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Enriching Professional Development in Disadvantaged Schools through the Targeting Talent Programme (TPP) Educators Enrichment Programme: Insights from Math and Science Educators

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Abstract. This study explores the lived experiences of educators from disadvantaged schools involved in professional development in the Targeting Talent Programme (TPP) at the University of the Witwatersrand. It elicits the perceptions of mathematics and science educators on professional development programmes. A qualitative research approach was employed, and data was collected through focus group discussions with 24 participants comprising Math and Science educators. The study's findings indicated that acquiring the requisite knowledge and skills from participating in the programme improved the understanding of pedagogical content, skills and teaching methodologies. The major barrier besetting the realisation of educators' professional development identified included the public-school system in South Africa characterised by resource constraints which limit educators' innovative strategies in integrating technology into teaching and learning. The study revealed that reflection is required regarding the rules and policies regulating learners' and educators' use of technological gadgets. From the findings, it is recommended that designing and implementing educator professional development must be embodied within South African school policies.

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1. Background of the study

In the landscape of education, the development of educators remains a cornerstone for fostering excellence in teaching and learning. The field of education has been known for being dynamic and ever-changing (Abbas, et al, 2021; Avidov-Ungar, 2016; Garner & Kaplan, 2021; Mihic´ & Ivica Zavrs˘ki, 2017). These changes range from technological advancement, evolving pedagogical methodologies, and classroom inclusivity, which places a need for educators to consistently modify their teaching strategies to effectively accommodate learners with different learning abilities and rely on professional development as a strategic method to ensure that they are well-equipped, skilled and can adapt to the changing education system (Avidov-Ungar, 2016). However, professional development models typically fail to adequately address and upskill educators to adapt to the complex and dynamic changes in the education system (Garner & Kaplan, 2021).

Extensive research has been conducted on the significance of educators' professional development to enhance teaching and learning. Researchers have focused on educators' perceptions of professional development through the narrative analysis of their stories, the factors motivating educators to pursue their professional development (Avidov-Ungar, 2016; Gess-Newsome, et al., 2019; Neumann, et al., 2019; Maaranen, et al., 2023), and the effectiveness of professional development programmes for educators (Tack & Vanderlinde, 2014; Sato, et al., 2021). Professional development programmes play an important role in upskilling educators by providing them with the necessary support and knowledge to thrive in the field (Gess-Newsome et al., 2019).

Educators from low socio-economic communities characterised by lack of resources necessary for teaching and learning form part of the excluded group in the professional development programmes (Geldenhuys & Oosthuizen, 2015). Educators from schools located in low socio-economic communities continue to suffer from a lack of professional development programmes that foster effective teaching and learning (Maaranen et al., 2023; Sato et al., 2021; Bernadine, 2019; Geldenhuys & Oosthuizen, 2015). In addition, Sato et al., (2021) argue that educators in low and middle-income countries face challenges in adapting to the changes in teaching and learning due to lacking the skills and resources to teach effectively. Sato et al., (2021) recommended professional development programmes to be implemented as a principal tool to harness and upskill educators. In light of this, schools located in low socio-economic communities with a lack of resources rely on the skills, efficiency and competence of educators. As a result, it is critical that educators' professional knowledge and skills go beyond the basic college training to the ongoing development (Bernadine, 2019).
A lack of professional development has been found to significantly impact a profession's perceived value and educators' confidence in advocating for

innovation and transformation in teaching and learning (Tack & Vanderlinde, 2014; Neumann et al., 2019; Ajani, 2019). These difficulties also influence educators' confidence to instil appropriate professional knowledge and values in their learners (Matthews, et al., 2019). Professional development programmes foster educators to adopt a critical stance to support the learners they teach and provide them with appropriate knowledge foundations. Such a critical stance advocates transformational approaches to uplift socially disadvantaged learners. However, little is known about the perceived effectiveness of the collaboration between higher education institutions and basic education when it comes to designing programmes aimed at empowering educators from disadvantaged schools in the field of math and science. This shows a need to bridge the gap in the availability and implementation of educators' professional development programmes located in different social backgrounds.

