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A Quest to Nurture Creativity in Technology Classrooms: Are Physical Factors a Spanner in the Works?

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ABSTRACT
Nurturing creativity in Technology classrooms will, potentially, prepare learners for adaptability to the sweeping transformations that the new industrial revolutions portend and equip them to maximise the opportunities inherent in these revolutions. This study examined the effects of physical factors on the development of creativity in Grade 9 Technology classrooms. A qualitative research design was employed to purposively sample three Grade 9 Technology teachers to participate in this study. Open-ended questionnaires and non-participant observations were used as the methods of data collection for the study and the data were analysed thematically. The research findings show that creative pedagogy and the resultant development of creativity in the classroom, to a significant extent, are influenced by physical factors – class size and availability of Technology equipment. The study contributes to the body of knowledge by outlining how unfavourable physical conditions hinder the development of creativity skills in Technology classrooms, which is a core objective of the Curriculum Assessment Policy Statement (CAPS) guiding Technology education in South Africa. The study outlines the importance of a conducive learning environment to the quest to enhance learners' creativity. Furthermore, the study recommends solutions to the paucity of resources for the enhancement of creativity in the Technology classrooms.

KEYWORDS
Technology education; creativity; physical factors; learning environment.

INTRODUCTION

The new education standards emphasise higher order skills such as critical thinking, creativity, and problem solving (Bao & Koenig, 2019). The need for creativity is increasingly being emphasised across the different spheres of society, be it entertainment, health, education, politics, culture, and social cohesion (Awawdeh & Lian, 2020). This has led to a growing need for teachers to prepare learners for efficient hands-on skills and this requires a conducive and resource-adequate learning environment (Isaac & Manto, 2019). This is often emphasised in Technology classrooms because of the centrality of practical sessions to Technology teaching. This explains why schools are encouraged to allocate as much time to practical sessions as they do theory sessions (Department of Basic Education, 2011).

The primary purpose of technology education is to expose learners to the fundamentals required in Civil, Mechanical and Electrical Technology (DBE, 2011). Additionally, it also intends to ensure that learners gain an idea of the way engineers apply scientific principles to practical problems. These practical activities are normally designed as mini-Practical Assessment Tasks (mini-PATs) which are done following the design process. These tasks provide learners with an opportunity to nurture and demonstrate their creative and problem-solving skills as they progress through the activities of the task (DBE, 2011).

It must be noted that despite the Curriculum Assessment Policy Statement's (CAPS) assertion that Technology as a subject should encourage learners to exercise their creative and critical thinking skills by solving real-world problems, there appears to be difficulties in promoting creativity in the classroom (Chiliba, 2019; Magolego et al., 2022; Tan et al., 2016). Besides many teachers being unsure of what it means to develop these skills in the classroom (Cropley, 2017), Chan and Yeun (2014) argue that physical environment, time and space, curriculum, parents, and society are among the physical factors that influence the development of creativity.

In 2014, Blamires and Peterson reviewed the movements in teaching for creativity in the United Kingdom and discussed the support for teachers towards enhancing learners' creativity in the classroom. Taking advantage of the necessary tools, including space and resources to provide real-time interactive opportunities was among the synthesised eight enablers in fostering creativity in the classroom. This supports Janak's (2019) assertion that the lack of instructional materials, resources, and classrooms is having an impact on how the technology curriculum is being implemented. Sufficient resources, including technological tools, have consistently been essential for technology learners to develop their creative and problem-solving abilities (Taylor & Van der Bijl, 2018).

To unlock the full potential of learners' creativity, focus should not be on the creative teaching strategies (Hanif, Wijaya & Winarno, 2019; Magolego et al., 2022; Wu & Wu, 2020) and creative learning (Beghetto, 2021; Selkrig & Keamy, 2017) alone, the learning environment must also be prioritised. The importance of learning environment has emphasised by Harris and De Bruin (2018) and Tan et al. (2016). They posit that the learning environment is an important

variable in contributing to the nurturing of creativity within a subject domain. Baafi (2020) adds that a conducive physical environment is an agent of intellectual stimulation and essential factor in strengthening learners' educational skills development.

Although studies on the development of creativity in education and physical learning environment exist, they however do not focus on how these physical factors directly affect the development of creativity in the classroom. For example, Ahmad and Amirul (2017) primarily focused on how the learning environment affects learners' health. Ikegbusi et al. (2021) and Fakunle and Ale (2018) were interested in how it affects learners' academic achievement. Therefore, there are still some gaps in literature on the impact physical factors may have on creativity enhancement in Technology classrooms.

Research question

To determine whether physical factors hamper the development of learners' creativity in the classroom, this study investigated the question below.

Do physical factors inhibit the enhancement of creativity in Grade 9 Technology classroom?

Role of theory

This study was framed from Rashmi's four elemental model of creative pedagogy for creative development through the four interrelated elements namely: creative teaching, teaching for creativity, creative learning, and psycho-physical environment (Lin 2011; Rashmi, 2012;). This framework holds that creativity can be developed and everyone has the potential to be creative (Esquivel, 1995; Feldman, 1999; Rashmi, 2012; Shaheen, 2010). It is argued that the creative endeavours of teachers and learners and teaching-learning process are essential, meaning the four elements of creative pedagogy interact and contribute to each other (Rashmi, 2012). However as much as this model embraces the four elements for teaching practice that fosters creativity, for this study, only the physical environment has been adopted.

