AFRICAN PERSPECTIVES OF RESEARCH IN TEACHING AND LEARNING
ISSN PRINT: 2521-0262
ISSN ONLINE: 2662-012X

Enhanced creativity with Mini-PAT: A case of grade 9 Technology teachers in Sekhukhune East

Magolego Maokanyane Patricia[1*]; Mtshali Thokozani Isaac[2], and Ramaligela Sylvia Manto[1]
University of Limpopo, South Africa[1]
Tshwane University of Technology, South africa[2]
Corresponding Author: patmaokanyane@gmail.com

ABSTRACT

Creativity has become a prerequisite for societal progress, and schools are critical to this progress. The purpose of this study was to explore Grade 9 Technology teachers' creative pedagogy when handing Mini-PAT in schools around Sekhukhune East district. Qualitative research design was employed by the researcher to purposively sample five (5) Technology teachers from five (5) schools to participate in this study. Non-participant observations and semi-structure interviews were used as the methods of data collection from the participants. This study adopted Rashmi's four elemental model of creative pedagogy as a conceptual framework. The findings of this study have revealed that grade 9 Technology teachers have challenges in engaging their creative pedagogy when handling Mini-PAT and that hinders the promotion of creativity. These challenges are some of the reasons why the purpose of Technology of producing creative learners is not obtained. This study calls for the Department of Basic Education to revamp the curriculum for Technology education, especially as it concerns time allocation for a smooth incorporation of creativity in the classroom. It also encourages subject advisors to come with better ways of training teachers on how to apply their creative pedagogies and the design process when handling Mini-PAT. Lastly, it encourages Technology teachers to reflect on their teaching strategies with respect to creative thinking skills.

Key words: Technology Education, Creativity, Teaching Strategies, Mini-PAT and Learning environment.

1 Introduction

Creativity is considered one of the higher orders thinking skills that must be taught in Technology education, but there is little evidence that it occurs in the classroom. For these skills to be facilitated successfully, they require Technology teachers to have a thorough comprehension of which Mini Practical Assessment Task (Mini-PAT) activities and teaching strategies to practice in the classroom. Mini-PAT refers to a set of short practical assessment tasks which make up the main formal assessment of a learner's skills and application of knowledge during each term (Department of Basic Education, 2011). Scholars believe that teachers fail to enhance creativity because the problematic nature of and inconsistent understandings about creativity make it difficult for teachers to know how to enact particularly in the absence of policy guidance or exemplars (Henriksen, Henderson, Creely, Ceretkova, Černochová, Sendova and Tienken, 2018).

The research projects conducted in South Africa concerning Mini-PAT such as Ramaboea, Ramaligela and Mtshali (2022)

and Gumbo (2019) have presented that some teachers do not even know how to apply Mini-PAT in their classrooms, while others fail to strengthen it due to the absence of educational resources (Kubheka, 2018). However, there have been a few studies on teachers' engagement of creative pedagogy when handling Mini-PAT in Technology classroom (Nkosi, 2020). Duchovicova and Tomsick (2017) note that while there is some consistent evidence of attention to creativity in education policy, school and teaching practice often remain rooted in conventional traditions (Collins & Halverson, 2018). These claims are supported by the observation made by Magolego, Mtshali and Ramaligela (2022) and Öksün and Kurt (2017) that teachers prefer using traditional didactics as compared to learner-centred because they are used to them.

It is very concerning that in this 21st century where creative engineers, technologists and artisans are in high demand, Technology teachers are still struggling to develop learners' creativity skills through Mini-PAT (Nkosi, 2020). One of the goals of the Technology subject in the CAPS document is to develop learners' creative thinking skills; however, Mathumbu, Rauscher, and Braun (2014) note that teaching in the Technology classroom is still limited to lower order thinking skills. They also emphasized that if learners are not encouraged to develop higher-order skills such as creativity, the goals of technology will never be realized, which may have consequences for future research.