For decades, school-university collaborations have been developed and researched as a method for implementing new programmes, addressing professional learning and development, and strengthening links between the school, university, and greater community for strategic collaboration (Bernadine, 2019; Geldenhuys & Oosthuizen, 2015, Herro, et al, 2022). In South Africa, the National Education Policy Act of 1996 calls for collaboration from the Department of Education with other state departments to advance development programmes necessary for quality teaching and learning. Moreover, the Department of Basic Education in collaboration with the Department of Higher Education and Training has been focused on influencing the quality and preparation of educators and ultimately, learners, in subjects such as Mathematics, Science and Technology (Department of Education, 2016).

A contextual gap was identified in terms of educators' professional development programmes among Math and Science educators from disadvantaged schools. While the previous studies are impressive in their scope and depth in exploring educators' professional development, they do not provide adequate interventions for the egregious inequalities of South Africa's education system in disadvantaged schools and the implementation of educators' enrichment programmes in such schools. Thus, a critical need for in-depth research that delves into the multifaceted nature of professional development of educators is essential. As such, this current research explores professional development programmes for mathematics and science educators in low socio-economic communities, specifically the Targeting Talent Program (TPP) implemented by the University of Witwatersrand in the Student Equity and Talent Management Unit (SETMU). The TTP focuses on providing academic supplementation and enrichment for grade 10-12 learners with academic potential, from disadvantaged schools in South Africa. The goal of the programme is to increase academic, social, and psychological preparation of learners with academic potential for admission to South African universities. This contributes to the goal of the National Education Policy Act which stipulates a right to equal access to educational institutions (National Education Policy Act, 1996). The programme relates to the National Education Policy Act which is aimed at achieving equitable education

opportunities and the redress of past inequalities in educational institutions (National Education Policy Act, 1996).

This study contributes to the literature on educators' professional development programmes in the context of socially disadvantaged schools. The study provided educators with an opportunity to reflect on their teaching experiences as well as on their academic development. It is envisaged that the findings of the study will portray the significance of educator professional development programmes in terms of educators' socialization, and the development of a supportive professional community to which they belong, and further offer educators opportunities to experience alternative ways of learning mathematics and science. The study informs policymakers who oversee the formulation of educators' professional development programme policies to develop policies and programmes that will enhance teaching and learning.

The current study further presents the profound experiences of Math and Science educators from low socio-economic communities who participated in the TTP Educators Enrichment Programme. It explores their understanding of professional development; challenges they encounter regarding participating in professional development programmes and potential improvements that can be made in order to guarantee their enough and meaningful teaching and learning. The research also explores educators' perspectives on the relevance and importance of participating in professional development programmes.

2. Literature Review

A key component identified that contributes to educators' professional development includes effective pedagogy (Gess-Newsome et al., 2019; Neumann et al., 2019; Guerriero, 2014; Sulaimani et al., 2017). Researchers reveal the crucial need for educators to strengthen their skills as much as their qualifications, to effectively deliver the curriculum (Carlson, et al., 2019; Neumann, et al., 2019). Research studies have recommended that educators should increase their curriculum knowledge, pedagogical content understanding, and teaching abilities (Sulaimani, et al, 2017; Van Driel & Berry, 2012; Bayar, 2014; Gore & Rosser, 2022; Campbell, 2022). Focusing on curricular content and how to effectively deliver it has continually been highlighted as fundamental to the success of professional development (Geldenhuys & Oosthuizen, 2015). Recent studies have emphasized that professional development activities should be offered according to the existing needs of educators and learners (Campbell, 2022; Matherson & Windle, 2017). Extant studies have indicated that successful professional development programmes must consider both subject knowledge and subject-specific teaching techniques (Van Driel & Berry, 2012; Roth, et al, 2019). Other studies reported that professional development activities should be conducted according to the individual school classroom needs, since needs may vary from school to school according to the demands of the student populations (Bayar, 2014; Kennedy; 2019; Hill & Grossman, 2013).

In addition, Hill and Grossman (2013) noted that professional development activities must be related to the school curriculum. According to the findings of Hill and Grossman (2013), educators must be able to link what they are learning in professional development programmes to their classrooms. Furthermore, Kennedy (2019) discovered that the effectiveness of professional development programmes is significantly improved when the activities involved are connected to the context of the school. The emphasis has also been on the inclusion of pedagogical practices. Gore and Rosser (2022) argued that professional development programmes should focus on developing educators' pedagogical knowledge as pedagogy cuts across grade levels and subject differences. This presented a different approach, shifting the focus of professional development to pedagogy rather than content. When pedagogy is addressed, the concern is how best to teach particular content to students. Gore and Rosser (2022) found that pedagogy-focused professional development generates crucial insights for teachers about their pedagogy and learners. It changed their beliefs and practices, enhanced collegiality and fostered ongoing professional collaboration across the wider school community.