According to the four-elemental model, the place where one lives is important for fostering and advancing creativity (Rashmi, 2012). Therefore, if all the elements are implemented without a conducive environment, creativity will not be fully developed. Learners' surroundings affect the activity and, of course, their creativity because of change in their basic disposition (Lewin, 1937; Rashmi, 2012). As a result, a positive and supportive environment is a prerequisite for creativity enhancement, and this makes it an important component in this conceptual framework. A creative learning environment is an environment where personal learning takes place and such learning assists every learner to spark their own creative and intellectual potential, thus providing opportunities in the future to produce unique and useful solutions to different situations. Rashmi (2012) posits that when learners find themselves in a well-resourced, positive, and beautiful setting, they are more likely to find new connections among ideas and have new perspectives on the societal issues they seek to address.

LITERATURE REVIEW

A few studies such as Szptma and Szpytma (2019), Awawdeh and Lian (2020), Garces, Pocinho, de Jesus and Viseu (2016), Beghetto and Kaufman (2014) and Keller-Mathers (2011) have highlighted that a learning environment is one of the paramount influences that determine whether creativity skills will be hindered or developed. Research has revealed that the physical learning environment should not only be treated as the location for educational practice but be seen as a fundamental feature for the materialisation of authentic and contextual ideas (Imms & Kvan, 2021; Lasky & Yoon, 2020) and be used flexibly to promote learners' creativity (Addison et al., 2010). This aligns with the assertion by Mróz and Ocetkiewicz (2021) that classrooms should not only be for knowledge acquisition but also skills to solve existing societal problems and the ones that may crop up in the future.

The role of the context has been increasingly emphasised in the creativity literature since the early 1990's (Tan et al., 2016). Amabile's (1988) model suggests that learners' creativity may be affected by even very minor aspects of the immediate social environment. For example, creativity may be impeded where there is undue time constraint, over-supervision or where choices are restricted in terms of working materials. In the same breath, Davies et al. (2013) have observed that environments and conditions that are most effective in promoting creative skills in learners include the availability of resources, flexible use of time and allowing learners to work at their own pace without pressure.

In contrast, Harris and De Bruin (2018) posit that the main hindrance to fostering creativity in classrooms goes beyond just allocating sufficient time; it also involves overcoming the fear of failure—a mindset prevalent among many learners and teachers. This is because creating a conducive learning environment for enhancing creativity entails considering not only the physical surroundings but also the psychosocial atmosphere (Rashmi, 2012). According to Moreira, Mesquita and Peres (2019), a creative learning environment is characterized by personalized learning, which helps each learner unlock their creative and intellectual potential and prepares them to generate unique and effective solutions to diverse situations in the future. Furthermore, creative learning spaces facilitate collaborative problem-solving between teachers and learners, allowing them to share ideas and work together to tackle challenges (Smith et al., 2014).

From the perspective of the theory of complex dynamic systems, learning isn't solely confined to the learner's mind; it emerges from interactions involving the learner, teacher, and environment (Rowlands, 2011). Despite its significance, the importance of learning spaces was long overlooked (Stadler-Altmann, 2015). However, with the educational shifts of the 21st century, it's imperative to give learning spaces the attention they merit. Crawford, Martin, and Tanguma (2002) delved into the correlation between the learning environment and teachers' practices, discovering that teachers often failed to recognize how the learning environment impacts learners' performance. This is concerning because successful fostering of creativity in the classroom relies on the interplay between effective teaching by a creative teacher, active

learning by the learner, and a supportive psycho-physical learning environment (Rashmi, 2012). Beghetto and Kaufman (2013) further emphasize the significance of a conducive learning environment, considering the diverse backgrounds, families, belief systems, experiences, interests, and abilities of learners.

Chan and Yeun (2014) conducted research to explore the factors influencing the promotion or inhibition of creativity in educational settings. Their study identified various physical factors such as time, space, atmosphere, curriculum and subjects, as well as influences from parents and society, which play roles in either facilitating or impeding creativity development. The researchers concluded that teachers often face challenges in finding a balance between nurturing students' creativity and fulfilling other educational obligations, such as adhering to curriculum standards. Additionally, Sawyer (2012) supports this perspective by suggesting that schools themselves may inadvertently hinder, rather than encourage, the development of students' creativity.

In numerous studies examining the impact of physical factors on enhancing creativity in technology classrooms, educational resources, time constraints, and overcrowded classrooms consistently emerge as key variables. This corresponds with Siperto's (2017) assertion that overcrowded classrooms present persistent obstacles to successful teaching and learning. Notably, the lack of proper laboratory facilities in many South African public schools exacerbates these challenges, significantly impeding the learning process (Dhurumraj, 2013). Mini-PAT activities in Technology classrooms are normally structured to solve societal problems. Problem solving is structured to succeed the design process stage. Stage 3, *making*, requires learners to engage in materials and equipment to build an authentic artefact for that activity. Therefore, educational resources play a fundamental role in the successful presentation of all the subjects that consist of a practical component.

