

International Journal of Learning, Teaching and Educational Research
Vol. 24, No. 5, pp. 497-516, May 2025
<https://doi.org/10.26803/ijlter.24.5.26>
Received Mar 28, 2025; Revised May 3, 2025; Accepted May 25, 2025

Exploring the Impact of Formal Continuous Professional Development Activities on Foundation Phase Mathematics Teachers' Instructional Quality

Nompumelelo Gcinile Nzimande* 

University of the Free State
QwaQwa Campus, South Africa

Abstract. Teachers attend continuous professional development (CPD) activities for various reasons. One of the reasons is to enhance their classroom practices, that is, the instructional quality of their respective subjects. However, the teaching of mathematics in South Africa is concerning, as learners as late as Grade 3 struggle to perform basic mathematical operations. Improving teaching and learning in mathematics, therefore, seems crucial. This paper thus discusses the impact of formal CPD activities on the teaching of Foundation Phase (FP) mathematics, focusing on the instructional quality (cognitive activation and individual learning support). Utilising the COACTIV model and the interpretivist research paradigm, a qualitative case study approach was adopted, where six purposively chosen teachers were interviewed. Content analysis was employed to ensure rigorous analysis. The results show that the teachers attended predominantly formal CPD activities and were motivated to do so. It was found that the knowledge gained from the formal CPD activities is practical and helpful in adapting teaching methods, which impacts FP teachers' instructional quality. Teaching and learning, as well as the learners' mathematical understanding, improve. Based on the findings, teachers should be required to attend formal CPD activities frequently, and teacher motivation should be considered. Future studies should explore the impact of informal activities and should include learners. The research concludes that formal CPD activities influence the teaching of FP mathematics. This study contributes to the existing body of knowledge on professional development, teacher professional development programmes, and the instructional quality of mathematics in South Africa, particularly FP mathematics.

Keywords: Teachers; Continuous professional development; Instructional quality; Foundation Phase and Mathematics

*Corresponding author: *Nompumelelo Gcinile Nzimande, NzimandeNG@ufs.ac.za*

1. Introduction

Teaching in any schooling system requires that the teacher be qualified. Beyond being qualified, teachers are required to attend professional development activities (Boyle et al., 2005). Growth of professionals' knowledge and skills through continuous professional development is essential in all professions, and teaching is no exception. According to Jojo (2019), South Africa has some of the worst mathematics teaching in the world. Machaba (2013) found that learners as late as Grade 3 cannot perform basic mathematical operations; this is concerning, as mathematical skills acquired in the early grades lay the foundation for mathematics to be studied in the higher grades. This suggests that basic mathematical skills should be acquired in the early stages of learning, because mathematics is one of the foci of knowledge and competence for the development of South Africa's people and its economy (Mokhele, 2017). Mathematics teaching and learner performance in South Africa has a chance to improve through continuous professional development (CPD) of teachers. Adler (2017) argues that specific, not general, mathematical knowledge is required and used in teaching, which implies that such knowledge should be part of pre-service and continuing teacher education.

This study thus seeks to explore the impact of formal CPD on the instructional quality (cognitive activation and individual learning support) of Foundation Phase (FP) mathematics teachers. The research questions guiding the study are the following:

1. What type of CPD activities do FP mathematics teachers attend?
2. How does the type of CPD activities attended impact the instructional quality (cognitive activation and individual learning support) of FP mathematics teachers?

2. Literature Review

2.1 The Understanding of Continuous Professional Development of Teachers

Professional development (PD) in education has long been researched, and the need for professionally developed teachers and the ineffectiveness of existing PD programmes has been noted (Darling-Hammond et al., 2017). However, teachers have often reported having benefited from PD programmes (Steyn, 2010). What seems unclear, however, is the link between the programmes and instructional practices, and it has been noted that studies rarely address the contribution of teachers' PD to the quality of instruction (Dulo, 2022). This paper attempts to address this gap and specifically to explore the impact of formal CPD activities on the instructional quality of FP mathematics teachers.

Educational research communities have made strides in enhancing the understanding of PD in education (Dulo, 2022). This understanding has been drawn from scholarship that attempts to define teacher PD. Although the terms "PD" and "CPD" are used interchangeably, they have different meanings where the development of teachers is concerned. The researcher here provides closely related definitions. Desimone (2009) defines PD as teachers' knowledge and skills that relate to changes in instructional practice that increase students'

learning and achievement. Abakah (2023) explains that, according to the literature, CPD in education is aimed at any activities that improve the knowledge and skills of teachers. It can be concluded that teachers need to attend CPD activities to enhance their teaching skills and knowledge. In this regard, Sancar et al. (2021) assert that teachers need to constantly learn. Teacher CPD is globally mobilised by governments to foster teacher quality, improve student learning, and enhance educational outcomes. Dulo (2022) states that teachers are expected to engage in CPD activities to effectively contribute to the improvement of the quality of education at all levels. In this study, the researcher focuses on mathematics at the FP level. Based on this understanding of CPD activities, it is essential to enhance CPD knowledge through the types of CPD activities presented.

2.2 Types of Continuous Professional Development Activities: Formal and Informal

Teacher PD has been facilitated in different forms (Collin et al., 2012). Reid's quadrant of analysis is used to examine the diversity of teacher development programmes (Fraser et al., 2007). The quadrant has two dimensions of learning opportunities: formal-informal and planned-incidental. Although there may be other models to examine CPD activities, Reid's quadrant was deemed most relevant for this study in terms of its formal-informal dimension. Mapping this dimension to context, Kyndt et al. (2016) define *formal learning* as systematic learning activities informed by time, space, goals, and support and organised by an agent (Fraser et al., 2007). Examples of South African formal teacher CPD activities that can be characterised as formal learning opportunities are the Integrated Quality Management System (IQMS), workshops (Centre for the Advancement of Science and Mathematics Education (CASME) and Jika iMfundo), and official courses presented by the Department of Education. Although these types of activities may be distinguished as structured or unstructured, both are relevant (Kyndt et al., 2016) and seem to have an impact on instructional quality.