Additionally, the ability of educators to take an active role in activities is an essential element of a professional development programme that is designed to be both effective and efficient (Avidov-Ungar, 2016). According to Niemi, et al (2016), educators learn by doing during professional development programmes and in light of this, it is essential that programme developers recognize educators as active agents who are responsible for their professional development. Canaleta, et al (2014) explored the correlation between active learning and professional learning outcomes and discovered that the implementation of active learning methodologies is effective in the educator's professional development programmes. Furthermore, Niemi and Nevgi (2014) investigated the associations between active learning, professional development, and competency levels. It was found that active learning strategies have a significant impact on the professional abilities of educators. Similarly, Dekker-Groen, et al (2013) recommended that effective educators' professional development must include the following essential components: content focus, active learning, coherence, and collective engagement. Learning through active participation is also a social process. Active learning presents educators with the responsibility for the creation of knowledge as well as the elaboration on the applications of that knowledge. It has been discovered that the inclusion of active learning in professional development programmmes for educators promotes collaboration, the ability to learn and work together, as well as refining new approaches (Abbas, et al., 2021; Niemi & Nevgi, 2014). In the current study, it is envisaged that the establishment of collaborative learning communities within socially disadvantaged schools, facilitated through professional development programmes will contribute to a supportive network, inform recommendations to address systematic barriers and promote equitable opportunities for professional growth.

2.1 Theoretical framework

In line with the constructivism paradigm, the viewpoint of constructivism challenges the conventional concept of knowledge as a static and external entity

awaiting passive absorption. Instead, it proposes that people play a central role in moulding their understanding through active participation, exploration and reflection (Bada & Olusegun, 2015). Knowledge in this framework is not a stagnant entirety received passively, rather, it evolves continuously through people's interaction with their environment. The process of knowledge construction is inherently dynamic, where people engage in activities, experiments and problem-solving initiatives to interpret and organize knowledge (Kalpana, 2014). This active participation enables people to build upon their existing cognitive structures and experiences. One of the pivotal aspects of knowledge construction constructivism is creating and making meaning behind new information (Chuang, 2021). When people interact with new information, they go beyond the absorption and attribute personal meaning to it. This process involves connecting new knowledge by drawing on prior experiences and making sense of the information in ways that are relevant and significant to each individual person.

In addition, constructivism emphasises the social nature of learning, recognizing that meaningful learning doesn't occur in isolation but is significantly enriched through social interaction (Bada & Olusegun, 2015). Collaboration, discussions, and shared experiences with peers, mentors and the broader community contribute substantially to the construction of knowledge. Through these social interactions, learners gain insights from diverse perspectives, challenge their own assumptions and collectively contribute to the construction of a more comprehensive understanding. The theory aligned with the study's objectives in understanding how educators actively build knowledge through collaborative learning and interactions in professional development programmes. This shaped how educators construct their learning through collaborative processes. Fundamentally, constructivism and professional development of educators consider educators as active role players in their learning, fostering them to construct their knowledge collaboratively, reflect on their experiences, and apply their learning in practical and authentic contexts.

3. Methodology

3.1. Research approach and design

A qualitative approach was used to delve deeply into the educators understanding, challenges, and perceived benefits of participating in professional development programmes. This approach provided a more nuanced understanding of educators' professional development in the context of socially disadvantaged schools. A phenomenological research design was adopted to explore educators' experiences and their perceptions of professional development programmes. A phenomenological research design focuses on the lived experiences of the participants. The design gathers a phenomenon founded on the perspectives based on the participants' experiences including how they make sense or interpret their experiences (Cresswell, 2016).

3.2. Sample and population

A total of 24 educators were purposively selected to participate in the study. Participants were selected based on the following inclusion criteria: a) educators'

full participation in the Targeting Talent educator's enrichment programme, b) mathematics and science educators and; c) educators from TTP feeder schools located in socially disadvantaged communities. Educators from Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, the Northern Cape, North West and the Western Cape were invited to Gauteng province at the University of Witwatersrand where the programme was implemented were identified, and data was collected. The participants demographic details are shared below based on gender, qualification and highest level of education.