METHODOLOGY

The aim of this research paper was to investigate the physical factors influencing the promotion of creativity in Grade 9 Technology classrooms. A qualitative approach was adopted, utilizing a case study design as the methodology. This choice was motivated by two key considerations. Firstly, qualitative methods offer nuanced insights into human behaviors, life experiences, actions, and emotions that quantitative inquiries may not capture as effectively (Abrar, 2017). Secondly, qualitative research allows for the collection of rich data from participants, facilitating in-depth interpretations through the utilization of multiple methods and approaches (Creswell, 2009).

Sampling

To elicit expert opinion for the study, purposive sampling was employed. The sample consisted of Grade 9 Technology teachers with a Bachelor of Education (B. Ed.) degrees in Technology education. A total of three Grade (9 Technology teachers from different high schools at Sekhukhune East District, Limpopo Province, South Africa participated in the study. To ensure

confidentiality and anonymity, pseudonyms, rather than identifying information, were used. It is also noteworthy that the study focused on the Grade 9 class, which is an exit grade for Technology subject. This was aimed to check the creativity development that happened over the years in the senior phase as a preparation for Further Education and Training phase and the factors that influenced the development.

Data collection

An open-ended questionnaire, based on the reviewed literature and conceptual framework, was used to collect data. The questionnaire schedule comprised seven open-ended questions designed to elicit participants' perspectives on the physical factors that influence creativity development in the classroom. The questionnaires were hand delivered to the three respective participants to complete at their convenient time. Additionally, non-participant observation, derived from the conceptual framework, was used as a form of data to verify the consistency of observed behaviour in relation to the open-ended questionnaire data. Observation was conducted during lesson presentations to determine whether physical factors hamper the development of learners' creativity in the classroom. These observations took place at the beginning of the fourth term when *the strand of processing material* was being taught. Multiple data collection methods (triangulation) were deployed because it is believed that using a single method may not provide adequate insight into a phenomenon (Abrar, 2017).

Data analysis

The analysis of the data generated from the questionnaire was done using framework analysis. The analytic tool foregrounds the physical (learning) environment in which Technology teachers operate. The data collected were transcribed, familiarised, and categorised to identify common themes in the data for a more accurate interpretation in line with the physical environment element. The analysis of the data gathered through non-participant observation was done per item in the observation schedule. Data were transcribed manually into narratives and then coded into topical categories in line with Rashmi's (2012) creative pedagogy framework. Lastly, the data were summarised by linking them with the research question. The credibility of this study was ensured by giving the participants an opportunity to verify the true reflection of the collected data (Kelly, 2006). An audit trail, which allows a participant to comprehend the context of a research and the data collected, was used. To increase the trustworthiness of this study, the questions on the questionnaire and observation schedule were derived from the conceptual framework. Data from the open-ended questionnaires and observations were verified using triangulation, thus strengthening the findings of the research.

FINDINGS

Open-ended questionnaire data

A total number of three participants were used for this study and they all had Technology as one of their major subjects in their qualifications. Two of them had less than ten years work

experience while the other teacher (male) had 11 years. The participants' biographical details are in the table below.

Table 1.

Teachers' Biographical Data

Number of Teachers	Gender	Qualification	Teaching experience	Hours spent per week in Technology class	Attended Technology training workshops
1	Male	B.Ed. (Math, Science & Technology)	3	2	No
2	Male	B.Ed. (Math, Science & Technology)	11	2	Yes
3	Female	PGCE in Math, Science and Technology	7	2	No

The data obtained from the questionnaires indicate that physical factors are really a major setback in Technology classrooms as far as the development of creativity is concerned. From the views expressed by the teachers, similar themes were identified and are they are discussed below.

Lack of laboratory, tools, and educational technologies

It is difficult to facilitate Technology lessons without technological equipment and tools since it is a subject that combines theory and practice (Mapotse, 2014). Umar and Ma'aji (2010) are of the opinion that the goal of technical education is to prepare learners for successful employment in the labour market and this condition can be met through a well-equipped workshop with relevant training resources. Technology intends to show learners that it is a subject that is close to the way the world works (Department of Basic Education, 2011), therefore resources form the backbone of the lesson presentations. Below are the direct submissions of the sampled teachers.

Teacher A: Lack of resources is one of the bigger problems I am facing with my learners. For formal tasks, learners use their resources from home to build artefacts, but I cannot do informal practical tasks with them because we do not have tools to work with. Most of the time, I give examples orally or show them pictures instead of demonstrating practically in a laboratory and this results in loss of interest in this subject. Most of them say Technology is difficult. Do you know why? It is because learners learn practical lessons orally, which is confusing.

Teacher B: Before I can even talk about the tools and equipment needed at Stage 3 of the design process, I am more concerned with the first stage. My learners have no access to computers

and tablets. I sometimes lack data to assist them with my phone too. Our school does not have Wi-Fi or even a mere library to, at least, try doing things the old way. They lose interest on the spot because they do not have resources to conduct their research.

Teacher C: Learners need to be exposed to new information so that they can come up with creative ways to deal with the challenges at hand. The lack of access to adequate resources is a serious challenge. Creativity goes along with resources. If a learner thinks of developing a new idea, such idea may not materialise because of resource constraint.

Time constraints

Regarding the teaching time, below are their submissions.

Teacher A: Time constraints have always been a huge challenge considering the workload we have.

Teacher B: It is hard to cover the content outlined in the Annual Teaching Plan because of the limited time. Technology is allocated 2 hours per week. It is barely enough for practical sessions.

