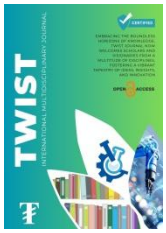
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Examining the Topic-Specific Nature of PCK in the Teaching of Graphs in Dynamics of Market: A South African Case

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Abstract
Understanding graphs in economics education remains a global challenge but specifically, understanding graphs in the topic 'Dynamics of Market' (DM) is a critical issue for South African learners in economics education. This study aimed to examine the nature of Pedagogical Content Knowledge (PCK) of economics teachers in the teaching of graphs in DM. A case of two different economics teachers' PCK of the 10th and 11th grades on the same topic at different grade levels had to be compared to understand the phenomenon better. Focusing on different teachers' PCK for teaching the same topic at different grade levels will help economics education researchers to understand why the same topic is taught differently by different teachers and therefore helps to throw more light on individual teachers' PCK in teaching economics topics. Using Mavhungas' Topic Specific Pedagogical Content Knowledge (TSPCK) model as the theoretical framework, two topic-specific components, learners' prior knowledge and knowledge of representations, were examined. Data was collected using the observation method and analyzed thematically. This study found that both teachers demonstrated adequate prior knowledge of learners' misconceptions of graphs in DM. It was also found that both teachers used topic-specific classroom activities to enhance learners' understanding of graphs in DM. However, both differ in the extent to which they understand learners' learning difficulties. The study suggests a framework for teaching graphs in DM and suggests that teachers should adopt a systematic approach to teaching graphs in DM. The study concludes that the nature of PCK is specific to an individual teacher.

Keywords
Dynamics of market, Topic-specific, Pedagogy, Content knowledge, Knowledge of learners, South Africa

INTRODUCTION

Pedagogical Content Knowledge (PCK) has been a useful theoretical framework in economics education research. According to Shulman (1987), PCK is an amalgamation of content and pedagogical knowledge needed to teach a specific topic to students in an understandable way. It is "the knowledge needed for the transformation of content knowledge in a particular topic into a teachable form using pedagogical reasoning" (Shulman, 1987). However, there are many controversial questions surrounding the issue of PCK being topic-specific. For example, in an earlier study, Abell (2008) questions, "How do teachers transform their subject matter knowledge of the same topic into PCK for teaching the same topic in different grade levels?". Abell went further to ask, "How can teachers use different instructional strategies and different representations in teaching the same topic in the same discipline but different grade levels?"

To address this concern, studies (Aydin et al., 2014; Matitaputty et al., 2022) have provided significant information on the nature of PCK for multiple topics, however, these studies have not provided adequate insight for the nature of teachers' PCK in teaching same topic at different grade levels. Therefore, focusing on different teachers' PCK for teaching the same topic at different grade levels will help researchers to understand why the same topic is taught differently by different teachers and therefore helps to throw more light on the question asked by Abell (2008) on why the same topic, is taught differently by different teachers.

Understanding graphs in Dynamics of Market (DM) is significant in economics education. According to Ogbonnaya & Ngulube (2023), understanding graphs in DM helps to minimize learners' misconceptions in understanding other difficult concepts in economics thus learners must construct meaning and understanding from prior knowledge. Glazer (2011) supported this assertion by emphasizing that the fact that one of the characteristics of graphs in economics

is that theories rule them affects the interpretation of graphs, as such, learners most often face the challenge of providing interpretations and explanations for data that contradicts theories.

Indeed, understanding graphs in economics education remains a global challenge. In his study on graphs DM, Ayers (2015) noted that teachers should expose learners many times to the supply and demand concepts as learners often considered the content dry, graphical and overly mathematical. Matuk, Zhang, Uk, & Linn (2019) shared the same view that learners have challenges in almost all aspects of graphs, such as reading, converting one type of graph to another type and plotting and interpreting graphs.

Nature of PCK

In recent times, Şen et al. (2022) explored the interaction among PCK components and how it impacts on content knowledge. Their findings revealed that although there was a significant interaction between knowledge of learners and knowledge of instructional strategies, PCK components did not interact strongly with content knowledge thus the study concluded that the interactions among PCK components for teachers depend on the differences in the PCK nature of their content knowledge. In another study, Gencer and Akkus's (2021) examined two topics; chemical species and states of matter and their results showed that while one of the participants' orientations to science teaching was topic-specific, the other was not topic-specific. While the study by van Driel et al. (2014) found integration of PCK among components, Sickel and Friedrichsen (2018) found that teachers lack integration of PCK components. Park and Chen (2012) investigated the nature of PCK for experienced biology teachers in teaching the topics of photosynthesis and heredity and found that the integration among PCK components was topic-specific and idiosyncratic; the PCK components in photosynthesis interact more among themselves than that of heredity. Akin and Uzuntiryaki-Kondakci (2018) examined experienced and novice teachers' PCK integration in two different topics, reaction rate and chemical equilibrium, and found that the experienced teachers integrated all PCK components, and the novice teachers did not.

Mavhunga (2020), on the other hand, investigated pre-service teachers on a single topic of chemical equilibrium using multiple components of topic-specific PCK and found that the components of PCK in a topic interacted with each other in a linear and/or interwoven form. Similarly, Chan and Hume (2019) investigated the integration of PCK components in planning and the enactment of instruction and found that researchers conceptualise and operationalise PCK differently. In response to an instructional event, Aydin and Boz (2013) found that while knowledge of instructional strategies and knowledge of learners had many connections with other PCK components, knowledge of curriculum (KOC) and knowledge of assessment (KOA) components were less frequently connected to other PCK components and that no integration occurred between KoC and KoA.

Topic-Specific Pedagogical Content Knowledge (TSPCK)

Van Driel et al. (2014) define TSPCK as what teachers know about the way their students learn about particular subjects or topics and the difficulties or misconceptions they may have about these topics in relation to the variety of representations and activities teachers know to teach this specific topic. However, TSPCK remains a PCK construct "observed to be different from the generic PCK. It focuses on the transformation of the understanding of the content of a particular topic only" (Mavhunga & Rollnick, 2016). Topic-Specific Pedagogical Content Knowledge is an observed competency specific to transforming knowledge of a given topic for the purposes of teaching (Mavhunga & Rollnick, 2016). Topic-Specific Pedagogical Content Knowledge is related to reasoning about a certain issue. It provides the foundation for teaching students about a specific topic.

