For research article

Response to Reviewer 2 Comments

1. Summary

Thank you very much for taking the time to review this manuscript. Please find the detailed responses below and the corresponding revisions/corrections highlighted/in track changes in the re-submitted files.

2. Questions for General Evaluation	**Reviewer's Evaluation**	**Response and Revisions**
Does the introduction provide sufficient background and include all relevant references?	Yes/Can be improvedX/Must be improved/Not applicable	We have revised the introduction and background in line with the reviewer's suggestions.
Are all the cited references relevant to the research?	Yes/Can be improvedX/Must be improvedX/Not applicable	We have evaluated our citations. Some citations were deleted, while a few were added.
Is the research design appropriate?	Yes/Can be improvedX/Must be improved/Not applicable	The methods were strengthened to add more information to the sampling, data collection and analysis method.
Are the methods adequately described?	Yes/Can be improvedX/Must be improved/Not applicable	Same as above
Are the results clearly presented?	Yes/Can be improved/Must be improvedX/Not applicable	We have strengthened the findings with few more participants' quotes. Some sections were reinterpreted for clarity
Are the conclusions supported by the results?	Yes/Can be improved/Must be improvedX/Not applicable	The conclusion has been improved to be in line with introduction, findings and discussion.

3. Point-by-point response to Comments and Suggestions for Authors

Comments 1: The abstract must be revised to follow the IMRD format (Introduction, Methodology, Results, Discussion). Currently, it is structured more as a general summary than a formal academic abstract. It does not clearly distinguish between the background, the design of the study, the key findings, and their implications. The use of signposting (e.g., "This study aimed to…", "Using a qualitative approach…", "Findings revealed…", "These results suggest…") is strongly recommended to guide the reader. This structural change would also ensure consistency with the journal's expectations.

Response 1: Thank you for pointing this out. We agree with this comment. Therefore, we have rewritten the introduction to cover introduction/background, methods, results and discussions. The revised abstract can be found in page 1, line s12-33.

"**Introduction:** Participation in science, technology, engineering, and mathematics (STEM) fields is crucial, as these fields present an opportunity for individuals to overcome socio-economic adversities such as unemployment and poverty. In South Africa, access to STEM education has improved in recent years, partly due to the availability of study grants for learners interested in these fields. However, evidence shows that women remain underrepresented in STEM fields. Gender stereotypes, bullying, and pay disparities are cited as some of the contributing factors. Despite these overwhelming challenges, female learners are increasingly pursuing STEM education. Guided by the resilience theory, we explored the factors motivating female learners to enrol in STEM fields at a public secondary school level in South Africa. **Methods:** The research adopted the snowball sampling technique to recruit learners attending a public secondary school in South Africa. Due to COVID-19 related restrictions in 2022, the research data was collected through telephonic one-on-one interviews. **Results:** The findings revealed that access to competitive employment opportunities, impactful careers, personal growth, and financial independence were some factors sparking the female learners' interest in STEM. However, the learners experienced gender stereotypes and discrimination, which made them doubt their abilities to thrive in STEM education/fields. To cope with the complexities of STEM, the learners relied on their caregivers for emotional support, and they attended extra lessons and tutorials offered by the education system. **Implications:** The findings highlight the need for the government to prioritize support programs for female learners who must continuously fight rejection in STEM fields."

Comments 2: The introduction contains many relevant references, but it lacks a strong conceptual thread. There is a tendency to compile existing studies without offering critical insight or clearly identifying a gap in the literature. While topics such as gender stereotypes, socioeconomic barriers, and the importance of mentorship are mentioned, they are not sufficiently problematized nor explicitly linked to the research objective. Additionally, the notion of intersectionality is introduced but not developed in depth, either here or in the rest

of the manuscript. This is a missed opportunity to strengthen the theoretical framing of the study