Teacher C: I think the teaching time is one of the factors that have a great effect on the enhancement of learners' creativity.

The pressure from a syllabus and limited time to practise creative teaching may constrain the integration of creativity in education (Wang & Kokotsaki, 2018), and this is evident in the views expressed by the teachers. The teachers felt strongly that the time allocated for Technology is not sufficient. Teacher B further elaborated thus: "anything to do with thinking critically and creatively needs time. But how can we achieve that when we have only two hours per week for both theory and practical, and the departmental heads want class works and corrections weekly. It is nearly impossible." According to this teacher, learners are not even motivated because they are always in a rush to manage time and assimilate content knowledge.

Technology is allocated two hours per week for both theory and practical activities as outlined in the CAPS document (Department of Basic Education, 2011). This time is inadequate to complete the stages of the design process in a workshop in the presence of the teacher. This aligns with what the teachers indicated in Chan and Yuen's (2014) study. They surmised that the teaching period was inadequate, and there was often not enough time to complete planned activities or to respond to learners individually.

Learner-teacher ratio

Overcrowded classroom has been considered one of the most challenging problems faced by teachers (Ayu, 2019). It influences the way in which teachers deliver the curriculum (Biyela, 2019; Fan & Cai, 2022). This aligns with the following responses from the teachers.

Teacher A: My learners share desks in three and this results in noisemaking while I am teaching, and this is disruptive and exasperating. I spend most of my teaching time trying to manage the class to come on board with me. From what I have observed, it has also made some of my learners to lose interest in my subject, so it is hard to even begin thinking of developing their creative skills.

Teacher B: Overcrowded classroom really hinders learners' creativity. The teacher -learner ratio is 1:72 in most of the classes in my school. You can just tell that my classroom is far from being conducive enough to develop learners' creativity. I tried using group work strategy to manage them but without resources for learners to work with, it is a waste of time. For formal practical tasks, I allow them to do their projects at home because at this point, we are doing it for the accumulation of marks. As a result, I cannot tell if they are indeed creative or got help from home.

Teacher C: I teach about 60 learners in my classroom, this really makes it hard for me to control the class and attend to all the questions they have about the topic at hand.

The challenge that is faced by Teacher A is aligned with the observations made by Makielski (2018), Leah (2018) and May (2018) that teachers in overcrowded classrooms spend about 30-80% time trying to address the issues of discipline, which make teaching difficult. This is supported by Makielski (2018) who asserts that overcrowded classrooms are a challenge in schools as learners become disruptive and that demands a lot of time spent disciplining them. Rashmi (2012) has brought to the fore the importance of the learning environment in the quest to develop learners' creativity, highlighting a conducive classroom that fosters interaction, autonomy, safety, relaxation, and teamwork. In that case, a rational conclusion can be made from the teachers' viewpoints that creativity is it not yet actualised in Technology classrooms due to overpopulated classrooms.

Observation data

The study found that the identified challenges such as crowded traditional classrooms with lack of technological equipment and tools mentioned by the teachers in the questionnaires are exactly what they are experiencing in the classrooms.

According to the Annual Teaching Plan in alignment with the CAPS document, teachers are expected to teach the theme processing, which involves preservation of materials and food. This theme can expose learners to activities that require them to exercise their creative skills since it aims to demonstrate knowledge and understanding of how materials can be processed (e.g., galvanised, frozen) to change or improve properties (lifespan), and how recyclable materials can be re-manufactured. Following this was a practical assessment task that all the three teachers gave learners to work on.

> *"You are going camping for five days with a group from your school. You don't have any way of keeping your food cold while you are away. Design and make a food product that will make your food stay fresh for the five days while you are camping".*

From the instruction given to the learners, they were not restricted to design the same prototype. They were afforded an opportunity to think thoroughly and design their unique artefact to solve the problem presented to them. It is common to think of the design process when one comes across a mini-PAT in Technology education. This is because the design process serves as the fundamental framework of the subject, guiding the delivery of all learning

objectives (DBE, 2011). Resultantly, the learners were instructed to follow the design process to solve the problem and they indeed followed the stages.

During the investigation stage, where learners are expected to conduct detailed research regarding the topic under study, they had a challenge of sources to consult from. They had no computers, the Internet and even a library. This limited their knowledge about the most suitable and yet unique food product to design. The Internet is believed to be the richest and most updated source of information, so in Technology classes where creativity is encouraged, learners should have access to it to avoid building what already exists. This aligns with the assertion put forward by Henriksen et al. (2018) that the integration of digital technologies into the teaching-learning process within 21st-century education provides various avenues to link concepts and facilitate ideation during the creative process through the exploration of ideas. Unfortunately, in the case of these learners, their textbooks, which are inadequate, are the only source of fostering their creative thinking skills.

It was also observed that the absence of adequate sources for learners to research has led to most learners losing interest in the process. For instance, in Teacher B's class, there were some learners who complained about not having any idea about what was required of them. One learner even asked their teacher to show them a picture online of the similar artefact, but the teacher could not be of their assistance due to lack of data. In Teacher C's class, some learners were just having their social conversations, showing no interest in their schoolwork. These findings are in line with the observations made by Bøjer (2021) that space affects the way learners behave and think and it determines whether they will concentrate, conduct usual tasks or forge a creative invention, learn or perform rote actions. Therefore, those observed classrooms were not conducive to keep learners glued to the project, hence the outcome that was observed.

