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Pre-Service Teachers' Experiences of Teaching Sectional Drawing

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ABSTRACT

The purpose of this study is to ascertain Engineering Graphics and Design (EGD) pre-service teachers' experiences of teaching topics that involved sectional drawing during a teaching practice. Level three pre-service teachers at the studied South African university did not struggle to pass EGD, but they struggled with sectional drawing topics. The study was guided by pragmatism and used a mixed-methods approach, comprising a case study design. Of the 50 EGD pre-service teachers' convenience sampled to participate, the study included 33 who responded to the open-ended questionnaire administered after 5 weeks of their teaching practice. Three pre-service teachers were also observed during their five weeks of teaching practice, while semi-structured interviews were conducted with six pre-service teachers in the first researcher's office after teaching practice to triangulate the findings. The findings revealed that during teaching practice, EGD pre-service teachers encountered difficulties explaining to learners where to cut and why, without seeing the object or model of the drawing. It also emerged that EGD pre-service teachers lacked strategies to assist learners when teaching sectional drawing. It was concluded that most pre-service teachers struggled to construct and explain tasks involving sectional drawing to learners. The study recommends that the Department of Education provide relevant models that are visible to learners to assist pre-service and in-service teachers when explaining, particularly the interior of the model and how it is cut and sectioned.

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INTRODUCTION

Engineering Graphics and Design (EGD) is a subject that develops students' creative thinking and drawing skills to solve design problems in mechanical and civil technologies and communicate these solutions as working drawings (Engelbrecht, 2010). Olkun (2003) avers that for one to succeed in learning about design aspects, such as in sectional drawing, it is important that their spatial thinking or abilities are enhanced. Šafhalter, Glodež, Šorgo, & Ploj Virtič, (2022) mentioned that spatial visualization ability (SVA) is the ability of an individual to mentally perceive and copy an object or figure and imagine what it would look like after the rotation of a specific angle. Sectional drawing topics require pre-service teachers to visualise the interior of an object or building; hence, spatial visualisation is a significant purpose for pre-service teachers to understand these topics. Sectional drawing cuts across EGD subject topics. Pre-service teachers studying the Bachelor of Education Technical (BE.d Tech), a teaching qualification, are required to be competent in sectional drawing. Thus, there must be specific skills and/or knowledge that these pre-service teachers need to acquire if they are to learn and later teach the topics.

Aglazor (2017) maintains that the success of teaching practice is dependent on collaboration among teachers, lecturers, and pre-service teachers. It appears that teaching topics involving sectional drawing requires the teacher's expertise. Pre-service teachers are to collaborate with their mentors for effective teaching. According to Bantwini (2019), collaboration and learning among educators in a school serve as a continuous source of motivation and enhance students' learning outcomes. A student teacher must also possess skills and art to attract learners, make their lessons interesting, and impart knowledge and education (Siddikov & Mahkamova, 2022). At the studied University, all level three pre-service teachers were enrolled in their first year and had different backgrounds from their previous schools. Most pre-service teachers had Physical Sciences, Mathematics, and Life Sciences, but not technical subjects related to EGD.

Based on the first researcher's experience as a lecturer, level three pre-service teachers at the studied University do not struggle to pass EGD, but they face significant challenges with topics involving sectional drawing. This study aimed to ascertain the experiences of level three pre-service teachers in teaching topics involving sectional drawing during teaching practice. Hence, it is very important for pre-service teachers to understand the content they will later teach to contribute to knowledge by exposing factors that influence teaching and learning in sectional drawing topics and further proposing enablers for successful implementation.

LITERATURE

Teaching is an important element of the education process, and teaching practice is a required course for all aspiring pre-service teachers enrolled in a teacher training program (Aglazor, 2017). According to Basilotta-Gómez-Pablos, Matarranz, Casado-Aranda, and Otto (2022), the origin of the teaching and learning by competences method may be traced back to the social changes that have occurred in recent decades. According to Urdarevik (2013), teaching any topic in EGD using a textbook is a classic way that students often struggle to understand. The teacher is critical in the process of integrating technologies and plays an important role in the adoption and implementation of technology tools in the EGD Lab, because the transformation and improvement of education will depend, among other things, on educational action, which implies that teachers must have effective digital competencies that allow them to integrate and use technologies in a pedagogical way (Basilotta-Gómez-Pablos, Matarranz, Casado-Aranda, & Otto, 2022). Level three pre-service teachers should have their own teaching materials to supplement their instruction, especially when teaching sectional drawing. The study was conducted at a university with insufficient resources and equipment to support the current industrial revolution. Few studies have focused on the materials that pre-service teachers should have when they go to teach practice. Pre-service teachers are expected to use appropriate teaching materials when teaching subjects such as EGD, which require strong visualization, creativity, and object manipulation during the drawing and design process. Few studies have focused on the materials pre-service teachers should have during teaching practice. Pre-service teachers are expected to use appropriate teaching materials when teaching EGD, which involves effective visualization, creativity, and object manipulation during the drawing and design process.