For CPD activities to have an impact on instructional quality, attendance of both formal and informal activities is required (Shirrel et al., 2019). Formal and informal interactions influence practices and classroom change. Richter et al. (2014) explain that informal learning is learning that occurs at work and is not systematic, with less planning. For instance, when ideas that could be useful in classroom practice are exchanged casually at work, it is regarded as a CPD activity that happens informally.

Research on PD activities reveals that *informal learning* processes have been brought to the fore (Kyndt et al., 2016). Indeed, in recent years, educators have started to access online spaces to enhance their informal learning activities, particularly in the digital realm (Avidov-Ungar, 2023). To illustrate how informal learning opportunities are part of CPD activities, the researcher draws on a study by Kyndt et al. (2016) aimed at identifying informal activities. In their study, 371 non-unique learning activities were listed by several studies that focused on identifying informal learning activities, and these were reduced to 129 unique learning activities. These were further reduced to 124 informal

learning activities, as five of the activities were found to be not part of everyday teaching practices (Kyndt et al., 2016). It is evident from the final number of 124 that there are many different informal learning activities. PD activities in education, such as communities of practice (CoPs) and professional learning communities (PLCs), are some of the informal activities that South African teachers attend. Both formal and informal learning activities may impact teachers' instructional quality as classroom practices; however, the impact of formal activities was explored in this study.

2.3 Instructional Quality

Instructional quality has been a topic of interest for decades (Mu et al., 2022). It is a classroom practice that can be studied from various perspectives. According to Kunter et al. (2008), instructional quality is supposed to create challenging and adaptive learning situations and guide learners through the learning process. The researcher used a study by Kunter et al. (2013) on instructional quality, where it was analysed according to three dimensions, namely cognitive activation, individual learning support, and classroom management. Of the three dimensions, two were chosen for the current study, namely cognitive activation and individual learning support. Although classroom management is a significant part of instructional quality, a vast body of research on classroom management exists (Praetorius, 2014).

Cognitive activation can be facilitated through the selection and implementation of tasks that draw on learners' prior experience and knowledge, different teaching approaches, and correcting misconceptions in whole-class discussions (Kunter et al., 2008). A positive association between cognitive activation potential and student outcomes has been suggested in the literature, and studies have found cognitive activation to be positively linked to learner enjoyment of and interest in mathematics (Sigurjónsson, 2023). In the context of Germany, cognitive activation has been found to significantly impact learner achievement (Kunter et al., 2013). Teachers should cognitively activate learners in class to enhance learner outcomes. However, Tieg et al. (2019) highlight that time constraints can hinder cognitive activation strategies. Challenges in implementation can be mitigated through PD. Teachers should also provide opportunities for guidance and make learners feel personally valued, as well as create supportive social environments (Kunter et al., 2008), thus also ensuring individual learning support.

Individual learning support promotes a positive teacher-learner relationship, which encourages learning in learners (Praetorius et al., 2014). Therefore, high-quality instruction in the classroom is needed. Through CPD activities, instructional quality in an FP mathematics classroom can be enhanced. FP mathematics is the subject in question, where the impact of formal CPD activities on instruction is being explored. Therefore, the teaching of this subject, before and after attending CPD activities, offers insights in this regard.

2.4 The Teaching of Mathematics and Learner Performance in South Africa

Based on national and international studies, such as the Annual National Assessments (ANA) of 2011 and 2012 and the Trends in International Mathematics and Science Study (TIMSS) of 2019, Arends et al. (2017) found that South African learners performed far below the international mean. The low performance sparked interest in understanding how teacher characteristics, pedagogical practices, and content knowledge influence academic performance (Venkat & Spaul, 2015). Mabena et al. (2021) state that existing research reveals that teachers have an impact on learner performance in mathematics, and if the teacher does not have good subject knowledge and pedagogical content knowledge, it leads to poor performance. The teaching of mathematics in South Africa is a cause for concern, and it affects learner performance.

Findings across studies reveal that many South African mathematics teachers lack a basic understanding of mathematics (Richter et al., 2014). This is also the case with primary school teachers who teach mathematics. FP mathematics, also termed “numeracy”, is part of primary school mathematics. Heyd-Metzuyanim and Graven (2016) explain that learners in South African primary schools participated in the above-mentioned studies, and they suggest that the results point to a crisis in mathematics education. There is an urgent need to improve the teaching of mathematics. Cobb and Jackson (2011) assert that improving the quality of mathematics instruction is critical for both researchers and teachers. A crisis demands a solution, and through this exploration, the findings of the study may present some solutions.

2.5 The Association between CPD Activities and Instructional Quality

Teacher education and training is essential, particularly CPD programmes for in-service teachers to enhance their instructional quality. The question arises as to what the link is between CPD and instructional quality. Only a tentative link has been found between teacher education and experience and learning outcomes (Burroughs & Chudgar, 2017); therefore, more research is needed. Instructional quality may be improved by PD (Burroughs & Chudgar, 2017). Dyosini (2024) argues that CPD is crucial for the empowerment of FP teachers and that, as education is evolving towards learner-centred and holistic approaches, FP teachers are challenged to continuously adapt and refine their teaching practices. Furthermore, teachers nowadays must use various methods to enhance teaching and learning, which can be acquired and practised through CPD (Mphojane, 2021). Instructional quality is part of teaching and learning. In Figure 1, a model is presented that depicts the relationship between teacher quality, teacher instructional practice, and learner outcomes, which can be used to portray the relationship between CPD activities and the instructional quality of teachers.