Although the Department of Basic Education (2011) states that, Mini-PAT is designed to give learners the opportunity to develop and demonstrate their levels of ability, precisely creativity, the Curriculum and Assessment Policy Statement (CAPS) document does not inform Technology teachers of how exactly they can develop creativity through Mini-PAT. With that being said it was deemed necessary to explore how grade nine (9) Technology teachers engage their creative pedagogy when handling Mini-PAT.

3 Research problem

Mini-PAT is the core of the formal assessment of learners' skills and application of knowledge in Technology education (DBE, 2011). As stipulated in the CAPS document, these Mini practical tasks are designed to develop learners' creative and critical thinking skills (Department of Education, 2011). However, the dominance of direct instruction in Technology lessons has often provided little opportunities for practical exposure and further exacerbated the development of creativity during Practical Assessment Tasks (Chiliba, 2019; Ohemeng-Appiah, 2014). This study is underpinned by growing concerns that nurturing of creativity has not yet become reality in most subjects in schools. Attesting to this claim is a pre-study conducted by Magolego, Mtshali and Ramaligela in 2020 which was examining how grade 9 Technology teachers enhance creativity in the classroom. The findings indicated that the sampled Technology teachers could not enhance learners' creativity in class. Besides, this study takes note that Mini-PAT in Technology is the backbone of practical skills acquisition and ignoring how teachers creatively execute it may lead to results that were previously discovered. Thus, this study is concerned with exploring Teachers creative pedagogy when undertaking Mini-PAT.

2 Research questions

To address these above-mentioned challenges.

- Development of creativity when handling Mini-PAT in Technology education
- Execution of the design process
- Physical factors influencing the enhancement of creativity.
- Use of traditional teaching strategies,

This study probed the subsequent questions:

- How do grade 9 Technology teachers enhance creativity when handling Mini-PAT?
- What are the physical factors that influence the reinforcement of creativity in Grade 9 Technology classroom?

4 The Four-Elemental Model of Creative Pedagogy.

This paper explores grade 9 Technology teachers' creative pedagogy when handling Mini-PAT in the classroom. This study adopted the concepts of teaching for creativity and physical environment from Rashmi's (2012) conceptual framework of "Four elemental model of creative pedagogy". Due of its emphasis on promoting creativity in the classroom, this framework is intended to provide a comprehensive view of fostering creativity through education by illustrating the relationship between creativity and pedagogical practices. Rashmi developed four interconnected elements of creative pedagogy in an attempt to improve learners' creativity in the classroom: (1) creative teaching, (2) teaching for creativity, (3) creative learning, and (4) psycho-physical environment.

However, for the purpose of this study only teaching for creativity and physical environment themes are adopted. In this context, teaching for creativity entails providing learners with opportunities to develop their creative potential through assessments and activities. (Pusca and Northwood, 2018). Physical environment has to do with the space of the learning environment itself (Richardson and Mishrab (2017), these include factors such as resources and learner-teacher ratio. This paper investigated teaching for creativity and the physical learning environment [in order] to understand how grade 9 Technology teachers engage their teaching strategies, activities, and resources to enhance learners' creativity. The study looked at how teachers engage in the design process, problem solving, resources, and teamwork to get a complete picture of how teachers enhance creativity skills when handling Mini-PAT. These are the key fundamentals that can lead to learners' creative development during Mini Practical Assessment Tasks (Kubheka, 2018). The study looked at the availability of resources, time, and learner-teacher ratio to identify the physical factors affecting teachers' ability to promote creativity in class.

5 The enhancement of creativity in Technology classrooms

Creativity is at the forefront of the latest education shifts worldwide including China (Cho, Pemberton & Ray, 2017), Australia, Canada, England and United States of America (Perry and Collier, 2018; Collard and Looney, 2014). Several researchers such as Magolego, Mtshali and Ramaligela (2022), Lasky and Yoon (2020) and Ahmadi, Peter, Lubart and Besançon (2019) agree that creativity is a skill we should be teaching in classrooms because of its importance in the current society. It is therefore not surprising that most teachers are expected to develop the theory and practice of teaching and learning, as well as all other aspects of this complex arrangement to ensure quality preparation of all learners to life and work (Serdyukov, 2017).