Dynamics of Market (DM)

Dynamics of market is one of the topics in economics education consisting of graphs as one critical aspect of the topic. This is a fundamental topic in economics education, encompassing essential concepts that lay the groundwork for a deeper understanding of other economic principles. Dynamics of market refers to the interplay between the forces of supply and demand and the resultant price fluctuations and it is perceived among learners as overly graphical and mathematical in nature (Ayers, 2015).

Graphs remain one aspect of DM that has proved challenging for learners to understand, perhaps because it requires some critical and analytical skills. Thus, understanding graphs in DM in economics education is a global challenge for learners. Ayers (2015) reports that "teachers needed to expose students multiple times to the supply and demand content because their students often considered the content dry and overly mathematical". Graphs consist of concepts such as supply, demand, price, and equilibrium. These concepts are represented through either graphical representations or symbolic expressions. For instance, the demand concept may be articulated as a demand function, such as Qd = f (P, Y, Ps, A, etc.), while the supply concept takes the form of the supply function, like Qs = f (P, P1, P2, G, etc.). Additionally, DM incorporates the demand and supply model, which offers a clearer comprehension of market structures.

The gap that appears to exist in economics education literature is, therefore, the understanding of the topic nature of the PCK of economics teachers in teaching specific topics. To gain an understanding of this, two research questions are the lynchpin of this paper:

1. How is the topic-specific nature of the PCK of two economics teachers teaching the same topic- dynamics of the market in different grade levels different or similar?

2. How does the understanding of the topic-specific nature of the PCK of economics teachers improve the teaching of graphs in dynamics of market?

THEORETICAL FRAMEWORK

Although this paper taps into the original Lee Shulman (1986) Pedagogical Content Knowledge theory of teachers' knowledge, Mavhunga's (2012) model, drawn from Shulman's model, acts as its illuminating lens. Mavhunga (2012) sees the Topic-Specific PCK aspect as a PCK construct "observed to be different from the generic PCK model. Mavhunga's (2012) focuses on the transformation of the understanding of the content of a particular topic only. The model consists of five components: teaching strategies (Ts), curriculum knowledge (CuK) or curricular saliency, learners' prior knowledge (LpK), knowledge of representations (KoR) and "What is difficult to teach?". Although we only focus on the last two PCK components: Learners' Prior Knowledge (LpK) and Knowledge of Representations (KoR), our interest in understanding the 'transformation of the content' in a particular topic as specified in Mavhunga (2012) leads to our enquiry in understanding the relationship between the teachers' content knowledge of graphs and other PCK variables.

Content knowledge (CK) is "teachers' knowledge about the subject matter to be learned or taught" (Koehler & Mishra, 2009). There is substantial evidence indicating that a teacher's use of PCK varies depending on the knowledge of the content being taught (Ward & Ayvazo, 2016). This implies that the transformation of every content area reflects the varying expertise of teachers on specific content.

Knowledge of Representation (KoR) is the different ways in which a teacher presents and conveys the meaning of a concept or topic to learners in a more understandable manner, and in this context, KoR refers to economics teachers' ability to use analogies, examples, and activities in representing subject matter knowledge in the teaching of graphs in DM. Research shows that the use of representation enhances student learning (Maries & Singh, 2018; McPadden & Brewe, 2017). Classroom activity is a form of representation, which Başerer (2020) defines as the events students carry out with various concrete materials to make a concept easily understandable. Studies conducted by Noreen and Rana (2019) and Altin et al. (2021) show that most of the students found classroom activity-based teaching to be more interesting than lecture-based teaching. Classroom activities can be used to represent abstract concepts in a specific topic. They also help to represent real-life scenarios, hence making learning more applicable and relevant to learners. For example, the use of role-play as a classroom activity is used to present real-life scenarios. Analogy is another form of representation that could be used to improve the teaching of difficult concepts. In their studies, Mohammed et al. (2023) and Burdina and Sauer (2015) found that teachers mostly use simplistic analogies with illustrative characters as pedagogical tools, and it enhances learning. Mestadi et al. (2017) found that learning by analogy allows easier understanding of a concept. In contrast to this, however, Farrugia and Musumeci (2022) found that students had difficulties in constructing an analogy. Tise et al. (2023) also found that the quality of the analogy used, whether complex or not, does not predict course performance.

Bhattacharjee (2014) points out that role-play is a pedagogical teaching strategy and a comprehensive teaching technique that teaches students about factual material, instils the process of critical thinking, and stimulates emotions and moral ideals. Another study by Abdessallam et al. (2023) proves that role-play activities contribute to developing students' speaking skills. Hidayati and Pardjono (2018) show that role-play allows students to be creative and is easy to apply. At the same time, Samperio (2017) and Akan and Basar (2013) found a mismatch between teachers' frequently used activities and students' preferences for activities. Şahin and Karakuş (2021) found limited use of classroom activities to teach difficult concepts.

Learners' Prior Knowledge (LpK) refers to teachers' knowledge about learners' understanding of economics topics. Learners' prior knowledge is pre-existing knowledge, beliefs, ideas, and experiences that one has before acquiring new ideas or concepts. According to Matthes et al. (2023), such knowledge could have been gathered over time from their experiences and personal, social, and cultural influences, and thus influence how someone interprets, attends, and organises incoming information. Prabha (2020) stresses the importance for teacher-educators to recognise and address students' difficulties and concerns and to familiarise themselves with students' perspectives of understanding difficult concepts. In their study, Li et al. (2015) found that prior knowledge positively affects learning outcomes by guiding learners' attention. Consequently, van Kesteren et al. (2014) discovered that teachers' understanding of learners' prior knowledge facilitates the interpretation and encoding of new information. On the other hand, a study by Thurn et al. (2022) found that prior knowledge can negatively affect learning outcomes as it prevents learners from finding new and better problem solutions.

Teachers' understanding of learners' prior knowledge could minimise learners' misconceptions. Misconception is an inaccurate or incomplete understandings of a concept that learners develop that contradict the correct meaning. In their studies, Siegler and Pyke (2013) and Hokor et al. (2022) found that learners experience misconceptions about concepts that look similar in characteristics and in differentiating between concepts. Yıldırım (2020) also found that students had difficulties understanding specific concepts in a topic because they did not have prior knowledge. Studies (Bursali & Gökkurt-Özdemir, 2019; Gökkurt-Özdemir et al., 2021) resonate with this finding as they found that teachers fail to identify the kind of misconceptions that can occur due to learners' prior knowledge and the reasons for them. Sarigöz and Özgür (2024) note that teachers are always conscious of covering the curriculum due to examinations and, as a result, rush through some topics without paying attention to specific concepts. Deveci (2021) also reported students' misconceptions of basic concepts in specific topics.