Learners continued with the task and wrote their design brief outlining the specifications and constraints. From what was observed, all the observed teachers did a commendable work on learners on how to carry out the design process. This is because they knew exactly what to do with each stage without engaging the teachers. They came up with possible solutions and presented them on the paper through freehand sketches. However, in Teacher A's class, there were some learners who only sketched one product. The obvious impression deducible was that they did not have a proper understanding of the context to determine various products suitable to solve the problem. Moreover, almost all learners could not draw their final product using first angle projection. Even though drawing board is not required in Grade 9, learners did not have basic proper drawing tools such as HP pencils, flexicurve, T square, set squares and compasses as recommended by the CAPS document.

The actual making of the prototype - where learners choose the appropriate materials and tools, measure, cut, shape, and join - did not happen. While Teacher A and B literally asked learners to go and complete their projects at home with their resources, Teacher C asked learners to bring the resources to school to work together in the classroom. Interestingly, in her

request she kept on emphasising that: “if you come to school empty handed, you will fail.” This shows that even the strategy of asking learners to improvise with resources is not really working because some learners do not bother to source for the resources.

DISCUSSIONS

According to Chan and Yuen (2014), teachers are often prevented from fostering creativity by physical restrictions in the building, resources, and competing demands within the curriculum. This assertion made by Chan and Yuen (2014) is coheres with the findings of this study. This study discovered that creativity is far from being actualised in Technology classrooms because of physical factors including lack of teaching and learning resources. For instance, Teacher A and B asked learners to go and complete their task at home using their own materials and Teacher C asked the learners to bring the materials to school. Basically, all these teachers, together with their schools, could not provide the Technology learners with the necessary tools and equipment to build artefacts. Additionally, one Teacher in the open-ended questionnaires mentioned that their learners are constrained to learn practical lessons orally because they do not have Internet access. The detrimental effects of physical factors were also seen in Ramongwane, Manto and Moses’ (2022) findings where resource inadequacy and paucity of infrastructure hampered the participants’ ability to exercise teaching skills to assist learners in developing practical skills.

According to Maffea (2020), teachers initially enter the field of Education fuelled by a passion for teaching. However, they often find themselves experiencing burnout over time, largely due to the stressors associated with working in schools that lack sufficient resources. Maffea’s (2020) view is prescient considering the observed side talks and loss of interest by the students while designing an artefact because they did not have an idea about what was expected of them. One learner in Teacher B’s class tried to surf the Internet to assist with examples but the Teacher did not have data. This was distressing because, according to them, they could not provide learners with an opportunity to learn to their fullest potential. Indeed, teaching and learning materials help to enhance learners’ imagination, prevent misconceptions, and make learning more interesting (Aneke, 2015). The challenge of lack of technological equipment in schools is also seen in the works of Patricia, Isaac and Manto (2023), Kgosi, Makgato and Skosana (2023) as well as Ramaboea, Mtshali and Ramaligela (2022). Correspondingly, Mokhothu, Maimane and Rankhumise (2015) observed that most critical challenge hampering the effective teaching and learning of the hands-on technology skills was rampant lack of materials and workshops. Consequently, this study infers that physical factors hold back the development of creativity in Technology classrooms.

From the findings, it is clear that the teachers were constrained and had difficulty enhancing learners’ creativity due to the problems inherent in overcrowded classrooms - such as; indiscipline, noise, conducting evaluation, attending to each learner’s academic needs, and addressing the learners’ inability to raise questions (Fatima, Mushtaq & Fatima, 2019). This problem slowed down the learning process and teaching ended up being stricken off (Sumera

& Mushtaq, 2017). This aligns with the findings from other studies that overcrowded classrooms lead to a lack of engagement and communication between learners and teachers (Prayitno, 2023) and compromise the quality of teaching and learning (Graham, 2023). This is a serious setback, given the fact that creativity is one of the greatest 21st century skills that Technology education is striving to equip learners with to ready the for the professional realm.

CONCLUSION

The study examined the significance of physical factors to learners' creativity in the Technology classrooms. The study gathered teachers' perspectives on how physical factors affect the cultivation of learners' creativity in their respective schools. From the results of this study, it is evident that Grade 9 Technology teachers fail to nurture learners' creativity due to absence of resources, limited time, absence of laboratories, and overcrowded classrooms. The findings of this study show that Technology teachers understand the importance of developing learners' creativity through mini-PAT as outlined in the CAPS document. This was confirmed by the activities they gave their learners even though they could not complete them due to the aforementioned challenges. The findings as well as literature further reveal that if learners can be provided with educational technologies such as computers - with Internet connection and furnished laboratories, technology learners can learn to their fullest potential, thereby enhancing their creativity skills. This will also keep teachers motivated to exercise their creative teaching strategies to assist learners in developing higher order thinking skills.

The study also discovered one of the reasons why learners tend to lose interest in choosing technical subjects when they are in their Further Educational Training phase. It begins at their senior phase with a poor foundation because they are never afforded an opportunity to fully engage in practical tasks due to the dearth of a well-resourced and furnished workshop as well as adequate time. Having to complete their projects at home using personal resources and relying on assistance from family members leads them to perceive the primary objective of these projects as merely about earning marks. Consequently, this study concludes that physical constraints are significant factors contributing to the unrealised potential of creativity in Technology classes.