Table 1: Participants' demographic details

Demographic characteristics	**Number of Educators**	**Percentage**
Gender		
Male	14	58%
Female	10	42%
Subject		
Life Science	4	17%
Physical Science	8	33%
Mathematics	12	50%
Highest qualification		
Bachelor's Degree	7	29%
B-Tech Degree	2	8%
Higher Diploma in Education	1	4%
Honor's Degree	2	8%
Postgraduate Certificate in Education (PGCE)	11	46%
Master's Degree	1	4%
Province		
KwaZulu-Natal (KZN)	3	13%
Western Cape (WC)	3	13%
Limpopo (LIM)	3	13%
Free State (FS)	3	13%
Northern Cape (NC)	3	13%
Mpumalanga (MP)	3	13%
Gauteng (GP)	3	13%
North West (NW)	3	13%
Total	24	100%

3.3. Data collection

Data was collected using focus group discussions with mathematics and science educators. The focus group discussions allowed for productive discussion and probing which provided richer feedback on educators' experiences of the educators' professional development programme. Two (2) focus group discussions were conducted, and each discussion consisted of twelve (12) participants. The duration of the interviews ranged from 50 to 60 minutes. The focus group discussions provided participants with an opportunity to express themselves in their own words and to share their experiences openly. The interviews were conducted with the use of an interview guide, which consisted of pre-determined questions that allowed for flexibility, and the order in which the researcher asked the questions. The interviews were conducted in English, recorded using an audio recorder and verbatim transcription was implemented to capture every single word from the audio file to text in the exact way those words were originally spoken.

3.4. Data Analysis

The data was analysed using thematic analysis. A qualitative software (NVivo version 8 software) was used to identify, analyse and report emerging themes from the focus group discussions. Two kinds of coding were utilized. The first method was descriptive coding which involved describing the sample. The second coding method used was analytic coding which focused on the content to evaluate and reflect on the significance of the information to come up with new concepts, ideas, themes and categories.

3.5. Ethical consideration

The study was conducted after ethical clearance was sought from the University of Witwatersrand and the Department of Basic Education. Throughout the study, the participation was entirely voluntary, and participants were given assurance that their identities will remain anonymous. The use of pseudonyms protected the participants' anonymity and confidentiality, and informed consent was obtained from all participants.

3.6. Data quality and trustworthiness

Credibility (internal validity), transferability (external validity generalisability), dependability (reliability), and confirmability are the four fundamental characteristics for enhancing the trustworthiness of any qualitative investigation (Guba, 1981). To ensure credibility, two researchers (NS & KS) independently co-coded the data, ensuring that the analysis was based on the data with supporting verbatim quotes for each of the themes and subthemes provided in the findings. Dependability was attained through the independent co-coding of the data by two researchers (NS & LN), who ensured that the analysis included verbatim quotes in support of all the main themes and sub-themes presented in the findings. The transferability of results was ensured by clearly describing study participants and offering a detailed description of the background, methods, and conclusion. The entire study procedure was recorded using field notes and audio recordings, and researchers actively participated in the data analysis process to increase conformability.

4. Findings

The data generated themes related to the experiences of educators in the educator's professional development programme. The themes identified from the focus group discussions included improved skills and competencies, improved understanding of the content and improved teaching methods and pedagogical knowledge. Educators further identified challenges experienced during the enrichment programme.

4.1. Theme 1: Improved skills and competencies

The first theme that was identified was the skills and competencies that are necessary for math and science educators. The educator's comments evidenced the acquisition of requisite knowledge and skills from participating in the programme. Skills essential for teaching math and science that educators gained from the enrichment programme included the ability to appeal to the different learning preferences of the learners, learner engagement, critical thinking skills and research skills. Similarly, Mihic´ & Ivica Zavrsˇki (2017) found that the field of education is ever changing including the teaching methods which require educators to constantly upskill themselves. Mihic´ & Ivica Zavrsˇki (2017) identified the skills associated with the professional development of educators such as communication, critical thinking, intuition and problem-solving skills.
K-P8 expressed that:

> *The challenge I had was the skill to appeal to the different learning preferences of the learners in the classroom because they all have their own way of how they process information and how they make sense of it. So sometimes it happens that when you are teaching, the content only appeals to a certain few in the classroom; therefore, as an educator I was capacitated in different ways to appeal to different learners in the class. (K-P8)*

The other prominent skill that emerged was the ability to engage learners in the learning process.