Another study by Gökkurt-Özdemir et al. (2021) found that teachers fail to identify the kind of misconceptions that can occur because of learners' prior knowledge and the reasons for them to occur. According to Lin et al. (2016), teachers should be aware of the sources of misconceptions emanating from themselves, textbooks, instructional strategies and daily experiences. İpekoğlu (2017) and Sahin and Soylu (2011) show that students' misconceptions are mostly eliminated by confronting students with contradictions and inconsistencies in their own solutions. Taber (2000) emphasises that students' prior knowledge formed because of alternative ideas could, at times, become so ingenious and permanent that they cannot be easily altered.

MATERIALS AND METHODS

This qualitative case study examines two economics teachers teaching dynamics of market in the 10th and 11th grades. These grade levels were selected because they are the base year levels in the teaching of economics in FET bands.

Two economics teachers (teacher A and teacher B) from two private secondary schools located in the city of Tshwane in South Africa were intentionally selected rather than teachers in the public schools. Private secondary school teachers tend to teach more conceptually than public secondary school teachers. Teacher A teaches Grade 10, while teacher B teaches Grade 11. These teachers have more than eight years of experience in economics teaching at the secondary school level.

Data was collected using classroom observation, which was deemed fit among other methods of data collection because teachers' topic-specific PCK needs to be observed in a real-life classroom setting. An observation protocol (Appendix 1) was used to carry out the observation which helped the researcher to know what exactly had to be observed while the lesson was videotaped. The video recording was transcribed and analysed following Creswell's (2015) stages of data analysis.

The lesson observation for this study began with researchers' initial visit to the classroom to get familiarised with the teacher, learners and the classroom setting. In other words, the researchers' first visits came before the start of the teaching of Dynamics of Market. In the first two visits, the lessons were not recorded. This implies that the lessons treated during these first visits fell outside the topic of DM. The lesson observation lasted for six weeks which means that every lesson on the topic of DM was video recorded from the start of the topic to the end of the topic. In all the lessons observed, the researcher arrived the classroom earlier before the learners, sat at the back of the classroom to avoid being noticed and disrupting the lesson.

Data was analyzed using thematic analysis. The following procedure was followed during the analysis. The first stage, **'open coding,'** involved the initial categorization of data, allowed the researcher to quickly identify patterns and group similar information into thematic ideas for further analysis and comparison. The second stage, **'axial coding,'** focused on reorganizing the data, establishing clear connections between categories, and identifying relationships and patterns. The final stage, **'selective coding,'** entailed identifying a core category and drawing comparisons with other categories. The final step in data analysis involved **interpreting the findings, presenting the results**, and extracting key insights from the categorized data. The researcher maintained an audit trail, documenting the entire research process from its inception to the reporting of results to ensure reliability of the findings. It is important to note that this study is a part of a larger study where interviews were conducted to complement classroom observations however, the interview section is not reported in this particular study.

The steps followed in the data collection and analysis are illustrated in the flowchart below (Figure 1).

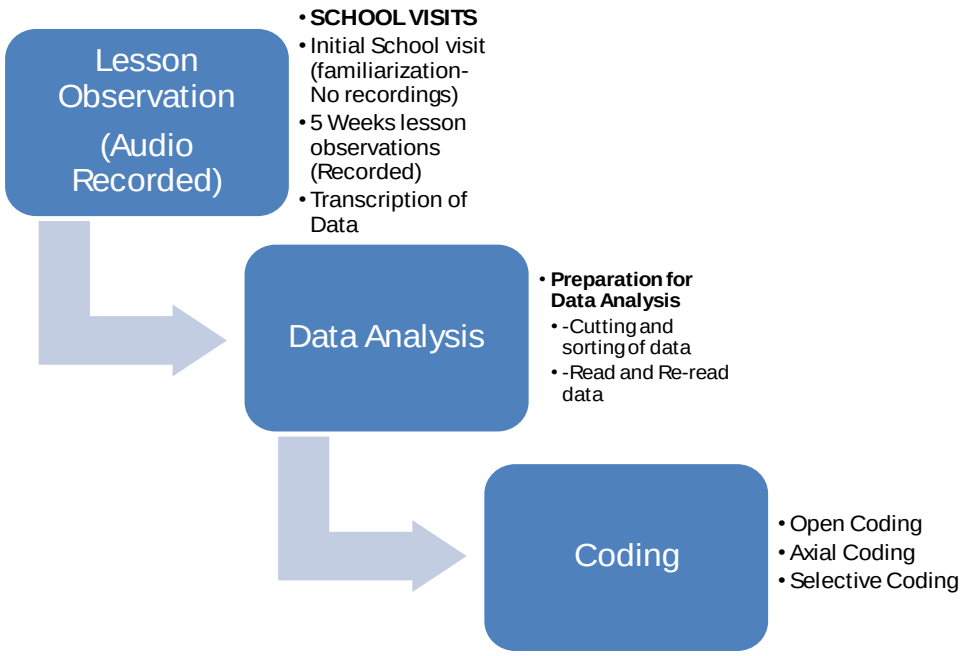


Fig. 1 Research Flowchart

RESULTS AND DISCUSSION

This section blends the presentation of findings with discussion to understand how the TSPCK of two economics teachers could improve the teaching of graphs on DM. As such, two major themes guide the presentation and discussion. These are *knowledge of representations* and *learners' prior knowledge.* For knowledge of representations, the emerging themes are topic-specific classroom activities and topic-specific analogies, while for the knowledge of learners' prior knowledge, the emerging themes were topic-specific learning difficulties and topic-specific learners' misconceptions.

Knowledge of Representation: Topic Specific-Classroom Activities

Following the observed classroom lessons, our findings showed that both teachers showed similar topic-specific knowledge of classroom activities to administer. Although both teachers had enough materials for classroom activities and good planning on the use of classroom activities, our findings show that these teachers had difficulties in providing a quality kind of activity suitable for a particular lesson due to their weak content knowledge of graphs. These findings concur with the findings of Mbatha and Moreeng (2024) on the quality of formal activities that teachers assign to learners to facilitate the development of the required skills, which is important to ascertain whether they were addressing and empowering learners adequately to develop historical skills.