Limitations of the study

This study and its findings were limited to schools around Sekhukhune East District. These schools are situated in rural areas; they are under-resourced, and their classrooms are overcrowded. If the study was conducted at schools with adequate Technology resources and tools, the findings might have been different. This study also used only three teachers as the participants, which limits the extent to which its findings can be generalised to other teacher populations. That said, the study is undoubtedly useful because it provides a basis for addressing the needs of Technology teachers.

Recommendations

1. Any school where technical subjects are taught should have a well-resourced and furnished workshop for a better facilitation and advancement of the 21st century's skills such as creativity.
2. Technology teachers should lobby the school management team as well as the school governing body to buy them some of the affordable tools to create a laboratory. They should also seek donations from organisations that use the same tools and equipment as the ones used for Technology lessons.
3. Technology teachers should also outsource and collaborate with nearby and well-resourced schools to do their practical tasks to address the resource-scarcity issues.
4. This study also recommends that the Department of Education needs to urgently attend to the issue of time insufficiency for Technology education because it is a subject requiring greater attention than it is currently receiving.

REFERENCES

Abrar, M. (2017). A critical evaluation of qualitative reports and their contributions to educational research. *Parole: Journal of Linguistics and Education*, *6*(2), 13–22. https://doi.org/10.14710/parole.v7i1.13-22

Addison, N., Burgess, L., Steers, J., & Trowell, J. (2010). *Understanding art education: Engaging reflexively with practice*. Routledge.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, *10*(1), 123–167.

Arokoyu, A. A., & Charles-Ogan, G. I. (2017). Availability and utilization of laboratory kits for practical teaching of mathematical skills in chemistry. *American Journal of Mathematics and Statistics*, *7*, 160-165.

Awawdeh, M. N. A., & Lian, L. H. (2020). The relationship between creativity domains and academic environment. *International Journal of Innovation, Creativity and Change*, *13*(7), 928-940.

Ayu, M. (2019). Interactive activities for effective learning in overcrowded classrooms. *Linguists: Journal of Linguistics and Language Teaching*, *4*(2), 1-6.

Baafi, R. K. A. (2020). School physical environment and student academic performance. *Advances in Physical Education*, *10*(2), 121–137. https://doi.org/10.4236/ape.2020.102012

Bao, L., & Koenig, K. (2019). Physics education research for 21st century learning. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 1-12.

Beghetto, R. A. (2021). Creative learning in education. In *The Palgrave handbook of positive education* (pp. 473–491). Springer International Publishing.

Beghetto, R. A., & Kaufman, J. C. (2013). Fundamentals of creativity. *Educational Leadership*, *70*(5), 10-15.

Biyela, B. N. (2019). Leading teaching and learning in an overcrowded classroom: experiences of four teachers in two secondary schools (Doctoral dissertation).

Blamires, M., & Peterson, A. (2014). Can creativity be assessed? Towards an evidence-informed framework for assessing and planning progress in creativity. *Cambridge Journal of Education*, *44*(2), 147–162. https://doi.org/10.1080/0305764X.2013.860081

Chan, S., & Yuen, M. (2014). Personal and environmental factors affecting teachers' creativity-fostering practices in Hong Kong. *Thinking Skills and Creativity*, *12*, 69–77. https://doi.org/10.1016/j.tsc.2014.02.003

Che Ahmad, C. N. C., & Amirul, N. J. (2017). The effect of the physical learning environment on students' health, enjoyment and learning. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, *7*(1), 47–55. https://doi.org/10.37134/jsspj.vol7.no1.4.2017

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).

Crawford, C., Martin, S., & Tanguma, J. (2002). Higher education and technology integration into the learning environment: Results of a survey of teacher preparation faculty. In Society for Information Technology & Teacher Education International Conference (pp. 736–740). Association for the Advancement of Computing in Education.

Creswell, J. W., & Zhang, W. (2009). The application of mixed methods designs to trauma research. *Journal of Traumatic Stress Publication of the International Society for Traumatic Stress Studies*, *22*(6), 612–621. https://doi.org/10.1002/jts.20479

Cropley, D. H. (2017). Creative products: Defining and measuring novel solutions. In Creativity and innovation: Theory, research, and practice (pp. 61-74).

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education – A systematic literature review. *Thinking Skills and Creativity*, *8*, 80–91. https://doi.org/10.1016/j.tsc.2012.07.004

Department of Basic Education, South Africa. (2011). *Curriculum and assessment policy statement (CAPS): Senior Phase Grades 7–9 Technology*. Government Printing Works.

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).

Esquivel, G. B. (1995). Teacher behaviours that foster creativity. *Educational Psychology Review*, *7*, 185-201. https://doi.org/10.1007/BF02212493

Fakunle, F. E., & Ale, M. V. (2018). School climate as determinant of students' academic performance in public secondary schools in Ekiti State, Nigeria. *African Educational Research Journal*, *6*(4), 236–239. https://doi.org/10.30918/AERJ.64.18.055

Fan, M., & Cai, W. (2022). How does a creative learning environment foster student creativity? An examination on multiple explanatory mechanisms. *Current Psychology*, *41*(7), 4667–4676. https://doi.org/10.1007/s12144-020-00974-z

Fatima, Z. U. A., Mushatq, M., & Fatima, Q. U. A. (2019). Overcrowded classroom problems faced by school teachers in district Muzzafarabad. *International Journal of Academic Research in Progressive Education and Development*, *8*(4), 328–339. https://doi.org/10.6007/IJARPED/v8-i4/6530

Feldman, D. H. (1999). The development of creativity. In R. J. Sternberg (Eds.), *Handbook of creativity* (pp. 159-162). Cambridge: Cambridge University Press.