Cultivating learners' creativity in Technology classrooms is crucial in aligning with the 21st century educational goals (Cremin and Barnes 2018). Creativity prepares learners to become technologists who are capable of solving problems in their respective places of work to meet the needs of the present society. In essence, the inclusion of Technology in the South African curriculum was motivated by the need to produce more engineers, technicians, and artisans, among other things (Department of Basic Education,

2011) through Practical Assessment Task (PAT) approach.

While there is some consistent evidence of attention to creativity in educational policy, school and teaching practice often remain rooted in conventional traditions (Duchovicova and Tomsik, 2017). Mathumbu, Rauscher and Braun (2014) add that, teaching in the Technology classroom is still restricted to lower-order thinking such as remembering, understanding and applying. They further emphasized that if learners are not supported to develop higher order skills such as creativity, the aims of Technology will never be obtained and this may have implications for further studies (Mathumbu, Rauscher and Braun, 2014). According to Kubheka (2018) design process, problem solving, educational resources and teamwork are key elements that can result in learners' creative development during Mini Practical Assessment Tasks (Mini-PAT). However, the research projects conducted in South Africa concerning Mini-PAT have presented that some teachers do not even know how to apply Mini-PAT (Gumbo, 2019) while others fail to strengthen it due to the absence of educational resources (Kubheka, 2018).

There is a plethora of literature on the factors that contribute towards the development of learners' creativity in the classroom (Beghetto & Kaufman, 2013; Rashmi, 2013; Smith & Smith, 2010; Beghetto 2010). Beghetto and Kaufman (2013) explored the role of individual factors and learning environment play in the development of learners' creativity. The individual factors include cognitive ability, self-belief, passion, and intrinsic motivation (Jauk, Benedik, Dunst et al., 2013). The importance of a conducive learning environment cannot be overemphasised because learners are from different backgrounds families, belief systems, experiences, interests, and abilities (Beghetto and Kaufman, 2013).

Rashmi (2012) opines that the learning environment, to a large extent, influences a learner vis-à-vis creativity in the classroom. He believes that creativity may be fostered successfully in the classroom through the interaction between successful teaching by a creative teacher, creative learning by the active learner, and a supportive psycho-physical learning environment (Rashmi, 2012). Additionally, in a study conducted by Liam (2018), he found that the learning process and school environment are the most important factors in developing creativity.

Chan and Yeun (2014) investigated the factors that facilitate or impede the enhancement of creativity in the classroom. The findings revealed personal and environmental factors as both facilitators and impediments. They also found that physical environment, time and space, atmosphere, curriculum and subjects, parents, and society were among the physical factors considered. They concluded that teachers frequently struggle to strike a balance between fostering learners' creativity and meeting other school demands such as meeting curriculum requirements. Sawyer (2015) also avers that schools appear to be the very settings that hinder rather than foster learners' creativity.

In most studies focusing on the physical factors affecting creativity enhancement in Technology classroom such Janak (2014) and Nkosi (2020), educational resources, time and pressure, and overcrowded classroom are commonest. These factors were also emphasised by the teachers in Chan and Yuen's (2014) study. With that said, factors including the learning environment, pedagogical content knowledge, collaboration between learners and teachers as well as the learning and teaching support material will all be examined thoroughly in this study.

6 Methodology

This study used qualitative approach as the methodology of this. Qualitative approach allows the researcher to combine descriptions of events, people and behaviours (Ramaligela, Mji and Ogbonnaya, 2015)

6.1 Population

The population for the study consisted of grade 9 technology teachers in Sekhukhune East. A purposive sampling of five Technology teachers from all the schools under Sekhukhune east district was chosen, precisely those who are in possession of B. Ed with Technology as a major subject and has been teaching Technology for at least two to three years. The participants' qualifications and experience were essential since teachers with suitable qualifications and experience in teaching Technology would be able to provide expert opinion on the object of the inquiry.

