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Attitude of mathematics students towards integrating GCEd: a quantitative study using the tripartite attitude model

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ABSTRACT

Global citizenship education (GCEd) fosters global awareness and sustainability within mathematics education by highlighting its role in solving global challenges. This quantitative study, grounded in the tripartite attitude model, examines how mathematics students at Institute of Teacher Education Malaysia (IPGM) perceive and integrate GCEd. The 18-item questionnaire, based on the tripartite attitude model, examines emotional response, knowledge, and implementation tendency. Findings show that students generally have a positive attitude towards GCEd integration (M=4.01, SD=0.59) and recognize its importance in fostering critical thinking and social responsibility (M=4.03, SD=0.54), but their understanding remains moderate (M=3.56, SD=0.76). They emphasize the need for professional development and institutional support (M=4.20, SD=0.65) to ensure effective implementation. A significant positive correlation was found between knowledge of GCEd and attitude towards its integration ($r=0.65$, $p<0.001$) suggests that deeper understanding enhances receptiveness. While students acknowledge GCEd's value in mathematics education, additional resources and training are necessary for its successful incorporation. Strengthening support systems through targeted educational programs and institutional initiatives will better equip future educators to integrate GCEd principles, promoting global awareness and responsibility among learners.

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1. INTRODUCTION

Globalization has brought about a major change in the way we view education, with a growing emphasis on learning that transcends national and cultural boundaries [1]. Modern education now aims not only to produce students who excel in academic fields but also to prepare them to face the challenges of an increasingly complex world [2]. In this context, the integration of the values of global citizenship into the curriculum of education is becoming increasingly important to train students to become responsible and sensitive citizens of the world to global issues [3]. Recent studies have explored this integration within various subject domains, such as geography education [4] and in-service teacher training [5].

Mathematics is one of the major subjects in education and has great potential to support global citizenship education (GCEd). Mathematics not only serves as a universal language that facilitates

communication between different cultures, but is also an important subject in solving global problems [6]. By integrating the values of global citizenship into mathematics teaching, students can learn how mathematical concepts can be used to understand and solve global issues such as climate change, social injustice, and public health [7].

However, the implementation of the integration of global citizenship values into the mathematics curriculum has its challenges. A compact math curriculum and pressure to high academic results often hamper efforts to incorporate elements of global citizenship into mathematics teaching [8]. Besides, the lack of resources and training for teachers in implementing this integration is also a problem that needs to be addressed [9]. Thus, the study seeks to understand how the integration of the values of global citizenship can be implemented more effectively in the mathematics curriculum at Institute of Teacher Education Malaysia (IPGM), with the aim of developing strategies capable of addressing these challenges [10].

Teachers play an important role in the implementation of science, technology, engineering, and mathematics (STEM) education in schools, where they are responsible for ensuring effective learning approaches in these subjects [11]. In this context, mathematics education involves not only teaching mathematical concepts but also delivering essential skills that are relevant to today's global challenges [6]. At the IPGM, mathematics teachers have an additional responsibility to integrate the values of global citizenship into their curriculum, which is the main focus of this study [12].

The integration of the values of global citizenship into the math curriculum aims to form students who are not only skilled in mathematics but also sensitive to global issues and able to solve problems involving a global perspective [8]. Therefore, this study aims to examine mathematics students' attitudes at the IPGM toward the integration of GCEd using the tripartite attitude model. This investigation is expected to provide insights into how these students perceive the relationship between mathematics and global citizenship [13]. Assessment of this attitude is important to ensure that students not only acquire mathematical skills but also develop attitudes that support global thinking and complex problem-solving [8].

This study applies the tripartite attitude model, as shown in Figure 1, which comprises affective (feelings), cognitive (knowledge), and conative (tendency) dimensions, to investigate future mathematics teachers' attitudes toward integrating GCEd at IPGM. The model provides a structured lens to examine emotional responses, conceptual understanding, and behavioral intentions related to GCEd in mathematics education. While most existing studies have addressed GCEd in general education or social science contexts, limited research has focused on its relevance and implementation within the mathematics curriculum. This study offers empirical insights into how teacher trainees perceive and are prepared to integrate global citizenship values into mathematics teaching in the Malaysian context.

A tripartite attitude model is a theoretical framework used to understand an individual's attitude to an object, idea, or situation, which consists of three main components: affective, cognitive, and behavioral. The affective component refers to the feelings or emotions felt by an individual toward something, such as feelings of liking or disliking mathematics [14]. The cognitive component involves beliefs or thoughts about such objects or situations, such as the belief that mathematics is essential in everyday life [15]. The behavioral component refers to the tendency or intention to act in a certain way towards an object or situation, for example, the willingness to spend extra time studying mathematics [16].