We found that both teachers made adequate preparations (planning) for the type of classroom activities to use in the form of role-play and simulations before the classes began. For example, Teacher A used a hands-on market simulation to help learners understand the concept of *demand*. He divided the class into two groups and assigned each group a smartphone as their product. He went further to provide each group with some money and have each group set an initial price for the assigned product. The group was asked to decide on the quantity they were willing to sell at that price. Teacher A allowed both groups to engage in a simulated market where they negotiated prices and quantities with the other group and analysed how the changes in price affected the demand for the product and how they needed to adjust their strategy accordingly.

Teacher B, on the other hand, used a class activity to illustrate a *change in demand*. She divided the class into three groups and provided each group with a scenario card that described a change in income. Groups were encouraged to move around the market and adjust their purchasing decisions assuming their income decreases. Teacher B encouraged learners to discuss and decide how the change in their income has affected their demand for various items they wanted to purchase. At the end of the class, the teacher asked the learners to illustrate this change in demand graphically. These classroom activities were found to make the concept of 'graph' in the topic of DM more concrete and enhance learners' understanding.

Our findings agree with the findings of Noreen and Rana (2019) and McPadden and Brewe (2017), who found that students taught using classroom activities engage more than those taught through lectures only. Altin et al. (2021) also indicate that the use of classroom activities increased students' participation. The findings, however, contradict the findings that indicate that teachers employed fewer activities in response to students' alleged preferences for more activities, thus students' understanding was not improved with classroom activities (Akan & Basar, 2013; Samperio, 2017; Şen et al., 2022). This finding does not align with the findings of Şahin and Karakuş (2021) who report limited use of representation to enhance learners' understanding of specific concepts. Sanders et al. (1993), on the other hand, establish that teachers struggled to find appropriate classroom activities to facilitate learners' understanding.

Although we found similarities in both teachers' use of topic-specific classroom activities to enhance learners' understanding of the topic, we also found some differences in the PCK nature of the two teachers. Teacher A used more lecture methods to deliver the lessons throughout the teaching of the content. The activity was only used after she had delivered the content through lectures. This is contrary to Teacher B, who used questioning and discussions to deliver her lectures. Lecture method seems to be a traditional method of teaching, which does not encourage the active participation of learners. This finding does not support the finding of Kılıç et al. (2015), who believe that the use of non-traditional methods is effective for teaching specific topics. However, the findings support those of Zakirman et al. (2019) on the use of the lecture method to deliver instructions. We do not condemn the use of lectures as a teaching method. Rather, we argue that teaching with activities should be integrated with the use of the lecture method. Consequently, while Teacher B made connections of the present topic to other topics in the discipline, Teacher A did not. This finding suggests that Teacher B had a wider overview of the curriculum than Teacher A.

The findings of this study have some implications for both the teachers and learners. There seems to be a need for the use of classroom activities in the form of simulation to enhance learners' understanding of graphs in DM. This is one of the challenges that need to be addressed as learners seem to have a quicker grasp of the concept when demonstrated either through role-play or simulations.

Representation: Topic-Specific Analogies

This study found that teachers used analogies when teaching graphs in DM. Analogies are instructional materials which include living and non-living materials as well as human and non-human materials provided by the teacher, which a teacher uses to bring life to the class and achieve the stated teaching objectives in a teaching and learning situation (Okeke & Ajadi, 2023). Analogies bridge the gap between unfamiliar concepts and students' prior knowledge by highlighting similarities between the new idea and something familiar. For example, Teacher A used *sea-saw* to explain the concept of price equilibrium, while Teacher B used the '*Nike'* (√) sign to show the concept of the marginal cost curve.

Our findings show that both teachers' topic-specific knowledge in the use of analogy improved learners' understanding of graphs in DM. This finding echoes the findings of Mohammed et al. (2023) and those of Burdina and Sauer (2015), who found the use of analogy helpful to enhance the teaching and learning of abstract concepts. The finding is also in line with Mestadi et al.'s (2017) findings that analogy makes the understanding of a concept easier. For both teachers our findings show that it was easier for the teachers to give and interpret an analogy than ask learners to construct an analogy. This finding resonates with Farrugia and Musumeci (2022), who found that students had difficulties in constructing an analogy.

In addition to the use of analogies, Teacher B used a '*smiling face*' to illustrate the concept of average cost, while Teacher A used the *'class captain'* and the '*assistant*' to illustrate the concept of substitute. He said, *"Any day the class captain misbehaves, we will replace or substitute him with the assistant".* While we noted that both teachers used real-life analogies that helped in conveying knowledge from teacher to learners instead of sharing their responsibilities with the learners, we also noted some differences in both teachers' approaches.

Teacher A preferred to use PowerPoint slides with photos that provided details on the teaching of graphs in DM, while Teacher B provided links to videos on the teaching of DM. We noted that most of the analogies used by Teacher B were more complex when compared to that of Teacher A. Although Teacher B used a more complex analogy in her teachings, it did not make the concept easier to understand. The finding is in line with that of Tise et al. (2023), who found that the quality of analogy used, whether complex or not, does not predict course performance or enhance understanding of the concept rather than understanding strategies that can support learners' learning. This resulted in the argument on whether analogies should be used as a last resort for higher-ability learners or for lower-ability learners. This finding is still contentious as Richland and Simms (2015) report that analogical reasoning is used between experts and Nobel prize winners when making sense of new concepts or communicating science. We argue that analogies can be used for both higher-ability and lower-ability learners, with the condition that caution should be taken that it does not lead to a misconception of a concept if inappropriately used.

Learners' Prior Knowledge: Topic-Specific Learning Difficulties

Our findings showed that both teachers were aware of the pre-requisite knowledge learners should have for graphs in DM. For example, both stated that learners should be able to understand simple facts such as 'the demand curve is downward sloping' while 'the supply curve is upward sloping', 'quantity' on the graph is placed on the horizontal axis while 'price' is placed on the vertical axis etc. This pre-requisite knowledge enabled both teachers to identify the topic-specific learning difficulties encountered by the learners easily.

Other findings showed that both teachers demonstrated adequate topic-specific knowledge in their understanding of learners' learning difficulties in differentiating similar concepts. Both teachers identified that the concepts of 'shift' and 'movement' in graphs were being confused to mean the same. We also found that both teachers demonstrated knowledge of learners' prior knowledge of the concepts of '*change in demand'* and '*changes in quantity demanded'* as these two concepts proved difficult for learners to differentiate. These findings are in line with the findings of Yildirim (2020) and Siegler and Pyke (2013), who found that due to the non-establishment of prior knowledge of a specific topic by the teachers, students had difficulties understanding specific concepts in a topic. Another finding from this study is interpretation difficulty. Both teachers' topic-specific prior knowledge was evident in their awareness of learners' difficulty in interpreting the graphs in DM, especially where learners confuse shift and movement along the demand curve.

