

The Effects of Competency-Based Mathematics Teaching Methods on Students' Academic Achievement in Public Secondary Schools

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Abstract

This study explored the effect of competency-based mathematics teaching methods on academic achievement in public secondary schools. The researcher employed a mixed method research approach with a concurrent research design. The population of the study involved heads of schools, mathematics teachers and students from selected public secondary schools. The sample size was 120 participants (5 heads of schools, 15 mathematics teachers and 100 students). The sample was selected by using the purposive sampling technique to select the mathematics teachers and heads of schools while stratified random sampling technique was used in selecting students. The study used interview, questionnaires and focus group discussion as data collection methods. The qualitative data collected were analyzed by using content analysis technique while quantitative data were analyzed descriptively through SPSS version 29.0. The findings revealed that competency-based teaching methods has effect on students' academic achievement in mathematics. It increased students' mathematics performance, level of understanding and application of mathematical concepts in other field, ability to solve mathematical problems, level of critical thinking and reasoning as well as level of participation in mathematics lessons. It is concluded that competency-based teaching approaches in mathematics are essential for students' academic achievement, especially in mathematics. It is recommended that, the government should provide the necessary resources and conducive environment for the implementation of CBT methods.

Keywords: *Competency, teaching methods, mathematics education, academic achievement.*

1.0 Introduction

In recent years, the effectiveness of mathematics education in public secondary schools has become a pressing concern (Mwamwenda, 2019). Students have been facing challenges in mastering mathematics competences, resulting in low academic performance and high failure rates in national examinations (Mazana, Montero & Casmir, 2020). The problem of low mathematics performance is critical as it does not only affect individual students' future opportunities but also affects the overall educational quality and workforce preparedness. However, the issue raised on the problem of low mathematics performance is the implementation of competency-based mathematics teaching methods.

In order to ensure the well implementation of competency based teaching methods, Tanzanian government through MoEST has made various efforts such as providing seminars to mathematics teachers, on job training, supporting Mathematics Teachers Association (MAT) by supporting them to conduct their seminars and workshops, provision of mathematics books, employing mathematics teachers and building classrooms to ensure that competency-based teaching methods is well implemented and improved mathematics education (Murithi & Murithi, 2018). Despite all the efforts made, students continue to struggle in developing a solid foundation in mathematics (Mohamed & Karuku, 2017).

There is low students' mathematics performance in Certificate of Secondary Education Examination and Form Two National Assessment, (National Examinational Council of Tanzania, 2023). Despite the fact that the government of Tanzania has been showing the efforts and initiatives to ensure the well implementation of competence-based teaching approaches, its effect on students' academic achievement, especially in mathematics is not well addressed.

Globally, researches indicate that competence-based teaching methods, which emphasize practical skills and real-world applications, can lead to improved student engagement and performance (Kiliku, 2016; Rainwater, 2016; Martinez & Brown, 2018). Studies conducted in developed countries have shown that these methods promote critical thinking and a deeper understanding of mathematical concepts (Kohn, 2016).

Locally, research on the effectiveness of competence-based teaching in Tanzania, particularly at the secondary level, remains scarce. Some studies have highlighted general pedagogical challenges but have not specifically addressed the effect of competence-based methods on mathematics achievement (for example, a study by Mwamwenda, 2019; Commins & Davis, 2017; Komba & Mwandanji, 2015). The lack of focused research presents a gap in understanding how these teaching strategies can be effectively implemented in the local context. Consequently, there is a need to explore the specific effects of competence-based mathematics teaching methods on students' academic achievement in public secondary schools. The primary research question guiding this study is: How do competence-based mathematics teaching methods influence the academic achievement of students in public secondary schools?

2.0 Materials and Methods

2.1 Research Approach and Design

This study employed a mixed method research approach. The mixed research approach was used as it allows for a comprehensive understanding of the effects of competence-based mathematics teaching methods. By combining both qualitative and quantitative methods, the study captured numerical data on students' mathematics performance while also exploring teachers' and students' perceptions and experiences. This dual perspective enriched the analysis, providing deeper insights into the contextual factors that influence academic achievement. Additionally, using mixed method research approach enhanced the validity of the findings, as it triangulated data from different sources to create a more nuanced understanding of the educational dynamics.