Response 2: We agree with the reviewer. We have, accordingly, strengthened the key points and this include the challenges faced by women in STEM fields, the need for women to be supported in STEM fields. We also broadened our discussion of how the research relates to the SDGs. However in doing so, we were mindful that the introduction and background is already long. Pages 2-3, lines to 50-62

In terms of the theoretical framing of the research, we adopted resilience theory, we described the theory in length (page 3, lines 120-166). The resilience theory text is as follows:

"This paper utilizes resiliency as a lens to analyze the coping strategies adopted by black female learners doing STEM subjects in South Africa. Resilience theory has emerged as an essential framework for understanding how individuals, communities, and systems adapt to adversity (Wu et al., 2013b). Initially rooted in psychological studies, it has expanded to encompass various domains, including sociology, social work, and health. The core premise of resilience theory is that despite experiencing significant stressors or challenges in one's life, such as trauma and disasters, people possess the capacity to recover, adapt, and thrive (Herrman et al., 2011; Wu et al., 2013b; Zimmerman, 2013). Zimmerman (2013) further notes that "Resiliency focuses attention on positive contextual, social, and individual variables that interfere or dis-rupt developmental trajectories from risk to problem behaviors, mental distress, and poor health outcomes" (p.1). Scholars such as Brennan (2008) also posit that resili-ence theory tries to explain the ability to withstand shocks, without those shocks significantly compromising one's function. Hence, this theory adopts a strength-based approach to understanding vulnerability. This theory asserts that people have strengths, and despite the overwhelming challenges they face, they also have assets to resist or cope with these challenges (Herrman et al., 2011; Mustari & Karim, 2015; Woods-Giscombe et al., 2023; Wu et al., 2013b). At its core, the resilience theory posits that resilience is not merely a trait but a dynamic process that involves interaction be-tween an individual and their environment (Beauboeuf-Lafontant, 2007).

Resiliency theory focuses on the capacity of individuals to thrive and overcome adversity despite challenging circumstances (Herrman et al., 2011; Mustari & Karim, 2015). This theory emphasizes the role of protective factors such as supportive peer and family relationships, positive role models, and personal strengths that foster resil-ience (Burt & Paysnick, 2012; Estêvão et al., 2017; Jones et al., 2016; Wu et al., 2013a; Zimmerman, 2013). Woods-Giscombe et al. (2023) further note that to fully understand resilience, there is a need to analyze the stressors that are associated with it. They ar-gue that resilience is shaped by adversities such as structural injustice, historical vio-lence, and oppression based on multiple intersecting identities such as race, class, sex-uality, and gender (Woods-Giscombe et al., 2023). This theory has also gained popular-ity in feminist, intersectional research, especially research focusing on the interplay of race, class, and gender among black women (Beauboeuf-

Lafontant, 2007; Woods-Giscombe et al., 2023).

In the context of black female learners, research shows that black female learners face a myriad of challenges in the South African education system because of their identities as black women (Keswell, 2010; Kricorian et al., 2020; Modisaotsile et al., 2023; Sikhosana et al., 2023). Scholars further recognize that despite these intersecting identities of oppression that shape the lives of these black learners, especially women, they manage to overcome these experiences and thrive (Beauboeuf-Lafontant, 2007; Jefferis & Theron, 2017; Matukane & Bronkhorst, 2017; Theron, 2013; Wills & Hofmeyr, 2019). Hence, the Resiliency theory aided in identifying pathways to success by high-lighting the factors that enabled female learners in STEM fields to navigate and tri-umph despite barriers to participation and success in STEM subjects. Furthermore, the application of resiliency theory provided a framework to explore and enhance the pro-tective factors that can support black female learners' journeys in STEM subjects. Un-derstanding how resilience functions in educational settings can inform interventions that empower learners to overcome systemic and personal challenges. It can also aid in nurturing self-efficacy and motivation, which are critical for persistence in STEM sub-jects."