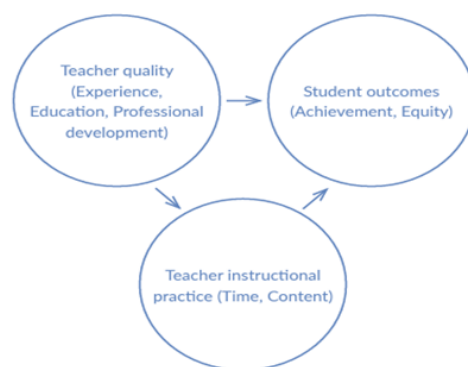


Figure 1: Model of the relationship between teacher quality, teacher instructional practice, and learner outcomes (Burroughs & Chudgar, 2017)

Teacher quality includes experience, education, and professional development, which influence teacher instructional quality (in terms of time and content), resulting in learner outcomes (in terms of achievement and equity). For this study, it can be assumed that professional development, as part of teacher quality, influences the content and effectiveness of instructional quality, which leads to achievement, as part of learner outcomes. Yang and Kaiser (2022) assert that the link between teacher professional competence, instructional quality, and learner outcomes has been investigated. The findings of a study by Kelcey et al. (2019) suggest that there is a relationship between knowledge, instruction, and learner outcomes, but that it is domain-specific. The COACTIV model unpacks professional development in such a way that it is understandable, which enabled the researcher to link it to instructional quality.

3. Theoretical Framework

The COACTIV model of teacher professional competence (Kunter & Baumert, 2007) was adopted as the framework for this study. The impact of formal CPD activities on the instructional quality (cognitive activation and individual learning support) of FP mathematics teachers can be understood by using the COACTIV model.

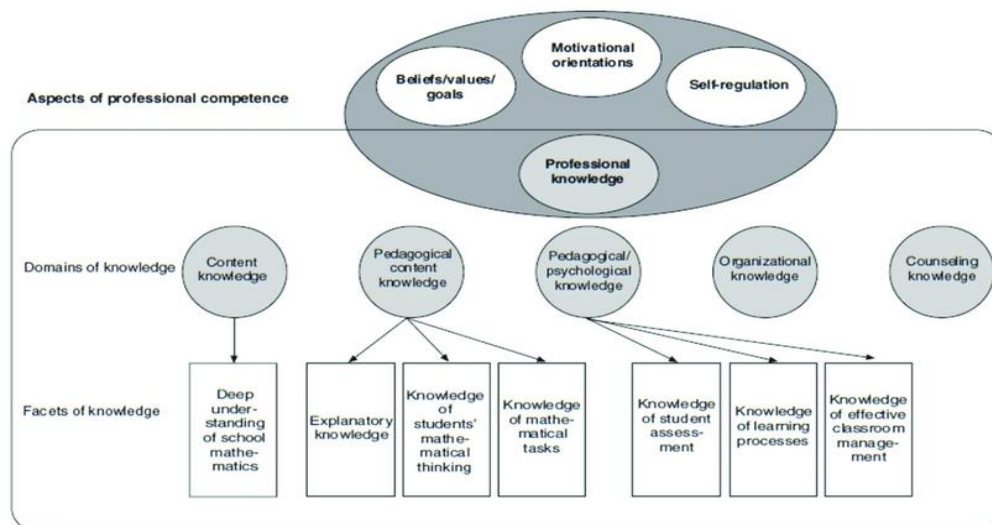


Figure 2: The COACTIV model of professional competence in the context of teaching (Baumert & Kunter, 2013)

In this model of professional competence, the professional knowledge of teachers is of interest to this study, because they gain this knowledge from attending CPD activities. Professional knowledge is the central aspect of the COACTIV model and professional competence (Baumert & Kunter, 2013). It includes different domains of knowledge (content knowledge, pedagogical content knowledge, and pedagogical/psychological knowledge) and their facets, as indicated in Figure 2. Teachers who have the necessary professional knowledge are competent to teach because teachers' instructional practices are influenced by it. In their teaching, they provide quality instruction, which leads to an insightful learning process, which, in turn, leads to positive learner outcomes.

Motivational orientations, beliefs/values/goals, and self-regulation should not be disregarded, as they can play a role in enhancing instruction. However, they are not the focus of this study. The implication is that when teachers are motivated, have certain beliefs/values/goals, and are self-regulated, it can enhance instruction. This model of teacher competence is relevant for this study because teachers' CPD activities are pivotal to improving their knowledge and instruction, as well as learners' learning. It is also relevant because the model has been assessed with mathematics teachers (Baumert et al., 2010), and FP mathematics teachers constitute the sample of this study.

4. Methodology

The interpretivist research paradigm was employed in this study. It argues that there is not one truth but several explanations of reality (Bertram & Christiansen, 2020). The reality of the participants in the study and the chosen qualitative data collection approach are consistent with this epistemological perspective. Using a case study design to explore the phenomenon under investigation, data was collected using semi-structured interviews to answer both research questions

one and two of the study. An interview schedule was drawn up for conducting the interviews, which were audio-recorded and later transcribed verbatim. This design enabled the researcher to collect in-depth information to answer the questions that guided the study.

Six FP mathematics teachers from schools that perform well were purposively sampled as a target group to explore the phenomenon under study. Purposive sampling targets a small number of people and specific sites and groups, or individuals who are knowledgeable or experienced in the phenomenon of interest (Creswell & Plano Clark, 2007). All the teachers sampled were female, and they had 1 to 26 years of experience as teachers. Inclusion criteria were teachers who taught mathematics at the FP level and who had attended a minimum of three and a maximum of five formal CPD activities, to determine the impact of these activities on instructional quality.