Concurrent research design was used under this study. This research design was employed to gather qualitative and quantitative data simultaneously, allowing for a comprehensive analysis of competence-based mathematics teaching methods. Using questionnaire to collect numerical data on student performance alongside interviews and focus group discussions for qualitative insights into teaching practices, it was effectively compared and contrasted findings. This integration enhanced the depth of understanding, providing a richer context for the data and facilitated a more thorough exploration of how these teaching methods influence academic achievement among students.

2.2 Participants

The target population of this study was heads of schools, mathematics teachers, and students from five selected public secondary schools. Sample size of the study was 120 participants (5 heads of schools, 15 mathematics teachers and 100 students). Purposive sampling technique was used in obtaining mathematics teachers and heads of schools while stratified random sampling techniques were used in obtaining students.

2.3 Data Collection Methods

In this study, questionnaires, interviews and focused group discussion were used for collection of data. The goal of data collection is to capture all quality evidence that allows analysis to lead the formulation of convincing and credible answers to the questions that have been posed (Kothari, 2004). In collecting data, no single data collection technique is considered adequate for collecting valid and reliable data. Therefore, it is advisable to use different methods of data collection. That is why triangulation of the data collection methods was seriously considered for the purpose of ascertaining the authenticity of the data.

2.4 Data Analysis and Ethical Considerations

In this study data were analyzed by qualitative and quantitative methods. The data that were obtained through interviews and focused group discussion were analyzed through thematic analysis. The researcher coded the data in order to develop categories and finally the results were interpreted and presented in descriptive and narrative way. The information collected from the field through the questionnaire was analyzed by using the Statistical Package for Social Sciences (SPSS, version 29.0).

Ethical issues were considered in three aspects, before collecting data, during the data collection process as well as during data analysis and presentation. Before data collection the researcher asked and received the permission letter from Ruaha Catholic University which introduced him to the area of study starting to the Regional Administrative Secretary (RAS). Thereafter researcher collected letter of permission from the District Executive Director (DED) which was used to introduce him to the heads of schools. During data collection, the researcher informed the informants about the purpose of the study, that it is voluntary nature of participating and it was

for academic purpose and not otherwise. The researcher also ensured confidentiality of the respondents by ensuring privacy of the information provided. The different symbols were used to represent the study locale and the participants who provided views in response to the study questions. Furthermore, during data analysis and presentation the researcher presented and analyzed the data collected in regard to the respondents' perception and their views.

3.0 Findings and Discussions

The study findings revealed effect of competency-based mathematics teaching methods on academic achievement in public secondary schools. The explored effects were such as increase on student's mathematics performance, leads to the achievement of competencies useful for solving real- life problems, students' understanding and application of mathematical concepts as well as promoting students' participation in mathematics lessons. The findings are presented in Table 1 and discussed hereunder.

Table 1: MTs' Responses on the effect of competency-based mathematics teaching methods on students' academic achievement in public secondary schools (N=13)

Sub-theme	Disagree	Agree
Increase students' mathematics performance	3(23.1%)	10(76.9%)
Transition from memorization to achievement of competencies useful for solving real- life problems	00(00%)	13(100%)
Leads to students' understanding and application of mathematical concepts	00(00%)	13(100%)
Promotion of students 'participation in mathematics lessons	00(00%)	13(100%)

Source: Field data (2024)

3.1 Increase on Students' Mathematics Performance

The findings showed that 76.9% of the respondents agreed that competency-based mathematics teaching methods lead to the increase of students' mathematics performance. Appropriate implementation of mathematics competence-based teaching methods establishes critical thinking

among students in public secondary schools which enable students to easily grasp mathematics concepts and hence increase in mathematics performance.

Similarly, the findings obtained from the interviews with HoS indicated that CBT play a great role in enhancing students' achievement in mathematics. This was evidenced when HoS from school A was quoted saying: *“Currently in four recent years, the government has been putting more efforts on the implementation of CBT. It is observed that students' achievement in mathematics was improved and strengthened curiosity rate and creativity among the students”* (Interview: HoS A.19th February, 2024).

Also, the findings obtained through FGDs with students indicated that CBT creates a sense of self-struggle among students a situation which helps them in solving mathematical errors and problems. The methods which were employed by mathematics teachers made students to be creative as students in the FGD 2 from public secondary school B said:

Our mathematics teachers prefer to use small group discussion, brainstorming and independent study when they are teaching us mathematics. We are very motivated with the methods used by our teachers. The method helps us to grasp mathematics concepts hence improving our mathematics competencies (FGD 2: Students from school B, 20th February, 2024).