However, the difference between the teachers is that Teacher A made a point to invite learners to come to the blackboard to illustrate these graphs. This is where active learning is encouraged rather than the lecture methods of teaching. Furthermore, learners struggle to interpret the difference between a change in quantity demanded (movement along the demand curve) and a shift in demand. This finding concurs with van Kesteren et al. (2014), who discovered that teachers' understanding of learners' prior knowledge facilitates the interpretation and encoding of new information. Similarly, Hokor et al. (2022) found that students had difficulties distinguishing between concepts.

Our findings, however, showed that both teachers differ in the extent to which they understand learners' learning difficulties. While Teacher B starts his lessons by eliciting learners' prior knowledge through probing questions to gain an understanding of their level of understanding of a concept, Teacher A uses a baseline assessment. Another finding from this study is that Teacher A's learners struggle to comprehend the terminology that "the demand curve slopes downwards from left to right". Instead, they confuse it with the phrase that "the demand curve shifts from left to right".

Learners' Prior Knowledge: Topic-Specific Learners' Misconceptions

Teachers' knowledge of 'Learners' Prior Knowledge' was demonstrated in their understanding of learners' misconceptions. Learners' misconceptions in this context refer to an inaccurate or incomplete understanding that learners develop that contradicts the economics way of thinking and meaning but makes sense to the learners in the teaching of graphs in DM. The key findings from this study are not only that both teachers are aware of learners' misconceptions in the teaching of graphs in DM, but that they used topic-specific discipline strategies to teach the content of DM, which reduced learners' misconceptions. This finding contradicts Bulut (2023), who states that teachers have insufficient knowledge of their students' misconceptions of the topic being taught. One aspect where we found both teachers inadequate in their topic-speciality of learners' prior knowledge was their over-reliance on the textbooks. Our observation shows that both teachers held onto their textbooks to the extent that they failed to relate to some learners' misconceptions that could emanate from their daily experiences. The findings by Gökkurt-Özdemir et al. (2021) resonate with this finding

as they found that teachers fail to identify the kind of misconceptions that can occur due to learners' prior knowledge and the reasons for these misconceptions.

We found that learners in Teacher A's Grade 10 class manifested a greater degree of misconception of graphs in DM. For example, learners confused the movement along the curve with a shift of the curve. They also confused the changes in quantity demanded or supplied with shifts in the entire demand curve. This kind of misconception appears to be an unyielding one which cannot be corrected easily by merely telling the learners that their concept is not correct. The interesting thing is that the teacher strongly emphasises the difference between movement along the curve (due to changes in price) and shifts of the curve (due to changes in factors other than price, e.g. income). This finding is in line with Taber (2000), who emphasises that students' alternative ideas could, at times, become so ingenious and unyielding that they are very difficult to modify, and modifying them requires much more effort than simply stressing the conventional ideas that are taught in the class.

For Teacher B in the Grade 11 class, our finding shows that learners tend to assume that supply and demand are independent entities. However, the teacher emphasised the concept that changes in supply and demand influence each other and affect the equilibrium price and quantity. The findings of this study are consistent with those of Radulović et al. (2022), who emphasise the use of appropriate strategies to teach discipline-specific topics. Our finding is also in line with the findings of Deveci (2021) who reports students' misconceptions of basic concepts in specific topics. Another remarkable finding from both teachers is their resolution techniques to reduce, eliminate and correct learners' misconceptions. We observed that both teachers always confront learners with inconsistencies in their own thinking and explanations of DM concepts to reduce misconceptions among them. The teachers also give adequate homework to help reduce learners' misconceptions. This finding resonates with İpekoğlu (2017) and Şahin and Soylu (2011), who prefer to eliminate students' misconceptions by confronting students with contradictions and inconsistencies in their own solutions. We argue that since this strategy helps to minimise misconceptions in the teaching of DM, it could be adopted and popularised by economics educators.

We also noted some differences in both teachers' approaches. Our findings showed that while Teacher B emphasised learners' understanding of these concepts for the sake of the matriculation examinations (the exit exams for the 12th graders) in Grade 12, teacher A focused more on the applications of these concepts to daily lives and made connections of the concepts to other subject areas. This finding echoed the findings of Sarigöz and Özgür (2024) that teachers tend to be conscious of finishing and rushing through a topic for the sake of examinations.

This study found that the different ways in which teachers' knowledge of representations and learners' prior knowledge led to interactions between themselves, their content knowledge of graphs and other PCK components. Our findings showed that the component Rp for Teacher A did not interact well with the LpK component but interacted well with other PCK components, which were not our focus; however, the interaction was not topic specific. This finding does not align with the findings of Park and Chen (2012), who found an interaction among all PCK components. This finding may not be surprising, having observed that Teacher A has used representations that are more advanced in the teaching of graphs in DM. It could be said that learners are not familiar with those advanced representations used and thus do not have prior knowledge of these representations. Another finding showed that while Teacher B's Knowledge of LpK had more connections among other components, it was less frequently connected to Rp. These findings concur with those of Aydin and Boz (2013), who found less frequent connections between KoR and LpK. This finding might imply that the teacher had more understanding of those concepts and misconceptions where learners are challenged than the kind of representations that are needed to mitigate those challenges. The study's findings further report a weak content knowledge of graphs from both teachers.

Drawing from our findings in understanding the topic-specific nature of PCK for economics teachers in teaching graphs in DM, a framework that could improve the teaching of the topic is proposed. This helps to assist in providing answers to our second research question: How does the understanding of the topic-specific nature of the PCK of economics teachers teaching the same topic in different grades improve the teaching of graphs in DM?