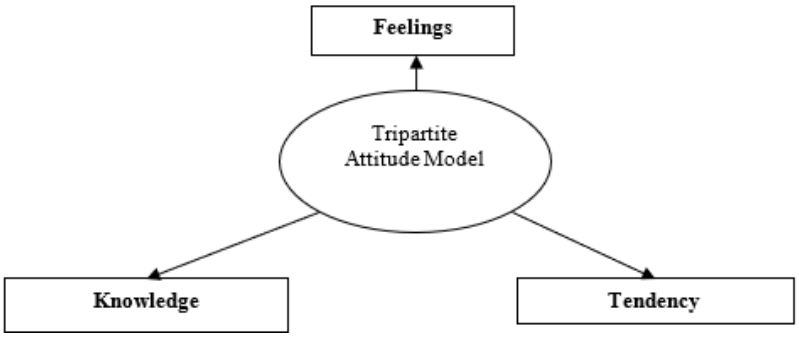

Figure 1. Tripartite attitude model [14]

In the context of future teachers at the IPGM, the tripartite attitude model can be used to assess their attitude toward the integration of GCEd in the teaching of mathematics. The emotional component of future teachers may show positive or negative feelings about this integration, for example, feelings of pride or excitement when learning that mathematics can be used to solve global problems [17]. From a cognitive

point of view, future teachers may have a broader view of the importance of GCEd integration in mathematics teaching, such as understanding that math is not only for examination but also for understanding global issues such as climate change and the global economy [18]. The behavior of future teachers may also change, with increased interest in studying and teaching mathematics with GCEd integration as well as using that knowledge in GCEd-based projects [19].

An assessment of these three attitude components can help managers and educators at IPGM understand the overall attitude of future teachers towards GCEd integration in mathematics teaching, thereby enabling improvements in practice and teaching approaches. For example, a study can be conducted to assess the (affective) feelings of future teachers towards mathematics after integrating the GCEd elements into the curriculum [20]. Besides, an understanding of the beliefs and (cognitive) thinking of future teachers about the relevance of mathematics in solving global problems is also important [21]. Finally, the behavior and intentions (behavior) of future teachers such as the willingness to participate and carry out activities that require the use of mathematics in the context of GCEd can be assessed to discern the long-term impact of this endeavor [22].

The tripartite attitude model, Figure 2 in this study focuses on three key dimensions: feelings, knowledge, and tendency. These elements represent how students emotionally respond to GCEd, how much they understand its principles, and their willingness to implement it in teaching practices. This framework supports a comprehensive evaluation of attitudes.

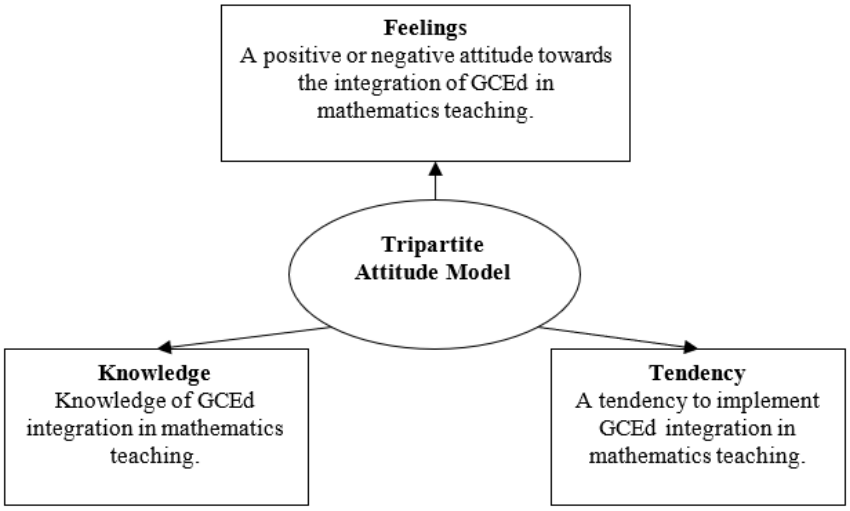

Figure 2. A study framework based on the tripartite attitude model

2. METHOD

The study uses a quantitative approach to assess the attitude of mathematics students toward the integration of the values of GCEd in mathematical teaching. Quantitative design is chosen because it allows for objective measurement and in-depth statistical analysis of the data collected [23]. The study involved 145 students of mathematics at the IPGM who were randomly selected. Simple random selection ensures that each student has the same chance to be selected, which increases the credibility and validity of this study [24]. This study also responds to bibliometric findings that highlight the need for empirical GCED research in Southeast Asia, particularly in teacher education [25].