The findings obtained from the HoS indicate that competence-based teaching methods have an effect on students' mathematics performance. Increasing students' mathematics performance through competence-based teaching methods involves shifting the focus from rote memorization to deeper understanding and application of concepts (Adams, Cummins & Davis, 2017). This approach encourages active participation and critical thinking, which are essential for mastering mathematical skills. Engaging students in real-world scenarios and collaborative learning, competence-based methods foster a more meaningful connection to the material, enhancing motivation and retention.

The findings are consistent with Komba and Mwandaji (2015) who stipulated that when competence-based curriculum (CBC) is appropriately implemented and teachers employ the required competence-based teaching approaches, students' performance may increase comparing to those who employ traditional teaching approaches. Also, Murithi (2018) conducted a study in Kenya and assessed the effectiveness of the CBC approaches in teaching mathematics in Kenyan secondary schools. The study found that CBC method had effect on students' mathematical competencies, and improved their motivation and engagement in mathematics. The researchers recommended the incorporation of CBC teaching methods in mathematics curriculum to improve students' performance in mathematics.

Competency-based methods often incorporate formative assessments that provide immediate feedback, allowing students to identify their strengths and weaknesses. This ongoing assessment helps tailor instruction to meet individual learning needs, ultimately leading to improved academic achievement. As students become more confident in their abilities and develop a stronger foundation in mathematics, their overall performance in assessments and examinations is likely to rise, contributing to better outcomes in public secondary schools.

3.2 Transition from Memorization to the Achievement of Competencies Useful for Solving Real Life Problems

Competence-based teaching methods shift the focus from rote memorization to developing practical skills and knowledge that students can apply to real-life situations. These methods emphasize understanding concepts deeply rather than just recalling facts, which prepares students to tackle complex problems outside the classroom. Kiliku (2016) pinpointed that by integrating real-world examples and encouraging critical thinking, students learn to use their knowledge in meaningful ways. This approach also fosters adaptability, as students become equipped with the competencies needed to navigate diverse challenges and scenarios.

In the question posed to respondents in which it sought to find out if competence-based teaching methods led to the transition from memorization of content to the achievement of skills and competencies useful for solving real life problems, the findings showed that 100% of the respondents have a positive view with the statement. Likewise, the findings from interviews conducted with HoS revealed that CBT was very useful for students in being knowledgeable and

skillful in solving real life problems rather than the former content-based teaching. This was evidenced when HoS said:

Traditional methods of teaching which was more content oriented rather than skills development. The students were graduating from schools, colleges and universities with contents and not with life skills which made them to be jobless people in the society. Therefore, introduction of CBT methods in Tanzanian schools it serves as the solution of our education challenges of preparing students to memorize rather than developing life skills which is potential for solving the world challenge of unemployment for the youth. (Interview, HoS, School D on 22th February, 2024).

Students through FGDs, had insights regarding the transformation from content based to competence based in which they explained that the approach makes them to be creative. Students added that through the concepts gained from mathematics as a result of the implementation of CBT; they were capable in conducting small scale businesses as students from school C said:

We are very motivated with mathematics subject because some of the topics which we learn in mathematics subject are useful in our day to day lives for example Accounts it helps us to develop the skill of how to establish and manage business after school life. (FGD 1: Students from school C. 21st February, 2024).

Through data collected from questionnaires interview and FGDs shows that, competence-based teaching methods led to the transition from memorization of content to the achievement of skills and competencies useful for solving real life problems. These findings concur with Mwamwenda (2019) who conducted a study on the effects of the Competency based curriculum on teaching and learning in secondary schools in Tanzania. The study established that the transition from memorization-focused learning to competency-based teaching methods represents a significant paradigm shift in education. The findings highlight the tangible benefits of this approach,

including improved problem-solving skills, increased independence, and better preparation for real-world challenges. Solving real-life problems is a key effect of competence-based mathematics teaching methods, as these approaches emphasize the practical application of mathematical concepts. Connecting classroom learning to real-world scenarios, students develop critical thinking and analytical skills that are essential for addressing everyday challenges. When students engage in problem-solving activities that mirror real-life situations, they learn to apply mathematical theories and techniques to find solutions. This relevance not only enhances their understanding but also increases their motivation and interest in the subject. As they see the practical value of mathematics, students are more likely to invest effort in their studies, leading to improved academic achievement.