According to Bashir, Alias, Saleh, and Halzah (2017), to effectively fulfil their teaching responsibilities, teachers must master their subject content, understand the characteristics of effective teaching, be aware of appropriate and diverse skills, understand learners' learning styles, and recognize their own teaching strengths and weaknesses. According to the study, teaching topics involving sectional drawing requires a prepared pre-service teacher who thoroughly understands EGD content so that explanations for technical school learners flow smoothly. If EGD pre-service teachers struggle to teach in high schools, it is unlikely that this is due to a lack of understanding of EGD content, but rather the teaching of EGD on how to deliver the sectional drawing. Instead, level three EGD pre-service teachers should learn from their mentors how to teach and prepare lesson plans, rather than the EGD curriculum, which they are now expected to deliver at technical school. Bantwini (2015) conducted a study to investigate the impact of teachers' learning styles on teaching practice and student learning. He discovered that 78 percent prefer studying in a group, whereas 22 percent prefer studying alone. EGD is a practical subject that requires pre-service teachers to discuss it before delivering a session. EGD can be taught without difficulty; advanced projects involving sectional drawings require support.

Makgato and Khoza (2016) conducted a study on level three pre-service teachers studying Engineering Graphics and Design, focusing on their practical attempts at sectional drawing during teaching. According to the study, many pre-service teachers began with inadequate basic EGD skills, particularly in sectional drawing concepts, principles, and the transfer from 2D to 3D representation. Observations in classroom settings demonstrated that these pre-service teachers frequently struggled with spatial vision and following proper line-work processes. Furthermore, both instrument handling (the use of drawing boards, pencils, and set squares) and instructing pre-service teachers from diverse backgrounds were found to be inadequate. Teaching 3D and 2D without a technological tool such as AutoCAD to support sectional drawing instruction led to pre-service teachers' confusion and poor performance on sectional drawing exercises. Mtshali (2021) explored pre-service teachers' metacognitive difficulties with reading mechanical drawings, particularly sectional views, during teaching practice. He maintained that they lacked an understanding of essential concepts, including cutting planes, hatching, projection orientation, and hidden-line interpretation. Many pre-service teachers were unable to understand how a sectioned object should appear, and even after assignment explanations, classroom assistance was insufficient to correct these misconceptions. The findings show that without structured pedagogical scaffolds and improved support mechanisms, pre-service teachers are confused and ill-prepared to teach sectional drawing effectively, emphasizing the critical need for targeted interventions in both spatial-visual skill development and teaching methods. Teacher professional development (PD) is commonly seen as essential for increasing student outcomes and attaining greater fairness (Gore & Rosser, 2022). Pre-service teachers of today are expected to mold their own lives, make decisions, and accept responsibility for those decisions more than in past generations. The present generation of pre-service teachers must also prepare for lifelong learning, as they will need to acquire new knowledge and skills throughout their professional careers. This places significant demands on students' abilities to govern themselves (Voskamp, Kuiper, & Volman, 2022).

OBJECTIVES OF THE STUDY

The study sought to answer the question: What experiences do level three pre-service teachers have when teaching sectional drawing during their teaching practice? And to what extent do level three pre-service teachers face difficulties when teaching sectional drawing during their classroom practice?

MATERIALS AND METHODS

Research Approach

This study adopted a mixed-methods approach. The core assumption of mixed-method research is that it provides a more complete understanding of a research problem. Mixed-method research utilizes a blend of qualitative and quantitative approaches tailored to the study's objectives and the characteristics of the research question, with the goal of enhancing understanding of the topic (Taherdoost, 2022).

Research Paradigm

The study employed a pragmatic research design to collect data from EGD pre-service teachers in the Technical Education programme at the University. Pragmatism emphasizes the human ability to learn, reason, make informed decisions, and actively adapt to, influence, and modify one's surroundings (Kaushik & Walsh, 2019). Data were collected through questionnaires, classroom observations, and one-on-one interviews.