Data was analysed using an inductive approach. The audio-recorded data was transcribed verbatim, and codes were assigned to segments to signify the meaning (Maree, 2016). After coding, categories were formed to make sense of the data and search for patterns. The patterns led to the themes that were generated for the discussion of the findings. From the data analysis, interpretation was done, and conclusions were made to answer the research questions. The findings and the study were reviewed by a professional in the field of teacher development studies. Ethical procedures were followed, where ethical clearance was obtained from the Humanities and Social Sciences Research Ethics Committee of the University of KwaZulu-Natal (reference number HSS/0341/019M). The KwaZulu-Natal Department of Education was contacted for permission to conduct the study (reference number 2/4/8/1794). Confidentiality was ensured using pseudonyms.

5. Findings and Discussion

Three themes emerged from the thematic analysis of the study, and the data is presented together with the discussion under the themes below.

5.1 Types of CPD Activities Attended by the Teachers

In terms of the types of CPD activities attended, it was found that mostly workshops were attended. Based on the formal-informal distinction used in this study, teachers had mainly attended the following formal workshops: Curriculum Assessment Policy Statement (CAPS) workshops, Jika iMfundo workshops, CASME workshops, inclusive education workshops, and departmental and management meetings. Activities that did not fall under the category of workshops were informal, namely PLCs and CoPs. The distinction came from explanations of the above-mentioned activities.

In addition to the formal-informal categorisation, the researcher explored how the formal activities were delivered, to study the impact of these activities on instructional quality. The teachers elaborated on the delivery of these activities by mentioning that practical examples were given during the workshops. This insight informed another categorisation. The categorisation stems from the explanation that in some workshops, the teachers gave the practical examples

themselves in groups (group practical's), while in other workshops, the facilitators gave the practical examples, and the teachers were the audience (facilitator-led practicals). An explanation by Andiswa, who had attended the Jika iMfundo and the CAPS workshops, indicates how workshops in the group practical category were conducted:

"During the activity, they put us in groups and then gave us one of the activities to do as a group." (Andiswa)

Mandisa, who had also attended the Jika iMfundo workshop, gave a similar response to Andiswa:

"For the Jika iMfundo session, we split into groups and are given topics. For example, one group is given number operations and relationships, the other is given patterns, and the other is given data handling." (Mandisa)

Phindile, who had attended the CASME, inclusive education and CAPS workshops, elaborated on facilitator-led practicals:

"There are different facilitators, but they are just the ones who are there by the board showing us many examples, how to tackle questions. Then we are just there to observe what is being taught." (Phindile)

Similarly, Mandisa, who had also attended a facilitator-led CASME workshop, mentioned:

"For the workshop, we are there to be empowered by just one facilitator." (Mandisa)

The teachers had attended similar workshops, but the workshops were conducted differently, which had an impact on how the teachers were developed to ensure instructional quality for FP mathematics. Collins et al. (2012) explain that CPD for teachers is viewed as consisting of diverse opportunities. This is consistent with the responses from the participants, as they mentioned having attended both formal and informal activities. Research question one is thus addressed. Hands-on activities inculcate the skills being taught and enable the teacher to apply them when teaching in class. The researcher explored the impact of the examples mentioned above. The diversity of CPD activities is confirmed in the literature. For instance, Abakah (2023) asserts that participation ranges from formal courses to informal learning opportunities inside and outside the classroom. However, in this study, the teachers had mostly attended formal activities, and they therefore provided mostly information on those activities. The teachers also shared their reasons for attending the CPD activities, as well as their perceptions regarding the usefulness of the activities.

5.2 Reasons for Attending CPD Activities and the Utility of the Activities

5.2.1 Reasons for Attending

Attending CPD activities is part of the job for teachers. Dulo (2022) states that teachers are expected to engage in CPD activities to effectively contribute to the improvement of the quality of education at all levels. CPD also enhances the knowledge, skills, and attitudes teachers need to be effective. Motivation was mentioned as one of the reasons for attending the activities. The teachers reported that they are motivated by gaining fresh insights, which helps to improve teaching and learning, by building personal motivation and a positive school culture.

With regards to gaining fresh insights, Phindile explained:

*"I find myself going there because there's always **new information**. We expect to deal with problems. And also, you find that you are learning new things as you go, [which] you might not have observed before, and you get a new example on how to tackle a problem."* (Phindile)

Regarding improving teaching, Mandisa responded:

*"There has been an **improvement** in our teaching in teaching activities in our Foundation Phase classrooms, and we can also see the improvement in our learners' performance."* (Mandisa)

Personal motivation was cited as a reason by two participants. Yolanda reported:

*"I attended because I wanted to **improve myself**, my teaching skills, and to know more about the Foundation Phase, because I am not a qualified Foundation Phase teacher. I majored in Intermediate Phase, so I specialised in EMS." Mary stated: "**I was willing** to attend."*

The school culture was also mentioned as a reason. Despite the fact that CPD is a school requirement, CPD activities are nevertheless helpful. Concerning the school culture, Mary explained:

*"It was a **school requirement**, together with the department, as teachers need to be developed every time, because times are changing, and we need to keep up with the times."* (Mary)

After attending development activities, it is expected that the knowledge gained will have some utility. Lessing and De Witt (2007) state that according to the literature, CPD in education is aimed at any activities that improve the knowledge and skills of teachers. The teachers reported gaining new insights to tackle the problems faced in teaching FP mathematics. This is confirmed in the literature.

From the type of activities attended, we see that the teachers are motivated to attend and that they find the CPD activities useful, for various reasons. This seems to be consistent with the COACTIV model by Baumert and Kunter (2013),

as motivational orientations are part of the professional competence of teachers, including professional knowledge.