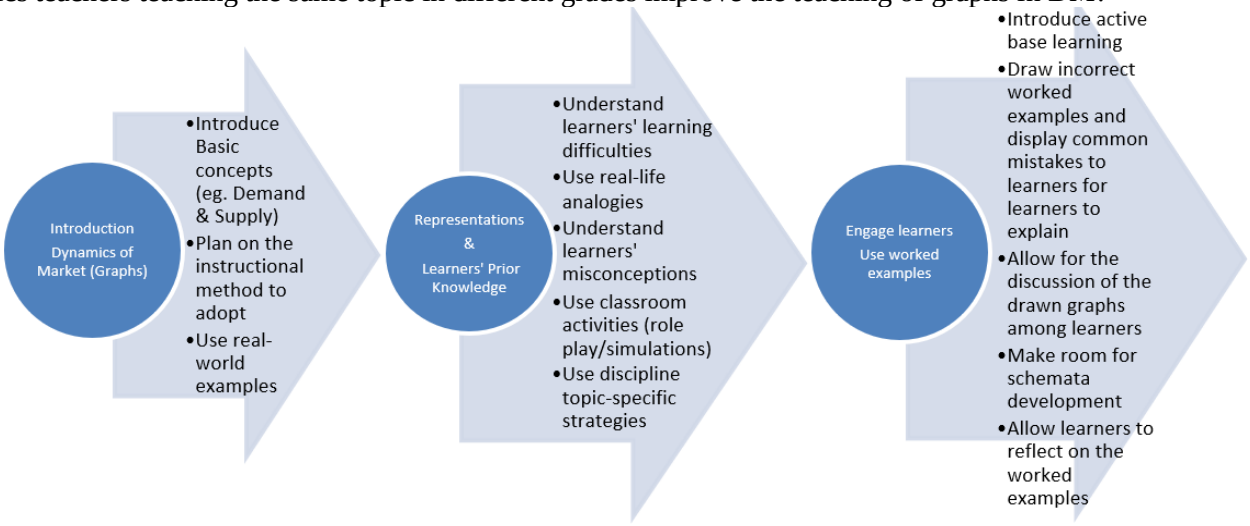


Fig. 2 Framework for the teaching of graphs in the dynamics of the market

CONCLUSION

Examining the TSPCK in the teaching of graphs in DM is an essential and transformative way to understand the difficulties associated with learners' understanding of graphs on the dynamics of the market. We noted that the challenges faced by learners and teachers in the teaching and learning of dynamics of market is not only a South African case but a global one. For example, challenges such the use of lecture methods still prevails in teaching this specific topic rather than trying other methods of teaching. Another challenge observed was handling learners' misconceptions that emanated from prior knowledge of similar concepts in the topic and also choosing the appropriate kind of classroom activities required to teach the topic was a challenge to teachers.

Indeed, emphasizing on the topic-specific kind of classroom activities required, the analogies appropriate to teach the topic and understanding different learners' misconceptions associated with the learning of the dynamics of the market allow learners to be directly engaged and foster practical knowledge and adaptability in understanding the topic. Ultimately, empowering economics teachers with the necessary competencies and insights into the nature of their PCK and how they interact will enable them to deliver the topic effectively and more impactful to learners.

To improve learners' understanding of graphs on the topic of the Dynamics of the market, it is suggested that teachers adopt a proposed framework for the teaching of graphs in DM. It is also suggested that teachers should use a systematic approach to the teaching of graphs in DM. While the study concludes that the nature of PCK is specific to an individual teacher, one of the study's' limitations is the limited number of teachers used in the study. Although it is a case study, the findings from this study may not be generalized to other economics teachers in the understanding of the PCK nature of teachers in the teaching of Dynamics of Market.

REFERENCES

1. Abdessallam, K., Mohamed, B. M., & Ghouati, A. E. (2023). The importance of role-playing activities in developing students' speaking competence. *International Journal of Innovation and Scientific Research, 66*(1), 225– 230. http://www.ijisr.issr-journals.org/
2. Abell, S. K. (2008). Twenty years later: Does pedagogical content knowledge remain a useful idea? *International Journal of Science Education, 30*(10), 1405–1416. https://doi.org/10.1080/09500690802187041
3. Akan, D., & Basar, M. (2013). The effect of classroom activities on classroom management in the teaching-learning process: The case of Uşak City. *Mevlana International Journal of Education, 3*(4). https://doi.org/10.13054/mije.13.63.3.4
4. Akin, F. N., & Uzuntiryaki-Kondakci, E. (2018). The nature of the interplay among components of pedagogical content knowledge in reaction rate and chemical equilibrium topics of novice and experienced chemistry teachers. *Chemistry Education Research and Practice, 19*(1), 80-105. https://doi.org/10.1039/C7RP00165G
5. Altin, Y., İlter, İ., & Gül, M. (2021). The investigation of attitudes towards physical activity and their levels of life satisfaction of high school students. *International Journal of Progressive Education, 17*(1), 16–34. https://eric.ed.gov/?id=EJ1286331
6. Aydin, S., & Boz, Y. (2013). The nature of integration among PCK components: A case study of two experienced chemistry teachers. *Chemistry Education Research and Practice, 14*(4), 615–624. https://doi.org/10.1039/C3RP00095H
7. Aydin, S., Friedrichsen, P. M., Boz, Y., & Hanuscin, S. L. (2014). Examination of the topic-specific nature of pedagogical content knowledge in teaching electrochemical cells and nuclear reactions. *Chemistry Education Research and Practice*. https://doi.org/10.1039/C4RP00105B
8. Ayers, C. A. (2015). *A qualitative study of the pedagogical content knowledge and personal orientations toward economics of award-winning secondary economics teachers.* The University of North Carolina at Greensboro.
9. Başerer, D. (2020). Activity-based teaching of concept types. *World Journal of Education, 10*(5), 122-130. https://doi.org/10.5430/wje.v10n5p122
10. Bhattacharjee, S. (2014). Effectiveness of role-playing as a pedagogical approach in construction education. In *50th ASC Annual International Conference Proceedings*, Vol. 1, No. 1, pp. 81–105.
11. Bulut, A. S. (2023). Mathematics teachers' knowledge on misconceptions and solution suggestions: Ratio-proportion topic. *International Journal of Educational Research Review, 8*(3), 596–609. https://doi.org/10.24331/ijere.1301822
12. Burdina, M., & Sauer, K. M. (2015). Teaching economic principles with analogies. *International Review of Economics Education, 20*, 29-36. https://doi.org/10.1016/j.iree.2015.10.001
13. Bursali, G. G., & Gökkurt-Özdemir, B. (2019). Instructional explanations of mathematics teachers and preservice teachers on misconceptions: The subject of probability. *Journal of Computer and Education Research, 7*(14), 642-672. https://doi.org/10.18009/jcer.639384
14. Chan, K. K. H., & Hume, A. (2019). Towards a consensus model: Literature review of how science teachers' pedagogical content knowledge is investigated in empirical studies. In *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science* (pp. 3-76). https://doi.org/10.1007/978-981-13-5898-2_1