> *The skill that I have acquired here that will improve my classroom environment is to engage my learners, like getting them to participate. Whether they raise up their hands or not, politely, I will just request them to offer their input because some of them are afraid and shy to talk. I will ask follow-up questions and ensure that they are critical thinkers. (K-P12)*

Educators' comments indicate an awareness of how learners learn and how learning is also the responsibility of learners. This was associated with the concept of active learning, which promotes learner engagement and improves relevance and motivation in the classroom. Niemi and Nevgi (2014) recommended a learner-centred approach where the educators' roles are to let learners explore and drive their own learning. Similarly, Avidov-Ungar (2016) recommended that educators should be skilled in facilitating teaching and learning in a way that will encourage learners to participate, engage, interact and be active players in the process. The nuanced response of educators indicates that the professional development programme equipped them with the skill to give learners the freedom to explore their learnings.

K-21 mentioned that:

> *The skill that was quite valuable that I gained was the power of allowing the learners to explore. In the workshop, we explored to a point of coming up with our own formulas and I think allowing learners to do that just to see how far they go, their level of thinking and their abilities.*

K-P7 similarly expressed that:

> *One of the skills that I gained is to have a full understanding of your learners, like knowing them as your own kids at home, and profile them according to their performance which will allow you to better assist your learners according to their abilities. In this workshop I learned to go beyond the textbook and allow my learners to be active in the classroom, therefore, I would say that I gained critical thinking and research skills.*

The second theme identified was the impact of the educators' enrichment programme as perceived by educators. The common points that emerged included an improved understanding of the content, innovative teaching strategies and an understanding of different learners in the classroom

4.2. Theme 2: Improved understanding of the content

Educators indicated that participating in the enrichment programme improved their understanding of the content. This is a reflection that educators' understanding of the content exerts a substantial influence on teaching and learning. The following are the responses quoted verbatim, and no corrections were made to the language:

> *I got to understand that as an educator you need to have background information on the formulas that you are using. For the entire duration of the workshop, the focus was on developing the formulas and the understanding behind the formulas. (K-P3)*
> *We got to learn how a lot of formulas in financial mathematics ad calculus come from, this helps in better understanding the concepts. (K-P9).*

Similarly, another participant stated that:

> *I gained how to solve calculations on work, energy and power. I also got to understand differences between acids and bases. (K-P16)*
> *I have learned a lot in this programme as I was given an opportunity to learn from doctors and professors who are experts in the field my content knowledge was advanced and we did perform more practical in the lab so my expectations were met. (K-P19)*

The comments above indicate the impact of professional development programmes on improving educator's content knowledge. Similarly, REF found the critical role of professional development programmes and improved understanding of the subject matter, contributing to more effective teaching and learning. Ingersoll and Strong found a correlation between professional development programmes and increased content understanding. In addition, the knowledge constructed through collaboration and practical work as mentioned by Participant K-P19 aligns with the principles of the constructivist theory which

posits that people actively engage with content to construct meaning through hands-on experiences, discussions and collaborative activities.

4.3. Theme 3: Improved teaching methods

The third theme identified was the impact on teaching and learning. Educators indicated that participating in the programme improved their teaching methodologies and integration of technology in teaching and learning. Educators mentioned being equipped with effective teaching methods to support and foster learners' learning needs and progress. This included the ability to simplify complex topics to learners and using the demonstration and active teaching method to enhance learners' understanding of the content. Educators also highlighted the importance of using creativity in teaching and learning.

> *With conducting practical (hands-on) in a school with no laboratory, we were given micro equipment to help conduct the experiments in class and also showed how to conduct these experiments. (K-P4).*

> *I got to learn new teaching methods, especially on a subject that I teach Life Sciences from other colleagues from different provinces which I am definitely going to implement in my classroom. The programme provided me with exposure. (K-P14)*

Participants also substantiated the improved teaching methods. Damrongpanit and Reungtragul (2013) stressed the importance of congruence between the educator's learnings and educators teaching methods.