3.3 Improvement of Students' Understanding and Application of Mathematical Concepts

The findings as presented in Table 1 showed that 100% of the respondents agreed with the statement that Competency-based teaching methods lead to students' understanding and application of mathematical concepts. Competence-based teaching methods enhance students' understanding by focusing on deep comprehension of mathematical concepts rather than surface-level memorization. These methods involve active learning, where students engage in problem-solving, exploration, and hands-on activities that reinforce their grasp of mathematical ideas.

The findings obtained from the interviews with head of school (HoS) revealed that CBT enhances student's academic achievement in mathematics since it fuels students' understanding of mathematics concepts. When students' understanding increases, they become capable in solving life problems and compete in the world of science and technology. This was evidenced when HoS said:

In Tanzania almost four years the CBT policy was in pick of implementation in secondary schools. Creativity to our students was improved; they are able to apply what they have learnt in classes for real –life situation. I belief the CBT methods is more preferred in this world of science and technology, since it is

going to solve the problem of unemployment to many people and our graduates. (Interview: HoS B. 20th February, 2024).

Generally, the findings revealed that implementation of competence-based teaching methods in mathematics education has brought about a shift from traditional rote learning to a more holistic approach. The findings were similar with Martinez and Brown (2018) who explained that emphasizing understanding; application, and critical thinking, teachers are helping students develop a deeper comprehension of mathematical concepts. Also, in explaining CBT effects on students the study highlighted the positive effects on students' understanding and retention of mathematical concepts. The hands-on and practical approach of CBC methods enhances students' comprehension and retention of key mathematical concepts, contributing to a deeper understanding of mathematics competencies. Furthermore, the findings correlated with the study by Kirai and Kogo, (2017) who showed that the CBC approaches have a significant positive effect on student's mathematical competencies. The researcher recommended the adoption of CBC methods in schools to enhance the quality of education and improved students' performance in mathematics.

As students actively participate in their learning, they develop a deeper comprehension of core concepts rather than merely memorizing procedures. This understanding enables them to connect different mathematical ideas, recognize patterns, and apply their knowledge in various contexts. Furthermore, competence-based methods often include formative assessments that provide immediate feedback, helping students identify areas for improvement and reinforcing their learning process. Ultimately, by enhancing students' conceptual understanding and practical application of mathematics, these teaching methods lead to greater confidence and improved academic performance, equipping students with the skills necessary for future challenges.

3.4 Promotion of Students' Participation in Mathematics Lessons

The findings in Table 1 showed that 100% of the respondents have a positive view with the statement that mathematics teachers' implementation of CBT methods promotes students' participation in mathematics lessons. Competence-based teaching methods encourage active participation by making mathematics lessons more engaging and relevant to students' lives.

These methods often include interactive activities, group work, and problem-solving tasks that require students to actively engage with the material. By involving students in discussions and hands-on projects, they become more invested in their learning process. Additionally, the focus on real-life applications and personalized learning allows students to connect with the content, making them more motivated to participate and contribute during lessons.

Also, the findings obtained through the interviews with HoS revealed that when mathematics teachers employ and implement CBT students actively participate in teaching/learning process. HoS had this to say:

What I know implementation of CBT policy helps students to be motivated and fully engaged in lessons since the CBT methods emphasize students centered rather than teacher centered methods. Therefore, students are more motivated to be involved in a lesson hence they feel their responsible to take part of participation in mathematics lesson. This situation helps students to succeed academically in mathematics (Interview: Head of School A. 19th February, 2024).

Additional response, researcher obtained from students FGDs, students had this to say:

During mathematics lessons our teacher involved us in the process of teaching. They assign us some tasks to discuss in small groups and also provided to us independent take home assignment. The way our teacher taught us it motivates most of the students to participate in mathematics lesson and it helps us to become competent in mathematics subject (FGD: Students from school C. 21th February, 2024).

The findings revealed that competence-based teaching methods focus on developing students' skills and understanding rather than just memorizing facts. The results concur with Parker, Rubin, Erath, Wojslawowicz, and Buskirk (2015) who found that mathematics competence teaching approach encourages active participation as students are challenged to think critically

and apply their knowledge. Increased participation in mathematics lessons suggests that students are more engaged and motivated to learn. This can lead to better retention of mathematical concepts and improved performance overall.