Research Design

Cook and Kamalodeen (2020) stated that case study research is not limited to specific methodologies, and, like mixed-method research, method selection is based on the research aim and questions. This study employed a case study design to acquire a thorough understanding of pre-service teachers' experiences with sectional drawing throughout their teaching practice in Engineering Graphics and Design (EGD).

Population and Sampling

The "target population" is a collection of people or items about which researchers wish to make broad generalizations. A sample can be obtained from a group of people known as a "target population" (Rahman, Tabash, Salamzadeh, Abduli, & Rahaman, 2022). In this study, the population consisted of all fifty level three pre-service teachers enrolled in the EGD BE d (FET) Technical program. A sample is a subset of the target population that a researcher intends to analyze to generalize the findings to the entire population (Creswell, 2008). In this study, the researchers employed a total sample of thirty-three level three pre-service teachers who completed the open-ended questionnaire and were selected for the quantitative phase. Six level three pre-service teachers were selected from the thirty-three to participate in semi-structured interviews, while three were observed for qualitative data using a convenience instrument. Rahman (2023) noted that researchers use convenience sampling in the early stages of survey research because it allows for quick and easy data collection.

Questionnaires

You may ask some questions that are closed-ended and others that are open-ended (Creswell, 2008). Open-ended questions require respondents to spend more time considering and articulating their responses and empower individuals to express their opinions verbally (Baburajan, Silva, and Pereira, 2020). Open. The questionnaire was administered to pre-service teachers upon their return from teaching practice and was developed by the researchers in collaboration with academic staff experts in EGD.

Observations

According to Louis, Lawrence, and Keith (2007), the purpose of observation is to determine the extent to which a specific behaviour is present. In this study, the first researcher observed three pre-service teachers from two technical schools during teaching practice, based on the school timetables, which both allocated 45 minutes for EGD. According to the school timetables, each pre-service teacher was observed for not more than 45 minutes.

Interviews

Louis et al. (2007) argue that interviews enable pre-service teachers – whether interviewers or interviewees – to discuss their interpretations of the world in which they live and to express how they view situations from their own perspective. Six level three pre-service teachers participated in the semi-structured interviews.

Reliability and Validity

According to Koonin (2014), dependable research tools, high sample sizes, and random sampling all contribute to the reliability and validity of quantitative studies. The test-retest reliability approach was employed in this study, and a reliability coefficient of 0.7 was deemed sufficient. Validity was ensured through a pilot study and triangulation, which refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of the phenomenon (Patton, 1999). The study utilised observations, interviews, and questionnaires for triangulation, which assured trustworthiness. Trustworthiness ensures that the study's findings warrant attention and that the research is of high quality (Lincoln & Guba, 2000).

Data Analysis

Quantitative data for the study were analysed through SPSS version 26 and presented using descriptive statistics, while qualitative data were thematically analyzed. According to Braun and Clarke (2006), thematic analysis is a method for detecting, analyzing, and reporting patterns (themes) in data, with your data set being minimally organized and presented in (rich) detail. Pseudonyms were used to differentiate sources of qualitative data as follows: QPST4 referred to data from the questionnaire of the 4th pre-service teacher; IPST3 referred to data from the 3rd pre-service teacher; and OBPST2S1 referred to the 2nd pre-service teacher observed at school 1.

RESULTS AND DISCUSSION

Biographical Information of Participants

According to Koellinger, Okbay, Kweon, Schweinert, Linnér, & Goebel (2011), biography data sets can always be divided into time-invariant and time-dependent variables. The author further said that, alternatively, information that remains valid must be included throughout the analysis period under investigation. Table 1 presents selected information for the 33 participants who submitted complete questionnaires among the 50 participants targeted.

Table 1. Group and age analysis of participants (N=33)

Category	Division	Frequency	Percentage
Group	Civil group	22	66.7%
	Mechanical group	11	33.3%
Age	19-23	23	69.7%
	24-28	09	27.3%
	29+	01	3.0%

It emerged that out of the 33 pre-service teachers who participated in the study, 22 (66.7%) were drawn from the civil group, while 11 (33.3%) were from the mechanical group. Table 1 further shows that 69.7% of level three pre-service teachers were between 19 and 23 years of age, 27.3% were between 24 and 28, and 3.0% were between 29 and 34. That shows 69.7% of the participants were level three pre-service teachers. The participants by specialisation and age reflect the demographic mix of the cohort studying EGD. The table shows that the existing data come from the civil and mechanical group cohort of EGD to provide a better understanding of who was included in the data collection.