5.2.2 Utility of the Activities

One of the interview questions required the participants to comment on the usefulness of the CPD activities attended. Two common responses were that CPD activities are useful because they make lessons adaptive and help with incorporating practical activities. Regarding making lessons adaptive, Phindile reported that the activities are “*eye-opening*”. The activities also help with incorporating practical activities, which spark learners’ interest:

*“They are **very** useful, because learners can relate, and practical activities spark their interest.” (Mary)*

CPD activities are confirmed to be useful when viewed according to the COACTIV model. The usefulness of these activities is only evident after teachers attend the programme and implement the knowledge gained. The teachers reported a change in the way they teach after attending the activities. For instance, they can incorporate practicals and challenge learners to think (cognitive activation). Calleja (2018) confirms that an analysis of the Researching Effective CPD in Mathematics Education (RECME) project by Joubert et al. (2010) found that participants appreciate the knowledge and understanding of practice demonstrated by CPD facilitators and the practical advice provided during sessions, because it is directly applicable to their classrooms. Thus, it can be concluded that CPD activities are useful. However, establishing a direct link can confirm the usefulness of these activities. It thus seemed important to explore the impact that formal CPD activity knowledge has on teachers’ instructional quality in FP mathematics.

5.3 The Impact of Formal CPD Activity Knowledge on Instructional Quality

5.3.1 Incorporating the Knowledge Gained

To address research question 2, the researcher investigated how teachers incorporate the knowledge gained. From this, it can be determined how CPD knowledge impacts FP teachers’ mathematics instruction. The teachers reported that they incorporate the knowledge gained by changing their teaching methods and using the actual CPD activities as practical examples. Concerning changing their teaching methods, Yolanda said:

“I put it on the board. I explain. Then I ask questions. The time I keep on asking questions to see whether the learners are following, by the show of hands. Sometimes you see that you ask a question, and nobody raises a hand. So, it means that they do not understand what you are telling them. So, you keep on providing more examples, referring to the activity that is on the board.” (Yolanda)

She elaborated as follows:

“I take them step by step, because they are young. They can’t take a lot of things at the same time. As I take them step by step, I introduce the

simplest. I teach and provide examples with answers first. I engage them when I am teaching. I give my examples, and I give them a chance to provide their examples.” (Yolanda)

Regarding practical activities, Andiswa explained:

“We use practical, by asking them questions, by asking them to come to demonstrate what I’m going to teach after I have told them.” (Andiswa)

The teaching strategy of providing more examples encourages learners to keep trying, and it enhances their understanding of what is being taught. In a study by Holzberger et al. (2013), it was found that some teachers promote cognitive activation in the classroom by letting learners go off course until they figure something out. This cognitively activates the learners.

5.3.2 Cognitive Activation

Through using practical activities and changing their teaching methods, teachers begin teaching FP mathematics in a way that promotes cognitive activation. Baliscao (2025) asserts that CPD influences learning significantly through the adoption of interactive and inclusive teaching methods. Cognitively activating activities that teachers implement help learners construct new knowledge, understand or learn better, and become independent. Ondog and Kilag (2024) highlight that it is important to provide developmentally appropriate learning experiences in line with children’s cognitive capabilities, consistent with Piaget’s theory of cognitive development. This leads to an insightful learning process, referred to in the COACTIV model (Baumert & Kunter, 2013). It can be concluded that this is how teachers consider cognitive activation. Through adaptation and practical examples, the impact on instructional quality is inevitable. However, it is important to consider individual learning support as well.

5.3.3 Individual Learning Support

To understand how individual learning support was impacted by CPD activities, the responses of the participants were carefully studied. Cognitively activating learners fosters independence, which was identified as a bridge for providing individual learning support. Three participants cited strategies that they use to provide individual learning support.

Mandisa reported:

“With the learners who did not understand, I do give them individual support, by first explaining to the whole class the class activity, demonstrating it and leaving those who understand to tackle the work, and then calling individually the ones that did not understand to give them special attention.” (Mandisa)

Yolanda mentioned time as a factor in offering individual learning support:

“Maybe once a week, if I see that this learner is struggling, you may want the learner to stay behind after school. Even on that one, we have difficulties, because you find that these learners travel by transport. So you find that the transport will be here on time. Even if you want to stay behind with the learner, you cannot just keep the learner, because the learner takes hired transport.” (Yolanda)

Phindile explained that individual learning support is a school requirement:

“Yes, it’s required of us to offer individual support to learners, because you find that some learners are way behind others in terms of writing their work, getting their work finished, or understanding the work.” (Phindile)

Individual learning support is considered by teachers after attending CPD activities. It is asserted that it promotes a positive teacher–learner relationship, which encourages learning in learners (Praetorius et al., 2014). The teachers reported that special attention is given as a form of individual learning support. Special attention can be viewed as fostering a good teacher–learner relationship. Individual learning support is also necessary for learners who are behind or do not understand their work, as it encourages learning for learners. It can be provided when cognitive activation has been considered (from using new insights from CPD activities), which means that teachers can leave learners who understand to do their work, while they offer individual learning support to the learners who do not understand. Consideration of instructional quality (cognitive activation and individual learning support) thus does occur, and improvement is then expected.

5.3.4 A noticeable impact

The teachers shared that they noticed an improvement after incorporating changes in their teaching after attending CPD activities, which impacted their instructional quality.

Regarding the improvement in the learning process, Phindile reported:

“Learners can do activities given, and learners tend to understand more and relate more to the problems or find solutions for the questions, since now I have broken down the questions in a way that’s much more suitable for them to comprehend.” (Phindile)

Mandisa confirmed:

“Learners have changed their activities, even the way they handle a sum, or an activity given to them.” (Mandisa)

Melissa and Yolanda similarly responded that most learners “now can see what is going on”. Mary mentioned that she saw an improvement in both her learners’

performance and her teaching: *“Yes, there has been some improvement in my teaching and the learners’ performance.”*

A change is expected when teachers engage in PD activities. Teachers have often reported having benefited from PD programmes (Steyn, 2010). However, the contribution of teachers’ PD to the quality of instruction is rarely mentioned in studies (Dulo, 2022). This study has explored the impact of PD activities on instructional quality by investigating the types of CPD activities attended. It was found that mainly formal activities were attended. The dimensions of instructional quality that result in an improvement in the learning process and positive learner outcomes were then considered. Confirming these findings, a study by Cunado and Abocejo (2019) reported that teachers who had engaged in targeted (formal) PD showed a noticeable improvement in their lesson planning, which translated to enhanced instruction, learning goals, and learner understanding and processing.