Competency-based teaching methods encourage collaboration, discussion, and active engagement, allowing students to share their ideas and work together on mathematical problems. This participation fosters a sense of ownership over their learning, making students feel more invested in the subject matter. Incorporating activities such as group work, hands-on projects, and real-life problem-solving scenarios, students are motivated to engage more deeply with the material. This approach not only helps to break down traditional barriers to participation, such as fear of making mistakes, but also promotes a supportive classroom culture where students feel comfortable expressing their thoughts and questions.

Increased participation leads to greater opportunities for peer learning and diverse perspectives, enhancing understanding and retention of mathematical concepts. As students actively contribute to discussions and collaborate on tasks, they develop essential skills such as communication, critical thinking, and teamwork, which ultimately contribute to improved academic achievement in mathematics.

4.0 Conclusions

Conclusions on the effect of competency-based mathematics teaching methods on academic achievement in public secondary schools suggest that competency-based mathematics teaching methods significantly enhance students' academic achievement by fostering a deeper understanding of concepts and their practical applications. Students are more engaged and motivated, which leads to improved problem-solving skills and better performance in mathematics. The shift from rote memorization to active learning and critical thinking has shown to increase students' ability to tackle complex problems both in exams and in real-life situations.

5.0 Recommendations

Recommendations include the widespread adoption of competence-based teaching methods in public secondary schools to enhance mathematics education. Teachers should be trained to implement these methods effectively, ensuring lessons are interactive, relevant, and tailored to

meet the diverse needs of students. Continuous assessment and feedback should be integrated to monitor progress and address challenges promptly. Also, the curriculum should be designed to connect mathematical concepts with real-world applications, making learning more meaningful and engaging for students.

Additionally, there should be sustainable program of providing teaching and learning resources such as enough TIE mathematics books, mathematics equipments and also adequate classrooms and library.

References

- Adams Becker, S., Cummins, M., & Davis, A. (2017). NMC horizon report: Higher education edition. Austin, Texas: The New Media Consortium. *Cuaderno Activa*, 9, 171.
- Kiliku, E. (2016). Effects of competency-based curriculum teaching methods on students' mathematical competence: A study in Dar-es-salaam, Tanzania. *Journal of mathematics Education*, 30(2),78-92.
- Kirai, N., & Kogo, B. (2017). The impact of competency-based curriculum on the Acquisition of mathematics competencies among secondary school students: A study in Kenya. *Journal of Educational Research and Practice*, 20(3), 45-59.
- Kohn, A. (2016). *The future of competency-based education*. Pearson Publications
- Komba, S. C., & Mwandanji, M. (2015). Reflections on the implementation of competence-based curriculum in Tanzanian secondary schools. *Journal of Education and Learning*, 4(2) 234-243. Retrieved on 19th September, 2024 from <https://doi.org/10.5539/jel.v4n2p73>
- Kothari, C. (2004). *Research methodology: Methods and techniques*. New Age International (P) Ltd

- Martinez, S., & Brown, L. (2018). Improving understanding and retention of mathematical concepts through competency-based curriculum teaching methods: A study in Australia. *Journal of Educational Research*, 32(4), 78-92.
- Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2020). Assessing students' performance in mathematics in Tanzania: The teacher's perspective. *International Electronic Journal of Mathematics Education*, 15(3), 570-589. Retrieved on 30th June, 2024 from <https://doi.org/10.29333/iejme/7994>
- Mohamed, M., & Karuku, S. (2017). Implementing a competency-based curriculum in science education. *Journal of Education and Humanities* 2(1)101–118. Retrieved on 20th July, 2024 from https://doi.org/10.1007/978-94-6351-089-9_7
- Murithi, P., & Murithi, M. (2018). Assessing the effectiveness of the competency-based curriculum approach in teaching mathematics in Kenyan secondary schools. *Journal of Mathematics Education*, 25(2), 112-128.
- Mwamwenda T.S. (2019). The impact of the competency-based curriculum on teaching and learning in secondary schools in Tanzania. *Journal of Educational Policies and current Practices*, 2(2), 227-250.
- Parker, J. G., Rubin, K. H., Erath, S. A., Wojslawowicz, J. C., & Buskirk, A. A. (2015). Peer relationships, child development, and adjustment: A developmental psychopathology perspective. *Journal of Developmental Psychopathology*: 1(3) 419-493.
- Rainwater, T. (2016). Teaching and learning in competency-based education courses and programs: faculty and student perspectives. *The Journal of Competency-Based Education*, 1(1), 42–47. <https://doi.org/10.1002/cbe2.1008>