6.2 Data collection methods

The study used observations and interviews as data collection methods. The observations were aimed at determining the practices grade 9 technology teachers engage to enhance creativity when handling Mini-Practical Ass Task. According to Singh-Pillay and Sotsaka (2016), the advantage of using observation is that it provides researchers with first-hand experience, allowing them to generate detailed descriptions of the setting, activity, interactions, and participants' experiences. It also gives the researcher an opportunity to verify if the participants' observed behaviour is consistent with what they described in the interviews. A semi-structured interview approach was used to probe the physical factors that inhibit the development of learners' creative skills during Mini-Pat. Interviews allow researchers to engage in real time in-depth conversations with participants (Pietkiewicz and Smith, 2014). Rubel and Okech (2017) also add that interview provides the opportunity to build rapport with research participants and encouragement for meaningful reflection and sharing. Hence, this study deemed it suitable.

6.3 Data analysis

Data collected through observation were presented and analysed descriptively per item in the observation schedule. The observation data were presented narratively starting with the description of the participants, lesson presentations and the summary of the observation in relation to the applicable themes of the framework. In order to enhance the trustworthiness of the study, the researcher ensured credibility, applying triangulation and member checking. Triangulation helps to guarantee that, fundamental biases arising from the use of one method are overcome (Noble and Heale, 2019). Participants were given a chance to confirm the themes noted down during data collection, because credibility is mirrored when participants confirm that the findings are really what they said (Streubert & Carpenter, 1995).

The interview data were semantically analysed. Semantic analysis is a systematic description of the surface meanings of data, and the analyst is not looking for anything other than what a participant said or what has been written (Clark & Braun, 2013). Therefore, participants' inputs from semi-structured interviews were transcribed and coded. During this process of coding, responses projecting similar ideas were grouped together. This was done by reading all the transcripts and of course taking into consideration the key concepts and statements. Subsequently, the researcher coded important statement of each teacher's experiences in relation to the applicable themes of the framework to avoid repetition of the same statements.

The study consisted of open-ended questions which allowed flexibility in

expressing their opinions and experiences, which mirrored transferability (Polit & Beck, 2012). To enhance confirmability, the researcher presented the findings exactly how the participants shared their interpretations without adding anything. Participants were given an opportunity to confirm the correctness of their word for word recorded through notes during the interviews. The outcomes obtained were not by any chance influenced by the researcher's personal views and values. Lastly ethical clearance was issued by the University of Limpopo, the faculty of education, to guide the researcher in terms of ethical considerations.

7 Findings

The findings of this study were presented in a way that answer the research questions in relation to the teaching for creativity and physical environment themes of the conceptual framework.

7.1.1 How do grade 9 Technology teachers enhance creativity when handling Mini-PAT?

Teachers had a challenge in developing learners' creativity during Mini-PAT. These findings were based on observing the following.

Teaching for creativity

Design process

Looking at how teachers presented their lessons, most of the teachers' lessons, learning objectives, and content knowledge delivery were in line with the design process. Even though all the stages of the design process were not covered, one of the five stages was featured in their lessons. This is in tandem with the CAPS document that states that a Mini-PAT does not need to cover all the aspects of the design process unless it is a full capability task (Department of Basic Education, 2011). For instance, Teacher A asked learners to tabulate the differences between the three methods of preservation while Teacher B instructed the learners to analyse the properties of different plastics. These tasks are in line with the investigation stage of the design process. Investigation provides learners with an opportunity to evaluate existing products to develop a thorough understanding (Department of Basic Education, 2011).