Based on the COACTIV model, South African FP mathematics teachers should attend CPD activities (teacher knowledge), because there is a noticeable improvement in their instructional quality (instruction) and the learning process (insightful learning) after attendance of such activities, which influences learner outcomes (learners). This is especially so as it has the potential to improve the current mathematics performance of learners in South Africa. When the learning process improves, it can impact learner achievement.

6. Conclusion, Limitations, and Implications

This article has explored the impact of formal and informal CPD activities on the instructional quality of FP mathematics teachers. From the findings, it can be summarised that instructional quality is impacted mainly by formal CPD activities, the reasons for attending these activities, and the usefulness of the activities after attendance. Despite the study’s contribution to knowledge and pedagogical gaps, it has limitations. The sample size was small, which could have led to the study being biased, and the data collection methods could be improved. The implications for research are that studies that explore the impact of informal activities should be conducted, because teachers engage in these activities as well. Researchers can investigate the impact of these activities on the administrative duties of teachers when planning to teach the subject. The implications for practice are that teachers should attend more formal activities to have an impact on instructional quality, and coaching, follow-up sessions, and collaborative learning are necessary. Teachers’ reasons for attending should be considered when designing sessions. This study can be replicated with a larger sample and in a different geographical location, and other data collection methods can be used, such as a questionnaire or an observation or a mixed-method study. Learners should be included as participants to explore the improvement of the learning process and performance after CPD activity engagement.

7. References

- Abakah, E. (2023). Teacher learning from continuing professional development (CPD) participation: A sociocultural perspective. *International Journal of Educational Research Open*, 4, 100242. <https://doi.org/10.1016/j.ijedro.2023.100242>
- Adler, J. (2017). Mathematics in mathematics education. *South African Journal of Science*, 113(3-4), 1-3. <https://dx.doi.org/10.17159/sajs.2017/a0201>
- Akiba, M., & Liang, G. (2016). Effects of teacher professional learning activities on student achievement growth. *The journal of educational research*, 109(1), 99-110. <https://doi.org/10.1080/00220671.2014.924470>
- Arends, F., Winnaar, L. & Mosimege, M. (2017). Teacher classroom practices and Mathematics performance in South African schools: A reflection on TIMSS 2011. *South African Journal of Education*, 37(3), 1-11. <https://doi.org/10.15700/saje.v37n3a1362>
- Avidov-Ungar, O. (2023). *The Personalised Continuing Professional Learning of Teachers: A Global Perspective*. Taylor & Francis.
- Balisco, D. (2025). Exploring the Link Between Teacher Professional Development and Academic Success in Elementary Education. *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence (IMJRISE)*, 2(4), 58-64. <https://doi.org/10.5281/zenodo.15174794>
- Baumert, J., & Kunter, M. (2013). The COACTIV model of teachers' professional competence. In *Cognitive activation in the mathematics classroom and professional competence of teachers: Results from the COACTIV project* (pp. 25-48). Boston, MA: Springer US.
- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U., Krauss, S., Neubrand, M., & Tsai, Y.-M. (2010). Teachers' Mathematical Knowledge, Cognitive Activation in the Classroom, and Student Progress. *American Educational Research Journal*, 47(1), 133-180. <https://doi.org/10.3102/0002831209345157>
- Bertram, C. & Christiansen I. (2020). *Understanding research: an Introduction to Reading Research*. Van Schaik.
- Boyle, B., Lamprianou, I., & Boyle, T. (2005). A longitudinal study of teacher change: What makes professional development effective? Report of the second year of the study. *School effectiveness and school improvement*, 16(1), 1-27. <https://doi.org/10.1080/09243450500114819>
- Burroughs, N., & Chudgar, A. (2017). The Role of Teacher Quality in Fourth-Grade Mathematics Instruction: Evidence from TIMSS 2015. Policy Brief No. 16. *International Association for the Evaluation of Educational Achievement*. <https://files.eric.ed.gov/fulltext/ED588366.pdf>
- Calleja, J. (2018). Teacher participation in continuing professional development: Motivating factors and programme effectiveness. <https://www.um.edu.mt/library/oar/handle/123456789/32542>
- Cobb, P., & Jackson, K. (2021). An Empirically Grounded System of Supports for Improving the Quality of Mathematics Teaching on a Large Scale. *Implementation and Replication Studies in Mathematics Education*, 1(1), 77-110. <https://doi.org/10.1163/26670127-01010004>
- Coetzee, D. (2001). South African education and the ideology of patriarchy. *South African Journal of Education*, 21(4), 300-304. <https://www.ajol.info/index.php/saje/article/viewFile/24919/20531>
- Collin, K., Van der Heijden, B., & Lewis, P. (2012). Continuing professional development. *International journal of training and development*, 16(3), 155-163. <https://doi.org/10.1111/j.1468-2419.2012.00410.x>
- Creswell, J.W & Plano Clark, V.L. (2007). *Designing and Conducting Mixed Methods Research*. Sage Publications, Inc.