Comment 3: In the research aim, it would be advisable to number the research questions explicitly (e.g., Research Question 1 (RQ1): What factors encourage female learners to enroll in STEM fields?; Research Question 2 (RQ2): What coping strategies do learners employ to manage the challenges of STEM education?). This improves clarity, facilitates reader orientation, and allows for easier referencing in later sections of the article.

Response 3: We agree with the reviewer's suggestions. The research questions now read as follows, page 4, lines 172 – 176

Research Question 1 (RQ1): What factors encouraged female learners to enroll in STEM fields?
Research Question 2 (RQ 2): What coping strategies do the learners employ to manage or cope in the STEM fields?

Comment 4: The methodology needs to be expanded and clarified. While the use of a qualitative, phenomenological approach is appropriate, the manuscript lacks detail regarding the development of the interview guide, the process of data collection, and the specific steps followed during thematic analysis. It is unclear whether one or more researchers were involved in the coding, how agreement was reached on emerging themes, or whether any form of triangulation was used. The limitations of the snowball sampling technique—such as potential sample bias and limited diversity—are not discussed. In Table 1, the formatting is inconsistent and should be revised for clarity and professionalism.

Response 4: Thank you for pointing out the gaps in the methodology. We have strengthened the section on sample, data collection and analysis method.

Sample text, page 5, lines 187 - 218

"The research was undertaken in a public secondary school located in Soweto township. Soweto is one of the oldest and most diverse townships in South Africa with a rapidly expanding population. In 2024, the township population was estimated at 1,895,921 (Statistics South Africa, 2024). The researchers were interested in female learners enrolled in STEM subjects such as mathematics, physical sciences, and engineering graphics and design (Table 1). The learners who participated in the research were aged between 15 to 18 years, and in grade 10. We focused on Grade 10 learners, as the South African basic education framework requires students to choose between science, commerce, and general streams at this stage.

The learners' recruitment started during the height of the COVID-19 waves in 2022. Due to travel and human contact restrictions imposed by the South African government to curb the spread of the virus (Ramrathan, 2021; Maree, 2022), the lead author (HS) encountered difficulties in accessing the school to recruit the learners. Snowball sampling, a technique traditionally used when participants are scarce or hard to identify, was employed to recruit learners (Alston and Bowles, 2003). Utilizing the limited opportunities to interact with the learners, HS recruited one learner who then assisted in the recruitment of more learners who met research inclusion criteria. To be included in the study, learners had to fulfill the following inclusion criteria.

- The learner must be a black female
- Be between the ages of 15 and 18 years
- Be enrolled in one or more STEM subjects at public secondary school
- Learners in nearby secondary schools and enrolled in non-STEM subjects were excluded from participating in the research."

Data analysis section, page 242

"We followed Braun and Clarke's (2012) thematic analysis method to analyze the data, which involves identifying, organizing, and establishing patterns in qualitative data.

Phase 1: Familiarization with the data

Following the interviews, the audios were transcribed verbatim to ensure accuracy and retention of participants' original expressions. The first author then immersed herself in the data by reading and re-reading the transcripts multiple times.

Phase 2: Generating initial codes

Each transcript was coded line-by-line. This step involved systematically identifying and labeling units of meaning that captured relevant features of the data. The codes reflected both the explicit statements of learners and the underlying meanings. For example, statements about choosing STEM for better job prospects were initially coded under "job security" and "career aspirations."

Phase 3: Searching for themes

After all the transcripts were coded, the first author collated similar codes and began the process of identifying broader patterns or themes. Related codes were grouped under preliminary theme categories, and visual representations (tables) were created to explore relationships between codes. It was at this stage that two primary themes were constructed: Learners' motivations to pursue education in STEM and Strategies employed by the learners to cope with the demand of STEM education.

Phase 4: Reviewing themes

The research team met to discuss, review and refine the preliminary themes and subthemes. Each theme was assessed in relation to the coded data extracts and the entire dataset to ensure consistency. The subthemes—such as employment opportunities, impactful and rewarding career, and eer tutorial and mentorship—were verified as representative of recurring patterns that were substantively meaningful.