However, the concern is these teachers only executed the first two stages of the design process, investigation and design and they did not present the scenarios of those tasks. Presenting the scenarios would have given learners an opportunity to develop and apply specific skills to solve authentic problems as encouraged by Rashmi's creative pedagogy. Learners were never provided an opportunity to build the actual artefact. The researcher believes teachers chose to focus on the theoretical part of the design process because they lack skills to facilitate practical lessons and resources since none of the schools had a Technology workshop. These claims are supported by the findings obtained by Mtshali and Ramaligela that, teachers lack understanding on how practical lessons are conducted in order to promote active learning.

Problem solving

With regard to problem solving, most teachers had a challenge in applying this strategy to develop learners' creativity. It was only Teacher E who engaged problem solving by asking learners to do a design brief and sketch the product they were going to make. The learners were expected to solve two problems, the first being to control land pollution and the second, producing a self-watering planter.

The sole purpose of teaching for creativity is to make the learning process interesting, productive. This element can only be mastered through the use of creative strategies such as problem solving, design process, project-based and case study. Reflecting back on Teacher C and D's

teaching strategies, they did not give some latitude for the learners to utilise their higher order thinking skills to solve problems. The focus was on surface learning and traditional tasks, because the class activities were just a memorisation of what the teachers taught. Teacher C's lesson objective that focused on designing and making a container to keep food warm for 24 hours without it rotting, was not achieved. Most of the learners were inactive as they were either sleeping or having private conversations. Rashmi (2012) avers that using imaginative approaches such as problem solving to deliver content often triggers learners' generation of new ideas, thus resulting in the enhancement of creativity. These teaching strategies allow learners to interactively participate and take control of their own learning. Thus, it is plausible to conclude that the research participants failed to enhance learners' creativity because they did not use the teaching strategies outlined in the four elemental model creative pedagogy and the recommendations enshrined in the CAPS document.

Resources

In terms of the availability and use of resources, all the observed teachers had a challenge. None of the teachers had a workshop furnished with Technology equipment and tools for practical tasks. However, there were some teachers who improvised by using their own resources and even encouraging learners to bring some resources from home. For example, Teacher E used his gadgets and data to show learners various plastic products. Teacher B as well instructed learners to bring resources such as milk bottles and freezer bags from home prior to the class. Even though they were not enough, the lessons were better compared to the ones who used textbooks only to facilitate their lessons. This is because learners were actively participating and engaging their creative skills in those classes that had resources. This in coherence with Taylor and Van der Bijl (2018)'s words that adequate resources such as Technological equipment and tools, have always been critical for Technology learners to acquire problem solving and creativity skills (Taylor and Van der Bijl, 201.

Teamwork

In the quest to develop learners' creative potential, Rashmi (2012) emphasises an environment that encourages a positive interaction, group work and prioritises learners' autonomy. During the observations most teachers encouraged learners to work in groups in most of the activities they gave them. The contrary was the case for Teachers C and D. It is noteworthy that in Teacher B's class, it is a norm to work in teams. This was evident in the group solidarity and identity which the learners exuded. Statements such as "my team and I and we" suffused the classroom. The researcher also observed how learners were eager to collaborate because they actively participated and could connect what they had learned in their previous lesson to the topic under study. Taqi and Al-Nouh (2014) believe this is owing to the fact that teamwork allows learners to achieve higher-order thinking skills such as creativity and retain knowledge longer than working individually. In the same breath, Erd and Al-Jabri, (2016) argue that that learners' interaction is an important asset that promotes creativity.

7.1.2 What are the physical factors that influence the reinforcement of creativity in Grade 9 Technology classroom?

Physical environment

This study also looked at the physical factors that influence the reinforcement of creativity in Grade 9 Technology classroom. The data revealed that teachers had challenges including inadequate resources and tools, limited allocated teaching time as well as overcrowded classrooms. Following are the teachers' responses.