- Cuñado, A. G., & Aboejo, F. T. (2019). Lesson planning competency of English major university sophomore students. *European Journal of Education Studies*, 5(8), 396–409. <https://doi.org/10.5281/zenodo.15174794>
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. *Learning Policy Institute*. <https://eric.ed.gov/?id=ED606743>
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualisations and measures. *Educational researcher*, 38(3), 181-199. <https://doi.org/10.3102/0013189x08331140>
- Dulo, A. A. (2022). In-service teachers' professional development and instructional quality in secondary schools in Gedeo Zone, Ethiopia. *Social Sciences & Humanities Open*, 5(1), 100252. <https://doi.org/10.1016/j.ssaho.2022.100252>
- Dyosini, T. P. (2024). Professional development of teachers: Perceptions and challenges of foundation phase teachers. *South African Journal of Childhood Education*, 14(1), 1572. <https://doi.org/10.4102/sajce.v14i1.1572>
- Evans, L. (2014). Leadership for professional development and learning: enhancing our understanding of how teachers develop. *Cambridge Journal of Education*, 44(2), 179-198. <https://doi.org/10.1080/0305764X.2013.860083>
- Fennema, E. (1992). Cognitively Guided Instruction. *NCRMSE research review: The teaching and learning of mathematics*, 1(2), 5-9. <https://files.eric.ed.gov/fulltext/ED372929.pdf>
- Fraser, C., Kennedy, A., Reid, L., & McKinney, S. (2007). Teachers' continuing professional development: Contested concepts, understandings and models. *Journal of In-Service Education*, 33(2), 153-169x: <https://doi.org/10.1080/13674580701292913>
- Heyd-Metzuyanim, E., & Graven, M. (2016). Between people-pleasing and mathematising: South African learners' struggle for numeracy. *Educational Studies in Mathematics*, 91, 349-373. <https://doi.org/10.1007/s10649-015-9637-8>
- Hoekstra, A., Beijaard, D., Brekelmans, M., & Korthagen, F. (2007). Experienced teachers' informal learning from classroom teaching. *Teachers and Teaching*, 13(2), 189-206. <https://doi.org/10.1080/13540600601152546>
- Holzberger, D., Philipp, A., & Kunter, M. (2013). How teachers' self-efficacy is related to instructional quality: A longitudinal analysis. *Journal of Educational Psychology*, 105(3), 774: <https://doi.org/10.1037/a0032198>
- Hoyle, E., & Megarry, J. (2012). *World yearbook of education 1980: The professional development of teachers*. Routledge.
- Jojo, Z. (2019). Mathematics education system in South Africa. In *Education systems around the world*. Intech Open: <https://doi.org/10.5772/intechopen.85325>
- Joubert, M., Back, J., De Geest, E., Hirst, C., & Sutherland, R. (2010). The Researching Effective CPD in Mathematics Education (RECME) research project. *Research in Mathematics Education*, 12(1), 77-78. <https://doi.org/10.1080/14794800903570020>
- Kelcey, B., Hill, H. C., & Chin, M. J. (2019). Teacher mathematical knowledge, instructional quality, and student outcomes: a multilevel quantile mediation analysis. *School Effectiveness and School Improvement*, 30(4), 398-431. <https://doi.org/10.1080/09243453.2019.1570944>
- Kunter, M., & Baumert, J. (2007). Who is the expert? Construct and criteria validity of student and teacher ratings of instruction. *Learning Environments Research*, 9(3), 231-251. <https://doi.org/10.1007/s10984006-9015-7>
- Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology*, 105(3), 805-820. <https://doi.org/10.1037/a0032583>

- Kunter, M., Tsai, Y.-M., Klusmann, U., Brunner, M., Krauss, S., & Baumert, J. (2008). Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction. *Learning and Instruction*, 18(5), 468–482.
<https://doi.org/10.1016/j.learninstruc.2008.06.008>
- Kyndt, E., Gijbels, D., Grosemans, I., & Donche, V. (2016). Teachers' everyday professional Development: Mapping informal learning activities, antecedents, and learning outcomes. *Review of Educational Research*, 86(4), 1111-1150.
 Retrieved: <https://doi.org/10.3102/0034654315627864>
- Lessing, A., & De Witt, M. (2007). The value of continuous professional development: teachers' perceptions. *South African journal of education*, 27(1), 53-67.
<https://www.ajol.info/index.php/saje/article/view/25098>
- Li, Liping & Khan (2018), *Research Methods in Education*. Sage Publications Inc.
- Mabena, N., Mokgosi, P. N., & Ramapela, S. S. (2021). Factors contributing to poor learner performance in mathematics: A case of selected schools in Mpumalanga province, South Africa. *Problems of Education in the 21st Century*, 79(3), 451.
<https://doi.org/10.33225/pec/21.79.451>
- Machaba, M.M. (2013). *Teacher Challenges in the Teaching of Mathematics at Foundation Phase* (PhD, University of South Africa).
http://uir.unisa.ac.za/bitstream/handle/10500/13262/thesis_machaba_mm.pdf?sequence=1&isAllowed=y
- Maree, K. (Ed.). (2016). *First Steps in Research (2nd Ed)*. Braamfontein: Van Schaik Publishers.
- Mokhele, M. L. (2017). Lesson Study as a Professional Development Model for Improving Teachers' Mathematics Instruction. *E-BANGI Journal*, 12, 49–56.
<https://research-ebSCO-com.ufs.idm.oclc.org/c/bouskj/search/details/pqkopzx5zj?db=asn&proxyApplied=true>
- Mphojane, M.C., 2021, 'The mentoring state of novice teachers in Lejweleputswa District, Free State, South Africa', *Journal of Educational Studies* 20(2), 122–140.
<https://doi.org/10.38140/aa.v44i2.1356>
- Mu, J., Bayrak, A., & Ufer, S. (2022). Conceptualising and measuring instructional quality in mathematics education: A systematic literature review. *Frontiers in Education*, 7. <https://doi.org/10.3389/feduc.2022.994739>
- Njenga, M. (2023). Continuing professional development of vocational teachers in Kenya: Motivations, practices teacher profiles. *International Journal of Educational Research Open*, 5, 100282. <https://doi.org/10.1016/j.ijedro.2023.100282>
- Ondog, J., & Kilag, O. K. (2023). A Constructivist Framework for Early Grade Numeracy: Drawing on Jean Piaget's Cognitive Development Theory. *Excellencia: International Multi-disciplinary Journal of Education* (2994-9521), 1(4), 308-320.
https://www.researchgate.net/publication/376646246_A_Constructivist_Framework_for_Early_Grade_Numeracy_Drawing_on_Jean_Piaget%27s_Cognitive_Development_Theory
- Praetorius, A.K., Pauli, C., Reusser, K., Rakoczy, K. & Klieme, E. (2014). One lesson is all you need? Stability of instructional quality across lessons. *Learning and Instruction*, 31, 2-12. <https://doi.org/10.1016/j.learninstruc.2013.12.0021>
- Richter, D., Kunter, M., Klusmann, U., Lüdtke, O., & Baumert, J. (2014). Professional Development Across the Teaching Career. *Teachers' Professional Development*, 97–121. https://doi.org/10.1007/978-946209-536-6_7
- Sancar, R., Atal, D., & Deryakulu, D. (2021). A new framework for teachers' professional development. *Teaching and Teacher Education*, 101, 103305.
<https://doi.org/10.1016/j.tate.2021.103305>
- Shirrell, M., Hopkins, M., & Spillane, J. P. (2019). Educational infrastructure, professional learning, and changes in teachers' instructional practices and beliefs. *Professional*