> *My pedagogical content knowledge has been uplifted and my approach to teaching has really been taught to me. As a new teacher did not have an approach to some topics such as electromagnetism so now I've benefited a lot. (K-P8)*

> *Most of the activities involved practicals, which are the parts of the curriculum we usually leave out because of time. We also had a hands-on way of preparing for a lesson, focusing on big ideas and how to deliver these ideas, and making sure that nothing is left out. (K-P4)*

K-P8 mentioned the use of active teaching method in ensuring that learners explore the content to the best of their abilities:

> *I'd like to think that through attending this workshop, I benefited a lot. I will not just look at the question just the way it is but I will ensure that we tackle the question using different strategies and go beyond simplicity like what we were doing today, we were trying to develop formulas, ey it was very hard cause in schools we don't develop formulas we just apply what is in the book. The session really broadened my understanding of mathematics.*

K-P7 indicated the importance of bringing creativity in class:

> *Yeah, I think live science I've realised something in terms of the quality of teaching. I've realised that creativity is the most important thing, because what we have been doing thing, those lecturers were just being creative about the topic. And even me, it makes us to be interested to the topic, so*

> *if we can implement that in the classroom, we'll grab like the attention of the learners because most of…these days…. the learners of these days, they think whatever were doing in class, is not related to what is happening in the environment. (K-P7)*

This was supported by K-P2 indicating that:

> *So, if you become more creative, you just try to link what is happening in class and also what is happening on the daily basis. So, I think is its one of the aspects which is very much important. If you can be able to link that, then learners will be interested, and you can see improvement. (K-P2)*

Comments from the participants align with the constructivist theory, particularly, in the context of active learning, collaboration and the social nature of knowledge construction. The response from participant K-P14 implies active engagement in the learning process, where learning is not passively generated but acquired through active participation and collaboration. This highlights active learning, collaboration and the intent to apply new knowledge to existing methods. The principle of knowledge construction through engagement, social interaction and application of learning in real-world contexts was evident from participants' responses.

4.4. Theme 4: Integrating technology into teaching and learning

Socially disadvantaged schools continue to suffer from lack of resources; therefore, it is imperative to foster equity and empowerment of educators in order to integrate technology into teaching and learning. Educators were asked how the enrichment programme enhanced their ability to integrate technology into teaching to maximise learning. Educators indicated that learners have different ways of learning, which forces them to go beyond textbooks and make use of technology such as playing videos and using pictures to ensure that all learners understand the content.

> *In us with Life Sciences I think more about getting like pictures and videos to show them and also encourage the kids to also check out some good material that can enhance them than studying or sitting in class. (K-P3)*

Educators acknowledged how learners are reared on rapidly evolving technologies which result in decreased tolerance for lecture-style teaching methods. Educators' comments indicate willingness to experiment with alternative methods of teaching and learning such as technology.

Similarly, K-P2 indicated that:

> *Yeah, I think that is important coz everyone has a different way of learning and sometimes the reading of the textbook is not enough, and they don't…it's not setting in for them. So maybe watching a video or seeing it visually on a picture whatever is a little bit more helpful than reading or whatever. So yeah, I think it's just important that you open yourself up to different types of or different ways of learning specific things. The different stimuli that you can use to enhance the learning, basically. The workshop covered a lot on PCK and also use of technological sources for teaching. I was exposed to modern trends in teaching that will*

help me to capture the interest of learners and probably improve their performance. (K-P24)

4.5. Theme 5: Educators' challenges in participating in the professional development programme.

The educators' enrichment programme exposed educators to practical experience in terms of teaching subjects such as physical science and life science. Educators identified challenges concerning the implementation of practical activities in their schools. They highlighted that most of the schools they come from are socially disadvantaged with a lack of resources. K-P24 made an important point that there is a lack of skill to utilize some of the resources available in their school environment.

I think, us in the schools, not that we lack the knowledge. I think it also goes back to the fact that we don't have a lot of teaching aids. We don't have the materials. Like for example if we are talking about the practical that we did on ideal solution, it was really easy here because we were able to dissect in depth, we were able to also see the stuff we were talking about and talk to what we are actually seeing. But with us when we go to class, we try to explain something, we try to make them imagine something and imagining sometimes that can develop different imaginations to different learners. I think what is more important is us not having enough resources and maybe having the resources, we are also not able to utilise them appropriately. (K-P24)

Additionally, K-P21 indicates the need for educators to evaluate the methods used in teaching and learning. It was mentioned that the teaching methods used can impact learners' performances. However, K-P21 highlighted that the methods shared in the programme were not practical due to time constraints.

