structuring (R1 and R4). "We teach them project management before their first group assignment" (R3). The topic of team internal dynamics evoked equally strong responses: "groups that battle with relationships just try to survive and deliver the minimum, while groups that work well together can go further in terms of creativity" (R1). R3 reflected this sentiment by saying that "We are passionate about cohesion and interpersonal problem solving" (R3). The framework components of team diversity and group creativity skills were acknowledged as important but appeared to receive less attention in practice.

Responses on framework category 3: The teaching environment

The category of the teaching environment was again acknowledged as important, but according to the feedback did not receive very much attention. In terms of risk taking for example, lecturers stated that the class environment should "be comfortable enough to take risks" (R4) and students "should not be inhibited" (R2), however "reality does not always allow for it", as R2 observed. Extrinsic motivation appeared to be present in the settings of all four lecturers, however it was not regarded as a strong driving factor, for instance "I'm not sure whether the year-end prizes motivate them" (R3). In terms of resources and infrastructure, the interviewees gave the impression that some technology and infrastructure was available, that lecturers would have liked to have better facilities but that this was unlikely to happen.

Responses on framework category 4: The nature of the problems presented

All four lecturers believed this category was important, and were keen to discuss how the kind of problems presented to students may lead them to more creative responses. Lecturers confirmed that their students were given open-ended problems, and used the synonymous descriptors such as "wicked", "messy" (R4) and "challenging" (R2). Two lecturers stated that they carefully managed the complexity level of problems and projects: it has to be complex enough so that students are forced to improvise and explore (and hence be creative) but not so difficult that they will lose heart (R1, R3). Regarding the framework component of capstone projects, the response from lecturers was that students needed to be exposed to real-world, complex and authentic problems, whether these were final year capstone projects, case studies or smaller assignments. In other words, they did not single out capstone projects. They were rather more concerned with the problem being real-world (R1, R2, R3) and authentic, that is, being close to the students' own life worlds (R3, R4).

Reflecting on feedback received regarding the theoretical framework

During the four interviews held in Phase 2, support was received in principle for the theoretical framework, in terms of its categories and components. The discussions highlighted which aspects of the framework the participating lecturers regarded as relatively more important. In the category of the individual student, it was clear that the lecturers thought that domain knowledge was a more important prerequisite for fostering creative ability than creativity skills. Lecturers also recognised the importance of intrinsic motivation but were less clear on whether and how intrinsic motivation could be influenced. They further added that entrepreneurship skills also contributed to creative ability. In the category of the team, lecturers emphasised two framework components above the other, namely the structuring of the task and team cohesion. They thought that careful management of these two aspects would have a significant impact on a student's ability to be creative within a team context. In the category of the teaching environment, lecturers confirmed that the components of an environment in which to take risks, the reward system and availability of resources were all relevant but that these were not the items on which they spent their energy. The last framework category, namely the nature of the problem presented, was one about which the lecturers were more outspoken and where they felt they could make a significant difference, even with limited resources. While one lecturer emphasised the significance of a capstone project, the overall feeling was that to present students with open-ended, complex, real-life and authentic problems was something that could be done in many ways during teaching.

Discussion

The data collected in Phase 1 showed us that the 11 participating IS departments had a variety of approaches which participants believed contributed to the development of creativity skills. All participating institutions employed case studies, most employed capstone projects and there were only a few examples of initiatives that explicitly employed and/or focused on creativity as an outcome. The theoretical framework that was subsequently developed, indicated that only looking at creativity techniques or particular projects constitutes a limited view of the development of a student's creative ability. The framework however, surfaced a multitude of other components to be taken into account when developing creative ability. Phase 2 of the data collection assisted in a first attempt to prioritise the framework components within a South African context.

While the literature survey indicates a lack of focus on the development of creativity skills in IS, and the data from Phase 1 also indicate a limited focus on projects dedicated to creativity skills development, the in-depth discussions of Phase 2 assist us to view this apparent problem in context. The discussions of Phase 2 highlight the relative importance of domain-specific knowledge above creativity skills by themselves. The Phase 2 data also indicate the importance of the way a problem is structured and presented to students, regardless of whether problems form part of case, assignments, class discussions or capstone projects. It is indeed the case that capstone projects are best suited to expose students to real-world, complex and authentic problems where they are forced to apply and integrate domain knowledge in a creative manner. However, where the resources are lacking to manage capstone projects, careful planning of project/problems can still result in exposing students to authentic, real-world complex problems.

Conclusion

In the introduction we argued that in the applied sciences, problem solving needs to extend beyond analytical ability. It also requires the ability to design, to innovate and to be creative.

In the field of IS, problem solving is included as a foundational skill in the IS 2010 curriculum, where it refers to analytical skills as well as creativity and the ability to innovate. This study was performed to investigate the current state of creativity teaching in IS at South African HEIs, at undergraduate level.

During the familiarisation phase with its open-ended discussions, participating lecturers suggested a variety of means in which creative ability could be stimulated, whether directly or indirectly, and through a wide variety of possible projects and assignments. In order to arrive at a more structured research outcome, a theoretical framework was drafted for the development of creative ability in undergraduate students. The framework was informed by the literature as well as data from the familiarisation phase. In the second empirical phase, the framework was discussed with four lecturers who were regarded as experienced in the development of creativity skills. Their feedback on the framework led to some interesting findings, such that domain knowledge is regarded as more important for developing creative ability than creativity techniques, and that careful consideration of the nature of problems presented to students is regarded as very important for developing creative ability.