15. Creswell, J. W. (2015). Revisiting mixed methods and advancing scientific practices. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199933624.013.39
16. Deveci, A. (2021). *Elimination of misconceptions about ratio and proportion using inquiry-driven learning and problem-solving*. [Master's Thesis, Department of Mathematics and Sciences Education, Mathematics Education Program, Necmettin Erbakan University]. .
17. Farrugia, S., & Musumeci, M. (2022). The use of analogies in biology and chemistry at the secondary school level. In *Conference Proceedings, New Perspectives in Science Education, Florence, Italy, 2022*.
18. Gencer, S., & Akkus, H. (2021). The topic-specific nature of experienced chemistry teachers' pedagogical content knowledge in the topics of interactions between chemical species and states of matter. *Chemistry Education Research and Practice, 22*(2), 498-512. https://doi.org/10.1039/D0RP00258E
19. Glazer, N. (2011). Challenges with graph interpretation: A review of the literature. *Studies in science education, 47*(2), 183-210.https://doi.org/10.1080/03057267.201 1.605307
20. Gökkurt-Özdemir, B., Yildiz-Durak, H., Karaoglan-Yilmaz, F. G., & Yilmaz, R. (2021). The effects of digital concept cartoons and digital concept maps on eliminating middle school students' misconceptions in the mathematics course: An experimental research. *Informatics in Education, 20*(2), 205-221. https://doi.org/10.15388/infedu.2021.10
21. Hidayati, L., & Pardjono, P. (2018). The implementation of role-play in education of pre-service vocational teacher. In *IOP Conference Series: Materials Science and Engineering*, Vol. 296, No. 1, p. 012016. IOP Publishing. https://doi.org/10.1088/1757-899x/296/1/012016
22. Hokor, E. K., Apawu, J., Owusu-Ansah, N. A., & Agormor, S. (2022). Preservice Teachers' Misconceptions in Solving Probabilistic Problems. Pedagogical Research, 7(1), em0112. https://doi.org/10.29333/pr/11441
23. İpekoğlu, A. (2017). An examination of secondary school teachers' solution proposals towards removal of misconceptions. *Gazi University Graduate School of Educational Sciences*, Ankara.
24. Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1). https://www.learntechlib.org/primary/p/29544/
25. Kılıç, A. S., Temel, H., & Şenol, A. (2015). An investigation of teacher candidates' knowledge levels of "point, line, plane and angle" concepts and misconceptions. *Dicle University Journal of Ziya Gökalp Education Faculty*, (26), 205-229.
26. Li, Y., Wang, P., & Liang, Y. J. (2015). Influence of entrepreneurial experience, alertness, and prior knowledge on opportunity recognition. *Social Behavior and Personality: An International Journal, 43*(9), 1575-1583.
27. Lin, Y. C., Yang, D. C., & Li, M. N. (2016). Diagnosing students' misconceptions in number sense via a web-based two-tier test. *Eurasia Journal of Mathematics, Science and Technology Education, 12*(1), 41–55. https://doi.org/10.12973/eurasia.2016.1420a
28. Loughran, J., Berry, A., & Mulhall, P. (2012). Pedagogical Content Knowledge. In *Understanding and developing science teachers' pedagogical content knowledge* (Vol. 12). Springer Science & Business Media. https://doi.org/10.1007/978-94-6091-821-6_2
29. Maries, A., & Singh, C. (2018). Case of two electrostatics problems: Can providing a diagram adversely impact introductory physics students' problem-solving performance? *Physical Review Physics Education Research, 14*(1), 010114. https://doi.org/10.1103/PhysRevPhysEducRes.14.010114
30. Matitaputty, C., Nusantara, T., & Hidayanto, E. (2022). Examining the pedagogical content knowledge of in-service mathematics teachers on the permutations and combinations in the context of student mistakes. *Journal on Mathematics Education*, *13*(3), 393–414. https://eric.ed.gov/?id=EJ1379743
31. Matthes, J., Schneider, M., & Preckel, F. (2023). The relation between prior knowledge and learning in regular and gifted classes: A multigroup latent growth curve analysis. *Journal of Educational Psychology*. https://doi.org/10.1037/edu0000848
32. Mavhunga, M. E. (2012). Explicit inclusion of topic-specific knowledge for teaching and the development of PCK in pre-service science teachers. [PhD thesis, University of the Witwatersrand.]
33. Mavhunga, E. (2020). Revealing the structural complexity of component interactions of topic-specific PCK when planning to teach. *Research in Science Education, 50*(3), 965-986 https://doi.org/10.1007/s11165-018-9719-6.
34. Mavhunga, E., & Rollnick, M. (2016). Teacher-or learner-centred? Science teacher beliefs related to topic-specific pedagogical content knowledge: A South African case study. *Research in Science Education, 46*(5), 831-855. https://doi.org/10.1007/s11165-015-9483-9
35. McPadden, D., & Brewe, E. (2017). Impact of the second semester University Modeling Instruction course on students' representation choices. *Physical Review Physics Education Research, 13*(2), 020129. https://doi.org/10.1103/PhysRevPhysEducRes.13.020129
36. Mestadi, W., Nafil, K., Touahni, R., & Messoussi, R. (2017). Knowledge representation by analogy for the design of learning and assessment strategies. *International Journal of Modern Education and Computer Science, 9*(6), 9-18. https://doi.org/10.1103/PhysRevPhysEducRes.13.020129
37. Mohammed, R. E., Odeniyi, O. O., Ameen, K. S., & Yusuf, A. A. (2023). Science Teachers' use of Analogies in Secondary School Classrooms in Ilorin, Nigeria. *Science Education International, 34*(2), 151–158. https://doi.org/10.33828/sei.v34.i2.9