Data Presentation and Discussion

Data presentation adhered to the adopted research design. Data drawn from the quantitative phase were triangulated with qualitative findings from the open-ended section of the questionnaire, semi-structured interviews, and classroom observations.

Comparing respondents' teaching challenges, learners' accessibility to EGD instruments, and mentorship availability

In the quantitative phase, the study compared variations in views on the existence of pre-service teachers' teaching challenges regarding sectional drawing, learners' accessibility to EGD instruments, and the availability of mentorship for pre-service teachers, as shown in Table 2. Table 2 shows that most pre-service teachers encountered difficulties when teaching topics involving sectional drawing. Approximately 64% of level three pre-service teachers reported difficulties in teaching topics involving sectional drawing. Regarding the availability of instruments, 73% of pre-service teachers taught EGD to learners without EGD instruments. Approximately 27% of research participants agreed that learners had instruments during teaching practice, indicating no EGD instrument challenges.

Table 2: Variations of views on the existence of pre-service teachers' teaching challenges, learners' accessibility to EGD instruments, and availability of mentorship

Responses	Existence of pre-service teachers' teaching challenges	Learners' accessibility to EGD instruments	Availability of mentorship
Agree	21 (63.6%)	09 (27.3%)	20 (60.7%)
Disagree	12 (36.4%)	24 (72.7%)	13 (39.3%)

Table 2 shows that 39% of participants disagreed that they were not supervised in difficult areas like assembly drawing and isometric drawing in EGD. The findings also showed that mentors had few teaching aids, particularly for topics such as assembly and isometric drawings, indicating a lack of sufficient resources in many technical schools. However, approximately 61% of pre-service teachers reported that mentors used simple teaching aids for solid geometry, often made from cut boxes, to support teaching and learning.

Lack of EGD instruments or models corroborates findings from interviews. Interviews further revealed that EGD was challenging when teaching it without the relevant objects, charts, or models to anyone who did not have a background. As IPST3 said, *"I think it is difficult because you will find that in schools where we did our SBE experience, learners did not have drawing tools, so you must move around checking if learners are doing the right thing because they do not have instruments to draw. You will find that lines are not correct when it comes to sectioning, or they do sectioning, but it is not accurate."* An interesting discovery was from IPST6, who mentioned that *"We did not teach topics that involve sectional drawing during teaching practice because my mentor said we should teach grade 11 only."* This revelation made it even more difficult to determine how many participants might not have been taught sectional drawing and were neither observed nor interviewed. The researcher's question is whether these mentors are afraid of pre-service teachers teaching sectional drawing topics, or if they are saying these pre-service teachers might not teach sectional drawing topics, but topics that are not cut.

Thus, responses from the open-ended sections of the questionnaire were consistent with the interview and the quantitative findings. This is consistent with the findings of Baleshta et al. (2015), who conducted a study on integrating 3D printing with EGD for large class sizes and found that solid models were presented in hard copy form, with notes that pre-service teachers found valuable. Reverberating the call for authentic education that utilises concrete objects, level three pre-service teachers appreciate models that are visible and touchable. According to Khoza (2017), pre-service teachers find classroom settings unfamiliar when teaching EGD. Furthermore, their

curricular saliency is frequently good, but they struggle with concept scaffolding and topic linking (Khoza, 2017). Visual aids are instructional tools used in the classroom to support pre-service teachers' learning, according to Shabiralyani, Hasan, Hamad, and Iqbal (2015). According to the researchers, learners can easily understand sectional drawing topics when models are used during teaching.

The importance of an EGD background

Quantitative findings revealed that only 18% reported that an EGD background was not important for enrolment in EGD. The level three pre-service teachers in level one did the basics of EGD, since they struggled with EGD content with no EGD background. In the qualitative phase, when asked about the importance of having an EGD background when pre-service teachers enrol in a University for EGD, various responses emerged. One of the participants said: *'Yes, because you might find that most learners struggle with many topics, they have challenges of not being able to handle or use drawing instruments'* (PSTQ4). In support of this, PSTQ18 confirmed, *'Yes, so that you will be able to catch up quickly and that will lead you to master EGD'*. Nonetheless, PSTQ9 had a different view, saying: *'No, it is not important to have an EGD background because in level one, a student is taught EGD from the foundation of it, so that it could be clear for us as students.'*

According to Skosana (2017), students who enrol in the EGD programme without an EGD background have consistently found this course very challenging. The author further stated that it was difficult for students to construct knowledge without prior knowledge (Skosana, 2017). Therefore, this makes things difficult for pre-service teachers with a background, as they sometimes become bored during the lesson. The researcher's view is that pre-service teachers with an EGD background can quickly visualize drawings and encounter fewer challenges than those without one.