> **Teacher A:** Factors such resources as drawing boards for designing the models, technological equipment and hand-outs on the walls.
> **Teacher B:** Overcrowded classroom and insufficient resources really impede learners' creativity. My class consists of 68 learners and my period ends before I can attend to all their learning needs or before the learners even get to use the available resources such as components to build their own circuits, because they have to share. This inadvertently causes a situation whereby the learners have to, in my absence, do these hands-on activities at home in my absence.
> **Teacher C:** Besides the overcrowded classrooms, I have to strive to cover the syllabus within a limited time.
>
> **Teacher D:** I think resources and time have a great effect on the improvement of learners' creativity.
> **Teacher E:** Overcrowded classes, unavailability of resources and laboratory, time constraints, teacher-learner relationship, and relevant teaching methods are some of the factors.

From the above utterances it is observable that teachers have a huge challenge of developing learners' creativity due to challenges such as lack of resources, time and pressure and overcrowded classes. This has led to them being unable to expose learners to opportunities of engaging in practical activities, the actual building of the artefact. For instance, teacher E highlighted that in their school they have neither a laboratory nor the equipment, and this affects learners badly in terms of nourishing their higher order thinking skills. Teacher A also added that for creativity to be enhanced successfully among Technology learners, technological resources and tools should be provided. This is in coherence with the claim made by Dhurumraj (2013) that most public schools in South Africa lack proper laboratory facilities for technology hands on activities, and this makes learning difficult. In the same breath Janak (2019) notes that the shortage of classrooms, resources, and teaching materials is affecting the implementation of the Technology curriculum.

In her response, Teacher C stated that she has to struggle to cover the syllabus due to time constraints. A two-hour period is grossly insufficient for a subject such as Technology that places more emphasis on hands-on activities than theoretical knowledge. This response corroborates with Mapotse's (2015) findings that the challenges affecting Technology teachers created are external factors such as time allocation (of 8% per week). Teacher B also posited that his period ends before he can attend to all their learning needs. This is further worsened by the sharing of the limited resources by the learners. Resultantly, most of the hands-on activities that should take place in the school are done at home by the learners without the teacher's guidance or input.

Besides the resources, the teachers' classrooms were overcrowded, which is a huge concern because the effects of overcrowding are detrimental to effective learning in the Technology classroom. A large classroom reduces the capability of teachers to control learners in a classroom (Norazman, Ismail, Ja'afar, Khoiry & Ani, 2019) and results in poor academic quality. Teacher C had a situation with some learners chatting and some sleeping during the presentation. This was inevitable

because of the rowdiness of the classroom and her inability to manage the situation.

Some of the teachers used group work as a way to manage the overcrowding; they also improvised materials to stimulate and maintain the interest and excitement of students. Nonetheless, one could observe that in their bid to achieve these, valuable lesson time was lost because they spent most of the lesson time trying to control the groups. Hence, they had little time for teaching. Rashmi (2012) emphasised that; creativity can be fostered in a well-resourced, supportive and positive environment. Therefore, it is fair to conclude that none of the observed teachers' classrooms was conducive for the enhancement of creativity because overcrowding, inadequate time and resources hinder the aspects promoted by the physical environment element of the creative pedagogy – interaction, freedom and generation of effective ideas.

8 Conclusion

From the above results and discussion, conclusion can be made that grade 9 Technology teachers have a challenge of engaging their creative pedagogy when handling Mini-PAT. For instance, during observation, most teachers were unable to practice the creative teaching strategies recommended by Rashmi's creative pedagogy to facilitate their lessons. Teachers were also unable to correctly implement the design process when handling Mini-PAT. Those who did, only focused on investigation and design stages and they did not present case studies for learners to identify the problem before they solve it. The intention of a case study is to show learners that Technology is a subject that is close to the way the world works (Department od Basic Education, 2011). As a result, they failed to connect that particular Mini-PAT with the everyday reality. This practice hinders the enhancement of creativity in a sense that teachers do not know how to facilitate the practical component of the Mini-PAT following the design process. The purpose of Mini-PAT is to give learners the opportunity to develop and demonstrate their levels of ability through the design process (DBE, 2011). However, in the case of those teachers the learners were deprived of the opportunity to develop their skills.