The contribution of this article is twofold: it provides a picture of how creativity is understood and nurtured at IS departments in South Africa. The article also suggests a possible theoretical framework for the development of creative ability in IS. The study is limited by its exploratory nature, and the small number of respondents that participated in Phase 2 of the data collection. As a result, the framework can only be regarded as a preliminary theoretical basis for creativity teaching in IS. There is a lot of scope for further research that looks more comprehensively at creativity teaching. This study presents a building block for such future research.

References

Amabile, T.M. (1988). A Model of Creativity and Innovation in Organizations. *Research in Organizational Behavior*, 10, 123-167.

Amabile, T.M., & Pillemer, J. (2012).Perspectives on the Social Psychology of Creativity. *The Journal of Creative Behaviour*, 46(1), 3-15.

Baer, J. (2010). Is Creativity Domain Specific? In J. Kaufman and R. Sternberg (Eds) *The Cambridge Handbook of Creativity* (pp. 321 - 341). New York: Cambridge University Press

Cooper, R.B. (2000). Information Technology Development Creativity: A Case Study of Attempted Radical Change. *MIS Quarterly*, 24(2), 245-276.

Couger, J.D., Higgins, L.F., & McIntyre, S.C. (1993). (Un)Structured creativity in Information systems organizations. *MIS Quarterly*, *17*(4), 375 - 397.

De Bono, E. (1995). Serious Creativity. *The Journal for Quality and Participation*, *18*(5), 12-18.

Department of Higher Education. (2015). Retrieved March, 2, 2015, from http://www. dhet.gov.za/.

Dinicaa, M., Dineswcua, L. & Miron, C. (2010). Developing the students' creative potential by using visual methods while studying Physics. *Procedia Social and Behavioral Sciences*, 2, 3731–3736.

Drohan, S., Stapleton, L. & Stack, A. (2006). *Problem solving skills in information systems development curricula*. Paper presented at All Ireland Society for Higher Education (AISHE) Conference, Maynooth, Ireland.

Evans, J.R. (1992). Creativity in MS/OR: Improving problem solving through creative thinking. *Interfaces*, *22*, 87 - 91.

Gill, T.G. & Ritzhaupt, A.D. (2013). Systematically Evaluating the Effectiveness of an Information Systems Capstone Course: Implications for Practice. *Journal of Information Technology Education*, 12, 69-94.

Govender. I. (2007). Experiences of learning and teaching: Problem solving in computer programming, *African Journal of Research in Mathematics, Science and Technology Education*, *11*(2), 39-50.

Joo, B-K., McLean, G.N. & Yang, B. (2013). Creativity and Human Resource Development: An Integrative Literature Review and a Conceptual Framework for Future Research. *Human Resource Development Review*, 12(4), 390 - 421.

Li, Y., Yang, M. H., Klein, G., & Chen, H. G.(2011). The role of team problem solving competency in information system development projects. *International Journal of Project Management,* 29(7),. 911-922.

Mûller, S. D., & Ulrich, F. (2013). Creativity and Information Systems in a Hypercompetitive Environment: A Literature Review. *Communications of the Association for Information Systems (CAIS)*, 32, 175-201.

NCTM. (2000). *Principles and standards for school mathematics: Executive Summary*. Retrieved 19 March 2015 from http://www.nctm.org/uploadedFiles/Standards_and_Positions /PSSM_ExecutiveSummary.pdf

Nguyen, L., & Cybulski, J. (2008). Learning to Become a Creative Systems Analyst. in D. Schmorrow, J. Cohn and D. Nicholson (Eds) *The PSI Handbook of Virtual Environments for Training and Education*. (pp. 208-226). Westport, CT: Praeger Security International.

Rhodes, M. (1961). An Analysis of Creativity. *The Phi Delta Kappan*, 42(7), 305-310.

Romeike, R. (2007). Applying Creativity in CS High School Education – Criteria, Teaching Example and Evaluation. Paper presented at the Seventh Baltic Sea Conference on Computing Education Research, Koli National Park, Finland.

Schatzberg, L. (2002). Applying Bloom's and Kolb's Theories to Teaching Systems Analysis and Design. Paper presented at ISECON, vol. 19.

Seidel, S., Muller-Wienbergen, F. & Becker, J. (2010). The concept of creativity in the information systems discipline: Past, present, and prospects. *Communications of the Association for Information systems (CAIS), 27*, 217-242.

Steyn, A.A., Matthee, M C., & Turpin, S.M. (2013).Teaching Creativity to First Year Students to Solve Relevant Problems – A Success Story. *Proceedings of the AIS SIG-ED IAIM 2013 Conference.* Paper 14.

Tappert, C., & Stix, A. (2012). Adapting to Change in a Masters-Level Real-World-Projects Capstone Course. *Information Systems Education Journal*, *10*(6), 25.

Tiwana, A. & Mclean, E.R. (2005). Expertise Integration and Creativity in Information Systems Development, *Journal of Management Information Systems*, 22(1), 13-43.

Topi, H., Valacich, J.S. & Wright, R.T. (2010). IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems. *Communications of the Association for Information Systems (CAIS)*, 26(18), 359-428.

Tsai, K. C. (2012). The value of teaching creativity in adult education. *International Journal of Higher Education*, 1(2), 84-91.

Wolmarans, N. & Collier-Reed, B.I. (2010). Problem-solving discourse models: informing an introductory engineering course, *African Journal of Research in Mathematics, Science and Technology Education*, 14(2), 28-41.

Woodman, R.W., Sawyer, J.E, & Griffin, R.W. (1993). Toward a theory of Organizational Creativity. *The Academy of Management Review*, 18(2), 293 - 321.

Zhou, C. (2012). Teaching Engineering Students Creativity: A review of applied Strategies, *Journal on Efficiency and Responsibility in Education and Science*, 5(2), 99 - 114.