Pre-service teachers' understanding of topics from level one up to level two

Few research participants (34%) reported that their understanding of EGD topics, with or without a background in sectional drawing, was not good and that they needed assistance. Then 66% of participants reported understanding EGD thus far. Research participants in this section indicated that topics that involved sectional drawing needed more practice. They also responded that topics involving sectional drawing needed assistance, and that more tasks should have been assigned, as the new tasks in examination papers involving sectional drawing took more than 2 hours to complete each drawing. In the qualitative section, participants were asked how they understood sectional drawings, regardless of their EGD backgrounds. PSTQ20 responded, *'My understanding is very poor because what I know about sectional drawing is what I have been taught; if you give an activity that is new to me, I become completely confused'.* Thus, regardless of EGD background, participants stated that completing those tasks was not easy.

Furthermore, in the open-ended section, a question was asked to determine whether pre-service teachers understood sectional drawing concepts from Levels one and two as background, up to Level three. Some of the responses were:

"To the extent that the topic, including sectional drawing, is a problem, in level one, I did understand those topics, but in level two, things started to be complicated, and in level three, it has become more complicated than level two" (PSTQ5). Another participant wrote, *'Sometimes I think I do understand them (topics that involve sectional drawing) when the teacher is teaching, but when I do it myself, I do not understand at all'* (PSTQ41).

Pre-service teachers at level one perform more basic tasks that require more time, as they have different backgrounds, which creates challenges for lecturers. This is why they think level three drawings are complicated and are more challenging than level two and level one drawings. Other views held that level three drawings consisted mostly of sectional drawings, and that was where the problem began. Thus, if they are not given enough time to practice with tutors or assistance, then they might encounter difficulties with EGD.

Difficulty of topics involving sectional drawing versus topics not involving sectional drawing

According to most research participants (79%), topics that involved sectional drawing were more difficult than those that did not. They further indicated that the sectional drawing topics required learners to think deeply, and they could not clearly see the parts that were supposed to be cut off. Objects that have been cut change their original shape. In the open-ended section, respondents were asked if topics that involved sectional drawing were more difficult than topics that did not involve sectional drawing. PSTQ2 indicated that, *'Yes – these topics with sectional drawing can be difficult to work on, sometimes a lot when you have to create your own vision on how the end product should look and where to section and not to section'.* Similarly, STQ8 wrote, *'Drawings having no sectional planes are more likely to be enjoyable, and it is easy to study and know them'.*

There was also a question about the need for assistance to complete EGD tasks. The first researcher's experience is that pre-service teachers complete one task for two or three days, suggesting they struggle to complete individual tasks. Thus, pre-service teachers were asked whether they needed assistance with EGD tasks. 88% responded that assistance was needed, especially for topics involving sectional drawing. Level three tasks have different parts that must be sectioned or not sectioned. PSTQ3 responded, *'Yes, sometimes I fail to understand certain chapters that do not need sectioning, hence I need assistance'.* Makgatho and Khoza (2016) conducted a study to investigate students' difficulties with sectional drawing. Their results revealed that students in technical education find it difficult to learn sectional drawing; as a result, they struggled to pass it. For pre-service teachers to enjoy and be passionate about sectional drawing topics, they must understand EGD and know how to visualise any drawings they encounter in teaching practice. Olkun (2003) avers that for one to succeed in learning about design aspects such as sectional drawing, it is important that their spatial thinking or abilities are enhanced. Pre-service teachers can be good at visualising drawing, especially if they start by drawing machines in level one, not the basics of EGD.

Rating EGD topics from the most challenging

Research participants were asked to rate the topics that were challenging in EGD. These topics appear in Table 3.