The study revealed that the Technology teachers had challenges in terms of the physical factors that influence their reinforcement of creativity in the classroom. These challenges include overcrowding, resource deficit, time constraint, and syllabus coverage pressure. Technology practical activities need a learning environment which is manageable, in terms of teacher-learner ratio, equipped with educational resources, and adequate teaching time as encouraged by Rashmi (2012)'s creative pedagogy. However, the study discovered that most of the Technology teachers failed to support the development of learners' creativity by creating conducive learning environment for them. All these challenges have a major contribution on the current problem that we have of Technology teachers failing to equip leaners with creativity skills when facilitating Mini-PAT.

This study calls for the department of Basic Education to revamp the curriculum for Technology, especially as it concerns time allocation for a smooth incorporation of creativity in the classroom. It also encourages subject advisors to come with better ways of training teachers on how to apply their creative pedagogies and the design process when handling Mini-PAT. Lastly, it encourages Technology teachers to reflect on their teaching strategies with respect to creative thinking skills.

REFERENCES

Polit, D. F., & Beck, C. T. (2012). Gender bias undermines evidence on gender and health. *Qualitative health research*, *22*(9), 1298.

Chan, S., & Yuen, M. (2014). Personal and environmental factors affecting teachers' creativity-fostering practices in Hong Kong. *Thinking Skills and Creativity*, *12*, 69-77.

Chiliba, K. D. (2019). *A closer look at how grade 9 technology teachers incorporate critical thinking in their teaching of the design process: A case study in KwaSanti cluster* (Doctoral dissertation).

Cho, H., Pemberton, C. L., & Ray, B. (2017). An exploration of the existence, value and importance of creativity education. *Current Issues in Education*, *20*(1).

Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The psychologist*, *26*(2), 120-123.

Collard, P., & Looney, J. (2014). Nurturing creativity in education. *European Journal of Education*, *49*(3), 348-364.

Cremin, T., & Barnes, J. (2018). Creativity and creative teaching and learning. In *Learning to teach in the primary school* (pp. 428-442). Routledge.

Department of Basic Education (2011). Curriculum assessment policy statements (CAPS): Civil technology. Available from download. Aspx?

Dhurumraj, T. (2013). *Contributory factors to poor learner performance in Physical Sciences in KwaZulu-Natal Province with special reference to schools in the Pinetown District* (Doctoral dissertation).

Duchovicova, J., & Tomsik, R. (2017). Critical and creative thinking strategies in teaching internal consistency of the research tool. *Slavonic Pedagogical Studies Journal*, *6*(2), 375-394.

Fleith, D. D. S. (2019). The role of creativity in graduate education according to students and professors. *Estudos de Psicologia (Campinas), 36*.

Fleith, D. D. S. (2019). The role of creativity in graduate education according to students and professors. *Estudos de Psicologia (Campinas), 36*.

Gumbo, m. T. (2019). A balance of scale: technology teachers'practice response to continuing professional development. *Rethinking Teaching and learning in the 21st Century*, 249.

Henriksen, D., Henderson, M., Creely, E., Ceretkova, S., Černochová, M., Sendova, E., ... & Tienken, C. H. (2018). Creativity and technology in education: An international perspective. *Technology, Knowledge and Learning*, *23*(3), 409-424.

Janak, R. (2019). *Technology teachers' perspectives on the Technology curriculum* (Doctoral dissertation).

Kaufman, J. C., & Beghetto, R. A. (2013a). In praise of Clark Kent: Creative metacognition 10 and the importance of teaching kids when (not) to be creative. Roeper Review, 35,155–165.

Kubheka, P. (2018). *Strengthening the teaching of mini-practical assessment task in a senior phase technology class* (Doctoral dissertation, University of the Free State).