Garcês, S., Pocinho, M., de Jesus, S. N., & Viseu, J. (2016). The impact of the creative environment on the creative person, process, and product. *Revista Avaliação Psicológica*, *15*(2), 169–176. https://doi.org/10.15689/ap.2016.1502.05

Graham, M. A. (2023). Overcrowded classrooms and their association with South African learners' mathematics achievement. *African Journal of Research in Mathematics, Science and Technology Education*, *27*(2), 169–179. https://doi.org/10.1080/18117295.2023.2244217

Hanif, S., Wijaya, A. F. C., & Winarno, N. (2019). Enhancing students' creativity through STEM project-based learning. *Journal of Science Learning*, *2*(2), 50–57. https://doi.org/10.17509/jsl.v2i2.13271

Harris, A., & De Bruin, L. (2018). An international study of creative pedagogies in practice in secondary schools: Toward a creative ecology. *Journal of Curriculum and Pedagogy*, *15*(2), 215–235. https://doi.org/10.1080/15505170.2018.1457999

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. https://doi.org/10.1007/s10758-018-9380-1

Ikegbusi, N. G., Eziamaka, C. N., & Iheanacho, R. C. (2021). Influence of school environment on academic achievement of preschool pupils in Lagos State. *Journal of Educational Research & Development*, *4*(2), 188-199.

Imms, W., & Kvan, T. (2021). Teacher transition into innovative learning environments: A global perspective. *Innovations in Education and Teaching International*, 58. https://doi.org/10.1080/14703297.2022.1995143.

Isaac, M. T., & Manto, R. S. (2019). Civil Technology Teacher's Environmental Knowledge in Promoting Active Learning During Practical Lessons: A South African perspective. *Online Journal for TVET Practitioners*, 4(1).

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

Keller-Mathers, S. (2011). 1. Building passion and potential for creative learning in higher education. *Collected Essays on Learning and Teaching*, *4*, 1–6. https://doi.org/10.22329/celt.v4i0.3263

Kelly, K. (2006). From encounter to text: Collecting data in qualitative research. In M. Terre Blanche, K. Durrheim, & D. Painter (Eds.), *Research in practice: Applied methods for the social sciences* (pp. 33–59). University of Cape Town Press.

Kgosi, M. K., Makgato, M., & Skosana, N. M. (2023). Teachers' views on the application of educational technologies in the classroom: A case of selected Tshwane west secondary schools in Gauteng. *Journal of Curriculum Studies Research*, *5*(2), 151–166. https://doi.org/10.46303/jcsr.2023.23

Lasky, D., & Yoon, S. (2020). A creative classroom for everyone: An introduction to a small "c" creativity framework. *Thinking Skills and Creativity*, *36*, 100660. https://doi.org/10.1016/j.tsc.2020.100660

Leah, J. (2018). The problems and solutions to overcrowding in modern cities research paper. *Words*, *1286*. https://www.studymode.com/essays/The-Problems-And-Solutions-Of-Overcrowding-113942.htm

Lewin, K. (1943). Defining the "field at a given time." *Psychological Review*, *50*, 292–310. Republished in *Resolving social conflicts & field theory in social science*. (1997). American Psychological Association.

Lian, B., Kristiawan, M., & Fitriya, R. (2018). Giving Creativity Room to Students Through The Friendly School's Program. *International Journal of Scientific & Technology Research*, 7(7).

Lin, Y. S. (2011). Fostering creativity through education-A conceptual framework of creative pedagogy research. *Journal of Scientific Research*, *2*(3), 149–155. https://doi.org/10.4236/ce.2011.23021

Loveless, A. M. (n.d.). Creativity, technology and learning—A review of recent literature. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.392.2297&rep=rep1&type=pdf Retrieved September 5, 2016

Magolego, M., & Mtshali, T. hokozani, & Sylvia, Ramaligela., S. (2022). Nurturing creativity as the 21st century skill: Effective strategies for promoting creativity in the Technology classroom. *NQ*, *20*, 2921–2931. https://doi.org/10.48047/nq.2022.20.19.NQ99249

Makielski, A. (2018). The Problem with Overcrowded Classrooms. Retrieved from http://www.theprospect.net/the-problem-with-overcrowded-classrooms-11001

Mapotse, T. A. (2014). An emancipation paradigm through critical theory in technology education: An action learning paradigm. *Mediterranean Journal of Social Sciences*, *5*(3), 502. https://doi.org/10.5901/mjss.2014.v5n3p502

May, L. (2018). Effects of overcrowded classrooms on teacher–student interactions. http://www.academia.edu/4550569/Effects_Of_Overcrowded_Clasrooms_On_Teacher-Student_Interaction

Mehmood, S., & Alvi, M. M. (2017). Effectiveness of reciprocal teaching versus traditional teaching. *PONTE International Scientific Researchs Journal*, *73*(5), 135–159. https://doi.org/10.21506/j.ponte.2017.5.12