Table 3: Rating difficulty of topics in EGD

Topics	Percentages
Assembly drawing	79%
Isometric drawing	70%
Perspective drawing	64%
Civil drawing	24%
Solid geometry	18%

Pre-service teachers (79%) indicated that the most challenging topic was assembly drawing, followed by isometric drawing (70%). It emerged that perspective drawing (64%) was considered moderately difficult, with civil drawing (24%) and solid geometry (18%) viewed as easier topics. In this section, the researchers needed to know topics that were challenging in EGD, even if they do not involve sectional drawing. Perspective drawing does not involve sectional drawing; it is a 3-dimensional drawing that uses many lines to form a complete 3D model. The topic with the highest percentage of sectional drawing was assembly drawing, because in level three, it deals with larger machines and different parts that require different sectioning. According to Pillay and Sotsaka (2017), learners performed poorly in assembly drawing in both tests and examinations. From the researcher's experience, it is worse during examination when pre-service teachers take more than two hours to complete a drawing. The sectional drawing topics, together with 3-dimensional drawings (perspective drawing), are challenging.

Teaching topics that involve sectional drawing during teaching practice

Pre-service teachers were asked how they taught topics that involved sectional drawing. The majority (67%) of pre-service teachers reported that teaching sectional drawing during teaching practice was difficult. Though they indicated that teaching EGD in schools was a good experience, they also noted that before they taught in class, they consulted their mentors on topics involving sectional drawing. In the qualitative phase, there were various responses. PSTQ6 mentioned that *'It is difficult to teach topics that involve sectional drawing, and it is even worse when there are no objects or charts because they make things easier'.* The same sentiments were echoed by PSTQ7, who responded, *'It was a bit difficult, since you are talking to the learners about something they do not see. It was hard for them to point out even the visible and hidden parts, so sectioning was something else.* On the other hand, PSTQ9 had a different response, saying that *'It is not yet difficult because there is a memorandum that guides me before going to classes.'*

The implication of the last response that there was a memorandum used before going to the classroom was that some of the pre-service teachers did not practice before going to the classroom, but looked at the memorandum and used it to teach topics that involved sectional drawing. Consequently, EGD topics involving sectional drawing are not easy to teach without preparation or practice. This was confirmed by findings from observations. Observations of teaching were conducted in two technical schools during the pre-service teachers' practicum to better understand how they taught and how learners experienced the environments they created. While the first researcher had initially planned to observe six EGD pre-service teachers in the classroom, she was able to observe only three who were teaching topics involving sectional drawings at the time. Two participants were at the same technical school, while one was at another.

Findings from one observation revealed that the observed pre-service teacher (OBPST1S1) was well prepared for the lesson and had all the EGD instruments that would be used, as well as lesson plans. During the lesson introduction, OBST1S1 began by greeting learners and handing out blank pages, then instructed them to copy what he was drawing on the board, even before explaining the day's business. The pre-service teacher drew on the board while asking learners about their previous work. OBPST1S1 then reminded them of the previous work; referred to what they were drawing, and how it related to the day's work. The researcher observed that learners and OBPST1S1 had a good rapport and were using examples from real-life situations. The pre-service teacher answered learners' questions individually during the lesson.

The second pre-service teacher (OBPST2S1) did not have a lesson plan, textbook, or lesson preparation materials with him. OBPST2S1's was solely on the board, with no eye contact with his learners. The pre-service teacher did not remind learners of previous assignments. In OBPST2S1's classroom, there was no learner involvement during the lesson. There was no communication as learners watched the pre-service teacher draw on the board. Learners did not take part or ask questions. During the lesson, the observer noticed that the learners were disoriented and doing nothing. Towards the end, when the OBPST2S1 asked them if they had understood, the learners responded in a chorus with a 'yes'. According to the first researcher, it was possible that learners had neither understood what the teacher had taught the previous time nor what he was teaching on that day. It also appeared there was no relationship between the learners and the pre-service teacher.

The third pre-service teacher (OBPSTS2) was well-prepared, with a textbook and a blank page for learners to work on. OBPSTS2 posed questions about the lesson to the learners as she moved around the classroom, assisting learners individually. The lesson presentation was slow, and the participant did not complete the drawing on time. They had to switch classes because the period was over while most learners were in the middle of the drawing.