It enlightened me that some of the approaches we use as teachers contribute to our learner's failing. Although some strategies suggested by the facilitators are not practical due to many constraints that we come across at our workplace such at time. (K-P21)

Two educators indicated that they experienced challenges due to exposure to the new content.

I'm not teaching the topics in life sciences so I did not have knowledge of some topics. (K-P18)

I'm still doing my PGCE, some of the grade 12 content I was lost during the lesson. (KP-15)

One participant stated that the content was insufficiently tailored to their specific classroom needs. The educator stated that they were not involved in the planning of professional development activities. Thus, they felt disconnected from the subject content covered and found some activities irrelevant. K-P23 stated that:

Personally, for me, the workshop developed me as a mathematician and not necessarily as a math teacher because we were going in-depth about where certain things come from in mathematics which are things that according to the curriculum and CAPS document, we don't really have to do them with learners. As a mathematician, I was developed but when you look at it in terms of

> *curriculum development and what I'm supposed to do at a school level, there wasn't much. (K-P23).*

One participant attested and added that what they need most is the focus on the content that is relevant to the school curriculum and ways in which they can deliver the lessons. K-P3 explained that they were not comfortable with all the topics that were covered as some topics were relevant to grade 12 educators.

> *Just to attest to what the two colleagues have said, yes, we were expecting to have something that is related to curriculum that we normally deliver in our school, but we were taught more on the history of financial math and calculus, so we were developed as mathematicians, but the history doesn't really address the content we teach in schools. The other thing I can add we were also mixed in one class from grade 10 educators to grade 12, but the focus was mostly on the grade 12 content. (K-P3).*

The participant's responses indicated the paramount role that educators play in fostering and implementing effective teaching and learning regardless of the challenges. The responses indicate that socially disadvantaged schools are faced with resource constraints and the challenges are multifaceted. The need for professional development programmes among educators from such backgrounds is more pronounced as the lack thereof may hinder educators from implementing active learning and bridging the gap using technology to foster effective teaching and learning.

5. Discussion of findings

An analysis of the educator responses in the study provided a better sense of their experiences. The reviews of the programme were mostly positive, and this was attributed to the improved content, skills and pedagogical knowledge. The study found that the professional development of educators is a necessity for quality education in South African high schools. The educator professional development programmes support the mandate of the South African Council for Educators, which specifies that teachers must participate in professional development programmes to acquire the professional points necessary for career advancement (South African Council for Educators, 2008). Gumbo (2020) holds a similar perspective that the provision of seminars, training and conferences improves educators' pedagogical content understanding.

The study further found improved content knowledge and skills of educators in terms of their readiness to respond adequately to a mathematics or science problem in any given situation. The responses of educators indicated that the programme was successful in terms of equipping them with the skills and competencies necessary to address diverse challenges that may require the application of mathematics or science in order to answer questions, solve problems, and comprehend phenomena. This was evident in the educators' responses regarding the clarity of concepts, formulas, and strategies for solving calculations that they gained by participating in the programme. The findings of the study are similar to the argument made by Guerriero (2014) which emphasises that although educators' knowledge is an essential component of educator professionalism, professional competence encompasses more than simply

knowledge alone. In addition to knowledge, skills are critical to becoming an expert in teaching and learning. Similarly, Campell (2022) found that professional development programmes foster an inclusive and supportive environment that can help educators perceive one another as peers and improve their teaching skills. Additionally, this aligns with constructivism regarding the alignment professional development programmes with practical knowledge, experiments and collaborative learning.

Educators are frequently motivated to design technology-based lessons, yet few possess the materials and expertise necessary to implement these programmes. Educators cited a lack of expertise and obstacles in integrating technology into the classroom. The study discovered that curricula focusing on training educators with technology pedagogy could be effective in modifying their course objectives and assessment design. The dearth of educator professional development programmes that give relevant support for educators to use technology and improve their pedagogical approaches was identified as the gap. Ajani (2019) mentioned that professional development programmes for educators should encourage the growth of their technological pedagogical content understanding which can assist educators grasp the knowledge they need to integrate technology into their teaching effectively. It was determined that the majority of educators require more support structures to aid them in their technology integration efforts. This relates to the conclusion reached by Spangenberg and De Freitas (2019), who found that educators require additional professional development programmes that emphasize technology-pedagogical content and its connection to school subject content.