38. Mbatha, Z., & Moreeng, B., (2024). Exploring History Teachers' Understanding of Using Local History Projects to Develop Learner's Historical Skills. *Studies in Learning and Teaching. SiLeT*, 5(2), 282-295. https://doi.org/10.46627/silet.v5i2.353
39. Noreen, R., & Rana, A. M. K. (2019). Activity-based teaching versus traditional method of teaching in mathematics at elementary level. *Bulletin of Education and Research, 41*(2), 145–159. https://eric.ed.gov/?id=EJ1229426
40. Ogbonnaya, IC & Ngulube, B. (2023). Assessing Grade 10 Learners' Misconceptions of the Supply Curve in Market Dynamics Graphs. *African Perspectives of Research in Teaching and Learning*. 7 (3).
41. Okeke, C. I., & Ajadi, O. T. (2023). Instructional Materials and Quality in Public Primary Schools in **S**outwestern Nigeria. *Studies in Learning and Teaching* (SiLeT)**,** *4*, (2), 205–215. https://doi.org/10.46627/silet.v4i2.175
42. Park, S., & Chen, Y. C. (2012). Mapping out the integration of the components of pedagogical content knowledge (PCK): Examples from high school biology classrooms. *Journal of Research in Science Teaching, 49*(7), 922–941. https://doi.org/10.1002/tea.21022
43. Prabha, S. (2020). Students' views on difficulties in conceptual understanding of science at secondary stage. *The Eurasia Proceedings of Educational and Social Sciences, 16*, 1- -10. https://doi.org/10.13140/rg.2.2.33117.03044
44. Radulović, J., Deretić, N., Vujanovic, N., Matic, R., & Djurica, N. (2022). Challenges and perspectives for remote work. In *41st International Conference on Organizational Science Development Society's Challenges for Organizational Opportunities, March* 23–25, 2022, Portorož, Slovenija, 841–854.
45. Richland, L. E., & Simms, N. (2015). Analogy, higher order thinking, and education. *Wiley Interdisciplinary Reviews: Cognitive Science, 6*(2), 177- -192. https://doi.org/10.1002/wcs.1336
46. Sahin, Ö., & Soylu, Y. (2011). Mistakes and misconceptions of elementary school students about the concept of 'variable. *Procedia-Social and Behavioral Sciences*, *15*, 3322-3327. https://doi.org/10.1016/j.sbspro.2011.04.293
47. Şahin, M., & Karakuş, F. (2021). Examination of the examples used by secondary school mathematics teachers in teaching ratio and proportion. *Cumhuriyet International Journal of Education, 10*(4), 1605-1624. http://dx.doi.org/10.30703/cije.887089
48. Samperio S. N. (2017). Discovering students' preference for classroom activities and teachers' frequency of activity use. *Colombian Applied Linguistics Journal, 19*(1), 51-66. http://dx.doi.org/10.14483/calj.v19n1.9292
49. Sanders, L. R., Borko, H., & Lockard, J. D. (1993). Secondary science teachers' knowledge base when teaching science courses in and out of their area of certification. *Journal of Research in Science Teaching, 30*(7), 723-736. https://doi.org/10.1002/tea.3660300710
50. Sarigöz, O., & Özgür, H. (2024). Examination of the reasons that lead teachers to abandon the curriculum. *Education, 82*(1), 118. https://doi.org/10.33225/pec/24.82.117
51. Şen, M., Demirdöğen, B., & Öztekin, C. (2022). Interactions among topic-specific pedagogical content knowledge components for science teachers: The impact of content knowledge. *Journal of Science Teacher Education, 33*(8), 860-887. https://doi.org/10.1080/1046560X.2021.2012630
52. Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14. https://doi.org/10.3102/0013189X015002004
53. Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-23. https://doi.org/10.17763/haer.57.1.j463w79r56455411
54. Sickel, A. J., & Friedrichsen, P. (2018). Using multiple lenses to examine the development of beginning biology teachers' pedagogical content knowledge for teaching natural selection simulations. *Research in Science Education, 48*(1), 29-70. https://doi.org/10.1007/s11165-016-9558-2
55. Siegler, R. S., & Pyke, A. A. (2013). Developmental and individual differences in understanding of fractions. *Developmental Psychology, 49*(10), 1994. https://doi.org/10.1037/a0031200
56. Taber, K. S. (2000). Challenging chemical misconceptions in the classroom. In *British Educational Research Association Annual Conference* (pp. 1-16). https://doi.org/10.1021/ed080p491.1
57. Thurn, C., Nussbaumer, D., Schumacher, R., & Stern, E. (2022). The role of prior knowledge and intelligence in gaining from training on proportional reasoning. *Journal of Intelligence, 10*(2), 31. https://doi.org/10.3390/jintelligence10020031
58. Tise, J. C., Sperling, R. A., Dann, M. S., & Young, T. M. (2023). Teaching postsecondary students to use analogies as a cognitive learning strategy: An intervention. *CBE—Life Sciences Education, 22*(1), ar10.https://doi.org/10.1187/cbe.22-05-0084
59. van Driel, J. H., Berry, A., & Meirink, J. (2014). Research on science teacher knowledge. In *Handbook of Research on Science Education, Volume II* (pp. 862-884). Routledge. https://doi.org/10.4324/9780203097267.ch42
60. van Kesteren, M. T. R., Rijpkema, M., Ruiter, D. J., Morris, R. G. M., & Fernández, G. (2014). Building on prior knowledge: Schema-dependent encoding processes related to academic performance. *Journal of Cognitive Neuroscience, 26*(10), 2250-2261. https://doi.org/10.1162/jocn_a_00630
61. Yildirim, H. İ. (2020). The effect of using out-of-school learning environments in science teaching on motivation for learning science. *Participatory Educational Research, 7*(1), 143–161. https://doi.org/10.17275/per.20.9.7.1

62. Ward, P., & Ayvazo, S. (2016). Pedagogical content knowledge: Conceptions and findings in physical education. Journal of Teaching in Physical Education, 35(3), 194–207. https://doi.org/10.1123/jtpe. 2016-0037
63. Zakirman, Z., Lufri, L., & Khairani, K. (2019). Factors influencing the use of lecture methods in learning activities: Teacher perspective. In *1st International Conference on Innovation in Education (ICoIE 2018)* (pp. 4-6). Atlantis Press.

APPENDIX 1 Classroom Observation Protocol

TSPCK ELEMENT TO BE OBSERVED	**EVIDENT WHEN THE TEACHER….**	**OBSERVED PRACTICE DISPLAYED** **1** **Low**	**OBSERVED PRACTICE DISPLAYED** **2** **Fair**	**OBSERVED PRACTICE DISPLAYED** **3** **High**
1. learner prior knowledge	1. Exhibits deep and thorough conceptual understanding of identified aspects of Market Dynamics. 2. Identifies critical Economics components within the topic that are fundamental for understanding and applying the concepts in Market Dynamics. 4. Displays skills for solving problems in the area of Market Dynamics. 5.Addresses learners' misconceptions 6. Displays expectations of possible difficulties learners may face during learning and address such. 7. Discusses learners' ways of thinking about a concept. 8. Taps into learners' prior knowledge to clarify expected difficulties			
Knowledge of Representations	1. Integrates representations into teaching 2. Uses examples, analogies, graphs to represent and show important facts 3.Uses real life examples to demonstrate important points 4. Uses appropriate activities in instruction			