The issue of the time required to teach sectional drawing also emerged as a time management matter during the interviews, when research participants were asked how much time they needed to teach topics involving sectional drawing. IPST5 said, *"I think I need maybe 2 hours because when you are doing sectional drawing you have to be patient so that they can get it so our period its one hour so you find that we do not finish with that hour, in sectional*

drawing we draw, then we cut then we have to show now where must we section, so that will take time." Similarly, IST6 responded, *"Maybe 2 hours, as 1hour period is not enough."* Compared to the time allocated for EGD lessons, all participants indicated they needed more than an hour. All participants said that 1 hour was not enough to teach topics involving sectional drawing. During their teaching practice, they taught EGD for an hour, which showed that it was not enough to teach it for an hour. However, that was deemed better than the observed participants, who were allocated 45 minutes. Overall, all observed learners lacked at least an EGD instrument. According to the observing researcher, pre-service teachers did not appear concerned about teaching learners without instruments. This is contrary to the Information Process Theory, which is the theoretical framework adopted to guide the study. According to the theory of information processing by Slate and Charlesworth (1988), learning cannot occur without a learner's attention to the task at hand. As such, we maintain that pre-service teachers cannot deliver an effective EGD lesson unless everyone has an instrument. Furthermore, pre-service teachers should evaluate themselves after class. Aligning with Bashir, Alias, Moh'd Saleh, and Halizah, (2017), pre-service teachers should consider self-report evaluation, which is a type of evaluation that asks teachers to report on what they do in the classroom through instructional records or discussions. Teachers' performance is defined as their ability to impart relevant skills and knowledge using appropriate methods consistently to improve students' learning and achievement (Bashir et al., 2017). Kalyoncu (2015) conducted a study on the relationships between learning approaches in Civil Engineering and found that one respondent was interested in the subject, but that interest was discouraged by the learning environment, such as an overcrowded timetable. Thus, overcrowded school timetables may have left level three pre-service teachers with insufficient time to teach EGD.

Access to mentorship assistance during teaching practice

Research participants were asked if they received assistance from their EGD mentors during teaching practice. About 88% of pre-service teachers received assistance from their mentors, indicating collaboration between pre-service teachers and their mentors in the technical school. This was confirmed by the qualitative findings, as many research participants, including PSTQ2, PSTQ4, PSTQ5, PSTQ10, and PSTQ14, responded positively: *'We received assistance from mentors, such as preparing before going to class and explanation if there is a task that they do not understand'.* However, about 12% of research participants (including PSTQ3, PSTQ12, PSTQ17) indicated, *'We did not receive any assistance from mentors, and some were not available at school'.*

About 12% of research participants did not receive any assistance from their mentors. 12% of research participants struggled during teaching practice without mentors' assistance. The researchers' view is that research participants might not have the passion to teach EGD in the future or will give learners memoranda to draw sectional drawing topics. Mentorship experiences of pre-service teachers also emerged as a subtheme during interviews. Interviews revealed that participants had different experiences with the support they received from their mentors, with most reporting negative experiences. They were asked whether the mentors supported them in any way, including providing materials such as charts or teaching aids, to teach topics involving sectional drawing. It emerged that teaching EGD in technical schools was a positive experience for some participants. They stated that they consulted their mentors before class to teach topics involving sectional drawing. As a result, EGD topics involving sectional drawing were not as difficult for them to teach, unlike for others who had no mentor assistance and attended classes without sufficient preparation or practice. For instance, OQPST3 wrote, *"We received assistance from mentors, such as preparing before going to class and explanations if there is a task that they do not understand."* From interview responses, IPST2 also said, *"Yes, teaching aids. That was made from using a cut box."* This was contrary to OQPST8, who wrote, *"We did not receive any assistance from mentors, and some were not available at school."* During interviews, IST3 said, *"The mentor from high school, no, I had to design my own models."* This was consistent with IST1, who indicated, "I was only given chalk and a duster*."* The study thus established that mentors provided varied support but did not provide as much support in terms of teaching aids or models, as some participants had to be creative to make things easier for learners.

Considering that some pre-service teachers had received assistance from their mentors, this indicated that collaboration between pre-service teachers and their mentors occurred in technical school under such circumstances.

Collaboration and learning among teachers in a school, according to Bantwini (2019), serve as a sustained motivational practice and lead to improved learning outcomes for learners. Bantwini (2019) stated that teachers should be self-directed and demonstrate a willingness to learn when they see a need, particularly for new skills and knowledge. The assistance they received helped them, especially when they taught, because they used their mentor's teaching strategies, models, or charts. On the other hand, without mentors' assistance, some research participants struggled during teaching practice. According to Khoza (2017), pre-service teachers and mentors must collaborate. In this case, such an oblique experience may prompt pre-service teachers not to desire to teach EGD in the future, thus giving learners memoranda to draw sectional drawing tasks. It is a risk that technical schools ought to work against. Moila (2025) suggests that recent advances in augmented reality, along with the arrival of mobile devices, have opened new opportunities for advancing technology education. Pre-service teachers must be adaptable during teaching practice; they must bring their own resources aligned with their work schedule and containing relevant items that will benefit learners at the technical school.