Phase 5: Defining and naming themes

The themes were clearly defined and named. Descriptive summaries were written for each theme and subtheme to articulate the story each one told in relation to the research questions. For example, the theme "learners' motivations to pursue education in STEM" covered various drivers such as the desire for professional growth and empowerment and financial independence."

Comment 5: In the results, while themes and subthemes are well presented, the analysis is mainly descriptive and would benefit from greater depth. The subthemes are often supported by just one or two quotations, and sometimes lack sufficient analytical elaboration. A highly recommended improvement would be the inclusion of a visual table that pairs each subtheme with a representative quotation to facilitate reading and comprehension. A good example of this can be found in:

Manzano-León, A., Rodríguez-Rivera, P., Raposo-Rivas, M. et al. (2024). Digital game-based learning for transgender identity awareness: a qualitative study in Spanish social education degree. Current Psychology, 43, 18065–18073. https://doi.org/10.1007/s12144-023-05556-3

In this example, each theme is paired with direct student voices, enhancing the connection between empirical material and conceptual categories. A similar structure would be highly beneficial in this manuscript to clearly present the richness of participant experiences and to ensure transparency in the analytical process.

Response 5: We want to thank the reviewer for suggesting ways to improve the presentations of the findings. We implemented the reviewer suggestions by reading through the findings with the aim of providing reach interpretation (page 8, line 342; page 10, line 428; page 11, line 485). We also added few more participants' quotes to justify the subthemes (page 8, lines 327,

337).

We considered using a visual table to present the subthemes along with related quotations. However, the manuscript already includes a table that captures both themes and subthemes. In addition, the first reviewer suggested expanding this table to indicate whether each theme reflects internal or external motivation. We found this recommendation helpful in supporting the reanalysis of our findings. We kindly invite the reviewer to refer to the revised table on page 7 of the manuscript.

Comment 6: In the discussion, the literature cited is relevant, but the section lacks conceptual depth and interpretive consistency. There is not enough engagement with the theoretical framework (resilience theory) or with the concept of intersectionality, which was mentioned earlier in the manuscript but then underused. The discussion would benefit from establishing a stronger conceptual thread that connects the empirical findings with broader debates in gender, education, and social justice. The current structure tends to reiterate descriptive content from the results section instead of developing new analytical insights. Additionally, some references are cited in a superficial way—what is needed is a more critical dialogue between the findings and the literature, which could include, for example, contrasting cases or theoretical tensions.

Response 6: we appreciate the reviewer's feedback. We agree with the reviewer's observation that the discussion lack theoretical framework – resilience theory. We have written the discussion to incorporate the domains of resilience theory and tie the discussions points to this theory. The revised discussion can be found in page 12, lines 536-628.

The revised parts read as follows:

"The study investigated the factors contributing to black female learners' enrolment in STEM and the strategies they used to cope with the demanding curriculum. The findings revealed that the learners enrolled in STEM with the future in mind. These learners wanted to have access to fields with opportunities such as medicine and engineering, positions with decent remuneration, and other developmental opportunities. This proactive approach to resilience is seen in this forward-looking mindset, where learners are proactively placing themselves within a difficult system to achieve better futures rather than just responding to hardship (Ungar, 2011). Such agency needs to be seen from an intersectional perspective, considering how class, gender, and race all work together to influence the obstacles learners faces (Collins & Bilge, 2016; Skhosana, Malatji & Munyoro, 2023)." Page 13, line 540-551

Another part,
"In the present study, the learners were similarly determined to continue their STEM education despite the magnitude of challenges they faced. To keep up with the complex and evolving curriculum, the participants sought guidance from peer tutors and educators while

also relying on the emotional support they received from parents. This is an example of "relational resilience," in which students use social networks to mitigate the negative impacts of educational disparities (Theron et al., 2010). The students' use of tutorials and mentorship can also be seen as a positive form of adaptation in the face of adversity, as described by Hunsu et al. (2021). This shows how resilience is not just an individual trait but a socially embedded process that draws strength from family, peers, and informal networks (Ungar , 2011)." Page 13, Lines 563-573.