The educators indicated that the programme provided them with skills on how to be creative and improvise in schools with a lack of resources. A study conducted by Ravhuhali, Kutame and Mutshaeni (2015) confirms that educator professional development programmes promote creativity in the designs of classroom activities and assessments. The findings revealed that the programme equipped educators with the skill to design teaching and learning support materials and activities that will suit learner-individual differences, and the peculiarity of their schools. According to Geldenhuys and Oosthuizen (2015), professional development programmes are extremely beneficial to educators who want to create educational materials that can cater to the needs of a variety of learners. Educators can enhance learning for learners' quick grasp of the concepts by using a variety of teaching and learning tools in the classroom.

The majority of the educators opined that the TTP Educators Enrichment Programme was of significant benefit to their classroom practices, teaching skills and methods, however, some of the educators were not satisfied with the content covered. According to Geldenhuys and Oosthuizen (2015), most South African educators are dissatisfied with professional development programmes because of lack of impact on their pedagogy. Dlamini and Mbatha (2018) concur, stating that the professional development programmes for educators do not always meet their professional needs. The findings of the current study indicated that some of the activities that were covered do not adequately address educators' classroom

needs. This indicated a need for the restructuring of the training and workshops to be held in the future, taking into consideration the inputs from the educators. Constructivism similarly stresses the need to take into cognisance current knowledge in shaping learning journey which in this context is an integral part of making professional development programmes more effective and relevant.

6. Conclusion

The main objective of this study was to explore the experiences of educators in the TTP Educators Enrichment Programme and their perceptions on professional development programmes for educators from socially disadvantaged schools. The study found that the educator's enrichment programme plays a crucial role in improving knowledge, skills, pedagogical content and teaching methodologies. Educators' enrichment programmes are essential in upgrading the subject-specific and curriculum-specific knowledge of Math and Science educators; educators' technical dexterity, which would better equip educators to create their materials for learners and offer assistance in the creation of professional learning communities amongst educators which will facilitate the dissemination of knowledge. The main goal of professional development is to improve teaching and learning for improved learners 'results, thus, the findings of the study highlight the need for educators to play a role in the design of professional development programmes to improve ownership and relevancy of the content and activities covered including activities and the curriculum focusing more on educators' classroom needs.

7. Recommendations

Strategic and individualised approach: The study recommends that professional development programmes should align with the professional development goals and objectives of educators. This includes a comprehensive needs assessment to identify the key requirements, challenges, aspirations, individual teaching contexts and skill levels of educators through surveys. The study also recommends the Department of Education and other concerned stakeholders to structure the professional development activities to focus on the classroom needs of the educators.

Support for Technology Integration: The study recommends initiatives towards supporting the integration of technology in the classroom to support teaching and learning. This includes targeted support to educators and training on effective ways to incorporate technology into the classroom and school policies accommodative of the use of suitable gadgets at schools.

Active learning strategies: Based on the participants' responses and the constructivist theory, the study recommends active learning methods in professional development programmes to model collaborative learning and enhance educators' teaching methods. Encourage the exploration of participatory teaching approaches that can improve learner engagement and understanding of the content.

Peer Collaboration: Due to the financial constraints and lack of resources to provide professional development programmes for educators, the study recommends the establishment of mentoring programmes within circuits to encourage peer collaboration where experienced educators with different expertise could facilitate and share insights for effective teaching. This way, the educators can be provided with a supportive network and have a culture of continuous learning and improvement.

Longitudinal research studies: the study recommends longitudinal research studies that can track the long-term impact of professional development programmes on educator's skills and teaching practices.

Learner outcomes: the study recommends the exploration of the impact of educators' professional development programmes on learners' outcomes to understand how improvements in educators' skills and teaching methods translate into improved learning experiences and academic performance of the learners.

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No potential conflict of interest was reported by the author(s).

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Ethics Approval
The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the University of Witwatersrand for studies involving humans.

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