Teaching practice experiences of teaching sectional drawing

Pre-service teachers were asked how they taught sectional drawing during their teaching practice. The participants believed that teaching was not the same as learning. The majority (58%) reported that it was difficult during teaching, thinking that many questions would be posed to them. Some of them mentioned that before teaching, they had to consult their mentors so that they would go to class prepared. PSTQ6 said, *'It was hard because first, I had to understand where it is cut and know where to section and how to section it'.* In agreement, PSTQ8 responded, *'It was challenging because in high school, it requires me as a teacher to go into more detail, which I find difficult.'* PSTQ15 also echoed that '*it was a challenge [for learners] to listen to a teacher teach topics that involved sectional drawing without models or seeing the object to cut at the end of the lesson'*.

Interview findings revealed that teaching sectional drawing was challenging. Most pre-service teachers stated that it was difficult to teach topics that required sectional drawing. For instance, IPST2 said, *"It was difficult for me to teach topics involving sectional drawing without instruments, even though there were a few learners who had instruments; it is frustrating because they do not finish on time. The following day, the teacher may begin a new chapter while other learners finish the task from the day before."* Echoing the same sentiments, IPST5 responded, *"It is very challenging to teach someone because you must make him or her understand everything so that he/she can understand that okay, when you say it's been cut, how does it cut? In all, there is a challenge there to convince someone that okay, it will look like this after it's been cut, so yeah, in applying it is more difficult than learning"*.

On the other hand, IPST1 said, *"I think it's not difficult if you prepare but it is difficult to explain to the learners a cutting section, for example, I can say it's difficult to imagine the cutting plane so for you to explain to the learners to use their imagination skills is kind of difficult"*. IPST4 also responded, *"It was difficult for some learners; other learners were understanding some were not understanding. When you look at the object from all sides, some parts are not cut, and in other views, you will not see them because they have been removed. So, some learners were able to see the challenges and not face them. Some learners had lots of questions, like, " How do you see a top view like this again? How do you see the front view when it is being cut?"* However, contrary to others, OQPST21 raised that, *"It was not difficult because there was a memorandum that guided me before going to classes."* Thus, for some, a memorandum was used before entering the classroom. Unfortunately, that might have prompted some research participants to skip practice before class and instead rely on the memorandum to teach sectional drawing topics.

It emerged that research participants' challenges included how to explain to learners or how to convince learners that this view, when cut, will change the shape, and some views will not change the shape. According to Khoza (2017), EGD lessons were abstract, and learners struggled to understand the topics taught. Khoza (2017) noted that pre-service teachers lacked EGD teaching resources, making EGD difficult to teach. According to Magdeline (2013), teaching practice can be a very challenging, demoralizing, and sometimes terrifying experience, especially if pre-service teachers are not well prepared.

CONCLUSION AND RECOMMENDATION

The study concluded that most pre-service teachers had challenges teaching topics involving sectional drawing, as the triangulated findings revealed that most struggled to construct and explain these tasks to their learners. It was also concluded that mentorship support among participants varied, with some participants reporting positive experiences and others reporting negative experiences due to having no mentors to assist them before classes. The study further concluded that mentors were not thorough in ensuring that pre-service teachers always had lesson plans in their files. Another conclusion was that research participants did not use enough models during teaching practice. As such, it is a challenge to ask learners to use their imagination to cut the drawing and section it.

Based on the findings, the researchers make the following recommendations: The Department of Education should provide technical schools with relevant EGD models to enhance the teaching and learning of sectional drawing. Technical school schedules should be revised to allow for adequate time for practical subjects. When presenting any lesson, whether it involves sectional drawing or not, mentors should be present in class with the pre-service teachers, and, through teamwork, learners should assist one another to overcome learning challenges during the lesson for EGD or any other subject. Pre-service teachers should create their own models for effective teaching, familiarize themselves with 4IR digital tools, and be flexible when they are to teach or work in well-resourced technical schools.

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