The main instrument used in this study is a survey developed specifically to assess the attitude of students towards the integration of GCEd into the mathematics curriculum. The questionnaire contains 18 items covering three main dimensions based on the tripartite attitude model: feelings, knowledge, and tendencies. The tripartite attitude model, introduced by Rosenberg and Hovland [14], provides a comprehensive framework for understanding individual attitudes by separating the emotional (affective), cognitive, and tendency (Conative) components. The questionnaire, which employed a 5-point Likert scale, was reviewed and tested for face and content validity by experts in mathematics education and GCEd, ensuring its relevance and effectiveness in measuring student attitudes, with a Cronbach's alpha coefficient of 0.91 indicating high reliability [26]. The division of questionnaire items is as in Table 1.

Data was collected through surveys distributed to mathematics students at IPGM. Students are given sufficient time to complete the questionnaire, and their participation is voluntary. The data collected is analyzed using descriptive statistics and inference. Descriptive statistics are used to describe averages (mean), standard deviation (SD), and student scores for each dimension. Pearson correlation analysis was conducted to determine the relationship between students' understanding of GCEd and their attitude toward the integration of these values into the mathematics curriculum. This analysis helps to identify whether an improvement in understanding of GCEd is related to a more positive attitude towards the integration of these values [27]. The results of this analysis can provide a deeper insight into the factors that influence student attitudes and can be used to formulate effective proposals for improving the integration of GCEd in mathematics education.

Table 1. The tripartite attitude model is based on the knowledge, feelings, and tendencies of IPGM mathematics students integrating GCEd into the mathematics curriculum

Tripartite attitude model	Number of items	Items
Feelings (affective)	4	I believe that mathematics can contribute to the development of global citizenship values.
	5	The integration of a global perspective in mathematics teaching is essential.
	7	I'm very interested in global issues and current news.
	8	I believe my interest in global issues can be integrated into mathematics teaching.
	13	Integrating the principles of global citizenship can enhance student involvement in mathematics.
	15	I understand and appreciate local and international cultural diversity in the context of mathematics teaching.
Knowledge (cognitive)	1	I understand the concept of GCEd.
	2	I can explain GCEd in my own words.
	3	I see a connection between mathematical education and the values of global citizenship, though not taught in person.
	6	I can imagine how to integrate a global perspective into my mathematics teaching.
	16	I'm going to use an example or a global situation as a learning stimulus in a particular mathematical topic.
Tendency (conative)	9	I predict there will be a challenge in integrating the values of global citizenship into mathematics education.
	10	I feel the resources to support the integration of the values of global citizenship into adequate mathematics education.
	11	Only certain resources will help in integrating the values of global citizenship into my mathematics teaching.
	12	There is a need for professional development related to the integration of the values of global citizenship in mathematics education.
	14	I see myself integrating the principle of global citizenship into the teaching of mathematics in the future.
	17	I will involve the local community in teaching mathematics to promote awareness of global citizenship.
	18	I'm going to use technology to integrate the values of global citizenship into mathematics teaching.

3. RESULTS AND DISCUSSION

The perceptions of IPGM mathematics students regarding the integration of GCEd into the mathematics curriculum were assessed through 18 survey items structured according to the tripartite attitude model, comprising three components: affective (feelings), cognitive (knowledge), and conative (tendencies or behavioral intentions). The findings are presented in Table 2 (affective), Table 3 (cognitive), and Table 4 (conative), and reflect the students' overall attitudes toward GCEd integration based on their mean scores and SDs. As shown in Table 2, students demonstrated a generally strong affective orientation toward the integration of GCEd into mathematics education. The mean scores ranged from 3.94 to 4.30, indicating high levels of agreement. The highest-rated item was "The integration of a global perspective in mathematics teaching is essential" (M=4.30, SD=0.62), followed by "I believe that mathematics can contribute to the development of global citizenship values" (M=4.20, SD=0.60). These results suggest that students emotionally value the connection between mathematics and global citizenship, and show interest in global issues such as sustainability, human rights, and cultural diversity. This positive emotional reception supports the potential of mathematics education to act as a platform for global values education.

Table 3 provides a descriptive overview of students' cognitive understanding of GCEd. The mean scores for this component were slightly lower, ranging from 3.44 to 4.17, indicating a moderate level of conceptual understanding. While students agreed that they understood the concept of GCEd ("I understand the concept of GCEd", M=3.69, SD=0.73), they were less confident in articulating it independently ("I can explain GCEd in my own words", M=3.44, SD=0.86). On a more applied level, the item "I'm going to use a

global situation as a learning stimulus" scored higher (M=4.17, SD=0.59), indicating that although theoretical understanding may be limited, students can still apply GCEd when prompted. Overall, these results highlight the need for enhanced exposure to theoretical frameworks and clearer instructional examples in teacher education.