- development in education*, 45(4), 599-613.
<https://doi.org/10.1080/19415257.2018.1452784>
- Sigurjónsson, J. Ö. (2023). *Quality in Icelandic mathematics teaching: Cognitive activation in mathematics lessons in a Nordic context*. (PhD, University of Iceland).<https://opinvisindi.is/bitstream/handle/20.500.11815/3843/JOS-PhD-thesis-without-papers.pdf?sequence=3&isAllowed=y>
- Steyn, G. M. (2010). Educators' perceptions of continuing professional development for teachers in South Africa: A qualitative study. *Africa Education Review*, 7(1), 156-179. <https://doi.org/10.1080/18146627.2010.490009>
- Teig, N., Scherer, R., & Nilsen, T. (2019). I know I can, but do I have the time? The role of teachers' self-efficacy and perceived time constraints in implementing cognitive-activation strategies in science. *Frontiers in psychology*, 10, 1-17.
<https://doi.org/10.3389/fpsyg.2019.01697>
- Venkat, H., & Spaul, N. (2015). What do we know about primary teachers' mathematical content knowledge in South Africa? An analysis of SACMEQ 2007. *International Journal of Educational Development*, 41, 121-130.
<https://doi.org/10.1016/j.ijedudev.2015.02.002>
- Yang, X., & Kaiser, G. (2022). The impact of mathematics teachers' professional competence on instructional quality and students' mathematics learning outcomes. *Current Opinion in Behavioral Sciences*, 48, 101225.
<https://doi.org/10.1016/j.cobeha.20>

Appendix 1

SEMI-STRUCTURED INTERVIEW SCHEDULE

Pseudonym:

CRITICAL QUESTIONS:

1. Which type of continuous professional development (CPD) activities do the Foundation Phase mathematics teachers attend?
2. How does the type of CPD activities attended impact the instructional quality (cognitive activation and individual

Proposed Interview Questions

Continuous Professional Development (CPD)

Professional development is the development of an individual's professional role, and the continuous professional development of educators can be referred to as processes and activities formulated to help improve the knowledge, skills and attitude of educators for the interest of the learner and learner achievement.

First, I would like to know:

- **What type of Continuous Professional Development Activities did you attend in the last year? *Which topics did you address in these sessions?**
- **How much time did you spend on these activities?**

- **How often did you do this?**
- **Do you engage in activities which are organised by you or other teachers?**

Probing questions:

1. Did you attend workshops, seminars or courses, or did you engage in other activities?
2. In which concept (Numbers Operations and Relationships, pattern, space and shape, Data handling, etc.) was chosen as topics for the activity?
3. Did you spend 45min-1 hour on the activities done, or was time allocated per activity?

- **Next, I would like to know more about what you did in these CPD activities.**

Probing questions:

1. How was the activity held? What did you do during the activity? What was the content, and how was it taught?
2. Did you do any practical activities?

- **Please also tell me why you chose to engage in these activities.**

Probing questions:

1. Do you think these activities will help you achieve optimal instructional quality?
2. Were they suggested by the subject advisor, or did you pick them out together with other teachers?

- **And how useful did you find these activities?**

Probing questions:

1. Do they help you with teaching primary mathematics?
2. Could you use what you learned during your teaching?

- **I would also like to know how you are using what you learned in your classroom.**

Probing questions:

1. Do you do similar activities in the classroom?
2. Do you use the activities that were done during CPD as a guideline?

- **Please explain to me what you do to teach mathematics to your learners?**

Probing questions:

1. Do you provide the information to your learners?
2. Do you use practical activities? Which ones?

3. How do you engage your learners in class when teaching mathematics?
4. What do you do to get them interested in the topic?

- **How did you use what you have learned in your professional development activities for your teaching of mathematics?**

Probing questions:

1. How much of the content you have learned could you use in the classroom?
2. Did you change how you teach after these courses? How?
3. If so, what strategy do you use?

- **Do you notice any improvement in the learners after you incorporated these changes?**

Probing question:

1. Is there any change in the learners since you have used the new method?
2. Has the activity of the learners in class changed since you used the new method?

- **And last, please tell me if you have experienced difficulties in using what you have learned in these activities in the classroom?**

Thank You for Participating!