Mokhothu, K., Maimane, J. R., & Rankhumise, M. P. (2015). The integration of technical subjects in civil technology curriculum with special reference to further education and training (FET) technical schools. *International Journal of Educational Sciences*, *9*(1), 11–18. https://doi.org/10.1080/09751122.2015.11890289

Moreira, F., Mesquita, A., & Peres, P. (2019, June). O modelo personalizado de ambiente de aprendizagem 4.0. In 14th Iberian Conference on Information Systems and Technologies (CISTI), *2019* (pp. 1–6). IEEE Publications. https://doi.org/10.23919/CISTI.2019.8760900

Mróz, A., & Ocetkiewicz, I. (2021). Creativity for sustainability: How do polish teachers develop students' creativity competence? Analysis of research results. *Sustainability*, *13*(2), 571. https://doi.org/10.3390/su13020571

Nyandwi, M. D. (2014). *Determinants of Poor Academic Performance of Secondary School Students in Sumbawanga District*. Tanzania. http://www.suaire.suanet.ac.tz/ Retrieved July 20, 2017

Patricia, M. M., Isaac, M. T., & Manto, R. S. (2023). Enhanced creativity with Mini-PAT: A case of grade 9 Technology teachers in Sekhukhune East. *African Perspectives of Research in Teaching and Learning*, *7*(1), 110-121.

Prayitno, M. A. (2023). Getting to know the term of class size reduction (CSR) and its positive impact in the world of education (historical review). *Competitive: Journal of Education, 2*(2), 103–112. https://doi.org/10.58355/competitive.v2i2.22.

Ramaboea, H., Ramaligela, S., & Mtshali, T. (2022). Grade 9 Technology Teachers 'Ability to Facilitate Mini-Practical Assessment Tasks through 9E Instructional Model in Technology Classroom. *International Journal of Mechanical Engineering*, *7*(12), 139–146.

Ramongwane, D., Manto, R. S., & Moses, M. (2022). Exploring challenges to implementing an effective agriculture-based TVET program in South Africa. *Journal of Technical Education and Training*, *14*(3), 125-139.

Rowlands, S. (2011). Discussion article: Disciplinary boundaries for creativity. *Creative Education*, *02*(01), 47–55. https://doi.org/10.4236/ce.2011.21007.

Rowlands, S. (2011). Discussion article: Disciplinary boundaries for creativity. *Creative Education*, *02*(1), 47–55. https://doi.org/10.4236/ce.2011.21007

Sawyer, K. (2012). Extending sociocultural theory to group creativity. *Vocations and Learning*, *5*(1), 59–75. https://doi.org/10.1007/s12186-011-9066-5

Selkrig, M., & Keamy, K. (2017). Creative pedagogy: A case for teachers' creative learning being at the centre. *Teaching Education*, *28*(3), 317–332. https://doi.org/10.1080/10476210.2017.1296829

Shaheen, R. (2010). Creativity and education. *Creative Education*, *01*(3), 166–169. https://doi.org/10.4236/ce.2010.13026

Siperto, J. (2017). Secondary school teachers experience in managing large classes: The case of secondary schools in Buchosa district council Mwanza.

Smith, C., Nerantzi, C., & Middleton, A. (2014). Promoting creativity in learning and teaching. In *Educational Development in a Changing World-Proceedings of the ICED*.

Stadler-Altmann, U. (2015). Learning environment: The influence of school and classroom space on education. In *The Routledge international handbook of social psychology of the classroom* (pp. 252-262). Routledge.

Szpytma, C., & Szpytma, M. (2019). Model of 21st century physical learning environment (MoPLE21). *Thinking Skills and Creativity*, *34*. https://doi.org/10.1016/j.tsc.2019.100591

Tan, L. S., Lee, S. S., Ponnusamy, L. D., Koh, E. R., & Tan, K. C. K. (2016). Fostering creativity in the classroom for high ability students: Context does matter. *Education Sciences*, *6*(4), 36. https://doi.org/10.3390/educsci6040036

Umar, I. Y., & Ma'aji, A. S. (2010). Repositioning the facilities in technical college workshops for efficiency: A case study of North Central Nigeria. *Journal of Stem Teacher Education*, *47*(3), 6. https://doi.org/10.30707/JSTE47.3Umar

Van der Bijl, A., & Taylor, V. (2018). Work-integrated learning for TVET lecturers: Articulating industry and college practices. *Journal of Vocational, Adult and Continuing Education and Training*, *1*(1), 126–145. https://doi.org/10.14426/jovacet.v1i1.17

Vincent-Lancrin, S., González-Sancho, C., Bouckaert, M., de Luca, F., Fernández-Barrerra, M., Jacotin, G., Urgel, J., & Vidal, Q. (2019). *Fostering Students' Creativity and Critical Thinking* p. F-75775 Paris Cedex 16. OECD Publishing. France. https://doi.org/10.1787/b156b4ac-en

Wang, L., & Kokotsaki, D. (2018). Primary school teachers' conceptions of creativity in teaching English as a foreign language (EFL) in China. *Thinking Skills and Creativity*, *29*, 115–130. https://doi.org/10.1016/j.tsc.2018.06.002

Wu, T.-T., & Wu, Y.-T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity*, *35*, 100631. https://doi.org/10.1016/j.tsc.2020.100631