Comment 7: Finally, in the conclusions, the manuscript makes broad claims regarding empowerment, economic opportunity, and SDGs, but it lacks specificity in terms of the actual contributions of the study. The limitations are acknowledged but only briefly. The fact that interviews were conducted in English—while the participants' first language was not English—is mentioned as a limitation, but this issue is not analyzed in detail in terms of how it might have shaped responses or limited participant expression. Similarly, the contextual limitations related to COVID-19, telephone interviews, and socioeconomic barriers deserve a more reflective and critical treatment.

Response 7: Thank you for pointing out the gaps in the conclusion. We have strengthened the introduction to wave out the SGDs related to the research, the discussions also picks on the affected SDGs. We thought the conclusion should also capture this. The revised conclusion now read as follows, page 14, line 630-646:

"The study explored the factors that motivate black female learners to enroll in STEM fields. The findings revealed that learners' intrinsic motivation to persist despite numerous challenges stemmed from their desire to qualify in high-demand fields such as engineering and medicine and to build successful careers. Some of the learners further expressed they will use the knowledge and skills they gained in STEM to contribute to South Africa's development. Studies have shown individuals with STEM skills are central to countries' reforms and development agendas (Bayode et al., 2019; Fomunyam, 2019). This is because these individuals tend to be innovative and contribute to addressing complex social, health and economic problems. However, as reported by Sikhosana et al (2025) and Sikhosana et al (2023), these learners, particularly those from needy backgrounds struggled to thrive in the field due to gender stereotypes and lack of learning resources. In pursuit of SDGs 4 and 5, appropriate support systems must be put in place to support female learners interested in STEM."

Regarding the limitations related to the use of English for data collection and the challenges posed by COVID-19, there is unfortunately little we can do at this stage to address these issues. However, we have highlighted strategies that other researchers working in this area can adopt to overcome such challenges. The revised text now reads as follows:

"The research was limited to black female learners attending a public secondary school, this

is a limitation as the findings may not be generalizable to other contexts/ female learners located elsewhere. However, it is important to note the researchers' goal was not the generalizability of the findings but to contribute debates about women representation in STEM and their resilience.

The research was undertaken during the height of the COVID-19 pandemic in 2022. During this period (2021-2022) educators, learners, and parents were anxious about the future of the education sector as many schools were forced to close due to failure to transition to online teaching and learning. It is possible that the learners' experiences, challenges and the coping strategies they employed were informed by the challenges the pandemic posed to the education sector at the time. It is recommended that researchers replicate this study in diverse contexts to enhance the generalizability of the findings.

Furthermore, the interviews were conducted in English. This is a limitation as the learners' home language was not English. The use of English might have impacted how the learners understood and answered the questions. To counter this challenge, the lead researcher (HS) allowed the learners to respond to questions in their home languages (IsiZulu). For future studies, it is recommended researchers consider translating research tools into languages spoken by locals. This will help enhance the credibility and dependability of research findings and conclusions." Page 15, lines 648-667

Comment 8: Throughout the article, the writing style requires attention. Some sections are repetitive, and there are syntactic and grammatical errors. Redundancies such as "as mentioned earlier" and long, complex sentences should be revised. The manuscript would benefit from careful language editing to enhance clarity, precision, and academic tone. The reference list is extensive but needs to be checked for consistency and formatting errors.

Response 8: Thank you for pointing out the issues with our text presentation. We used this opportunity to edit and collapse some texts. We are hopeful the manuscript now read much better.

4. Response to Comments on the Quality of English Language

Point 1: The English is fine and does not require any improvement.

Response 1: Thank you for positive feedback, we have used this second opportunity to read through the manuscript to address language errors picked by the other reviewers.

5. Additional clarifications

None. We would like to thank this reviewer for the detailed comments and suggestions.