Lasky, D., & Yoon, S. (2020). A creative classroom for everyone: An introduction to a small 'c'creativity framework. *Thinking Skills and Creativity*, *36*, 100660.

Lin, Y. S. (2011). Fostering creativity through education–a conceptual framework of creative pedagogy. *Creative education*, *2*(03), 149.

Mapotse, T. A. (2015). An emancipation framework for technology education teachers: An action research study. *International Journal of Technology and Design Education*, *25*(2), 213-225.

Mathumbu, D., Rauscher, W., & Braun, M. (2014). Knowledge and cognitive process dimensions of Technology teachers' lesson objectives. *South African Journal of Education*, *34*(3), 1-8.

Nakano, T. D. C., & Wechsler, S. M. (2018). Creativity and innovation: Skills for the 21 st Century. *Estudos de Psicologia (Campinas)*, *35*, 237-246.

Nkosi, P. B. (2020). An exploration of creative thinking skills in the grade 9 technology classroom (Doctoral dissertation) submitted at University of Limpopo.

Noble, H., & Heale, R. (2019). Triangulation in research, with examples. *Evidence-based nursing*, *22*(3), 67-68.

Norazman, N., Ismail, A. H., Ja'afar, N. H., Khoiry, M. A., & Ani, A. I. C. (2019). A review of seating arrangements towards the 21st century classroom approach in schools. Malaysian Journal of Sustainable Environment, 6(2), 21-46.

Ohemeng-Appiah, F. (2014). *Teaching the design process in the grade 9 technology class* (Doctoral dissertation).

Perry, M., & Collier, D. R. (2018). What counts as creativity in education? An inquiry into the intersections of public, political, and policy discourses. *Canadian Journal of Education/Revue canadienne de l'éducation*, *41*(1), 24-43.

Pietkiewicz, I., & Smith, J. A. (2014). A practical guide to using interpretative phenomenological analysis in qualitative research psychology. *Psychological journal*, *20*(1), 7-14.

Ramaligela, S. M., Ogbonnaya, U. I., & Mji, A. (2015). An Investigation into the Effectiveness of the University Curriculum in Preparing Pre-service Technology Teachers. *Journal of Higher Education in Africa/Revue de l'enseignement supèrieur en Afrique*, *13*(1-2), 75-87.

Rashmi, P. (2012). Fostering creativity: A four elemental model of creative pedagogy. *Journal of Education and Practice*, *3*(12), 190-201.

Richardson, C., Henriksen, D., & Mishra, P. (2017). The courage to be creative: an interview with Dr. Yong Zhao. *TechTrends*, *61*(6), 515-519.

Rubel, D., & Okech, J. E. A. (2017). Qualitative research in group work: Status, synergies, and implementation. *The Journal for Specialists in Group Work*, *42*(1), 54-86.

Sawyer, K. (2015). A call to action: The challenges of creative teaching and learning. *Teachers College Record*, *117*(10), 10.

Seechaliao, T. (2017). Instructional strategies to support creativity and innovation in education. *Journal of education and learning*, *6*(4), 201-208.

Singh-Pillay, A., & Sotsaka, D. S. (2016). Engineering graphics and design teachers' understanding and teaching of assembly drawing. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(5), 1213-1228.

Streubert, H. J. & Carpenter, D. R. (1995). Qualitative research in nursing: Advancing the humanistic imperative. Philadelphia: J. B. Lippincott Company.

Stylianidou, F., Glauert, E., Rossis, D., Compton, A., Cremin, T., Craft, A., & Havu-Nuutinen, S. (2018). Fostering inquiry and creativity in early years STEM education: policy recommendations from the Creative Little Scientists Project. *European Journal of STEM Education, 3*(3).

Stylianou, V., Savva, A., & Portides, G. (2019). Promoting Interactivity and Creativity in a Science Course. In Proceedings of the 2019 SIGED International Conference on Information Systems Education and Research. Association for Information Systems Special Interest Group on Education (SIGED), 126-138.