Table 4 focuses on the conative aspect, which reflects students' behavioral intentions and their readiness to act upon their attitudes. The results show a positive inclination, with mean scores ranging from 3.47 to 4.34. The highest scoring item was "I'm going to use technology to integrate GCEd into mathematics teaching" (M=4.34, SD=0.68), reflecting students' openness to digital tools in promoting global citizenship. Another highly rated item was "There is a need for professional development" (M=4.20, SD=0.65), suggesting students are aware of the need to further develop their capacity. In contrast, lower ratings for items related to resource adequacy (item 10, M=3.47, SD=0.96) suggest perceived institutional or infrastructural barriers. Nevertheless, the findings reflect students' readiness to implement GCEd values, given the right support and professional training. From Table 5, finding for attitude (affective) the overall mean score is 4.01 (SD=0.59), with the highest agreement (M=4.20, item 4: "I believe that mathematics can contribute to the development of global citizenship values" and item 12: "There is a need for professional development related to the integration of the values of global citizenship in mathematics education"). This reflects students' strong belief in the role of mathematics in fostering global citizenship and the necessity for training to enhance their competency in GCEd integration.

Table 2. A descriptive statistic for students' affective attitudes toward GCEd integration in mathematics

No of items	Items	Mean	SD
4	I believe that mathematics can contribute to the development of global citizenship values.	4.20	0.60
5	The integration of a global perspective in mathematics teaching is essential.	4.30	0.62
7	I'm very interested in global issues and current news.	4.14	0.75
8	I believe my interest in global issues can be integrated into mathematics teaching.	3.94	0.72
13	Integrating the principles of global citizenship can enhance student involvement in mathematics.	4.14	0.71
15	I understand and appreciate local and international cultural diversity in the context of mathematics teaching.	4.09	0.63

Table 3. A descriptive statistic for students' cognitive understanding of GCEd integration in mathematics

No of items	Items	Mean	SD
1	I understand the concept of GCEd.	3.69	0.73
2	I can explain GCEd in my own words.	3.44	0.86
3	I see a connection between mathematical education and the values of global citizenship, though not taught in person.	3.66	0.88
6	I can imagine how to integrate a global perspective into my mathematics teaching.	3.67	0.90
16	I'm going to use an example or a global situation as a learning stimulus in a particular mathematical topic.	4.17	0.59

Table 4. A descriptive statistic for students' conative intentions to integrate GCEd in mathematics teaching

No of items	Items	Mean	SD
9	I predict there will be a challenge in integrating the values of global citizenship into mathematics education.	4.19	0.71
10	I feel the resources to support the integration of the values of global citizenship into adequate mathematics education.	3.47	0.96
11	Only certain resources will help in integrating the values of global citizenship into my mathematics teaching.	3.59	0.99
12	There is a need for professional development related to the integration of the values of global citizenship in mathematics education.	4.20	0.65
14	I see myself integrating the principle of global citizenship into the teaching of mathematics in the future.	3.76	0.73
17	I will involve the local community in teaching mathematics to promote awareness of global citizenship.	4.07	0.73
18	I'm going to use technology to integrate the values of global citizenship into mathematics teaching.	4.34	0.68

Table 5. Descriptive statistics of IPGM mathematics students' knowledge, attitudes, and tendencies in integrating GCEd into the mathematics curriculum

Tripartite attitude model	N	Minimum	Maximum	Mean	SD
Knowledge (cognitive)	145	1.00	5.00	3.56	0.76
Feeling (affective)	145	2.50	5.00	4.01	0.59
Tendency (conative)	145	2.88	5.00	4.07	0.49

In terms of tendency (conative), the highest mean score is 4.17 (item 16: "I'm going to use an example or a global situation as a learning stimulus in a particular mathematical topic"), showing that students are highly inclined to incorporate real-world examples in their teaching. Additionally, a mean score of 4.07 (item 17: "I will involve the local community in teaching mathematics to promote awareness of global citizenship") suggests that students are open to engaging external communities in mathematics education. The overall mean score for tendency (conative), as presented in Table 3, is 4.07 (SD=0.49). This indicates a high level of inclination among students to integrate GCEd into mathematics teaching.

Figure 3 illustrates the relationship between GCEd knowledge (cognitive) and feeling (affective) among IPGM mathematics students regarding the integration of GCEd into the mathematics curriculum. The data indicated a strong positive correlation between these two variables ($r(145)=0.65$, $p<0.001$), indicating that students with a deeper understanding of the GCEd concept tended to have a more positive attitude toward integrating these values into mathematics education. This strong link emphasizes the importance of enhancing students' knowledge of GCEd, as a higher cognitive understanding is associated with stronger emotional engagement.

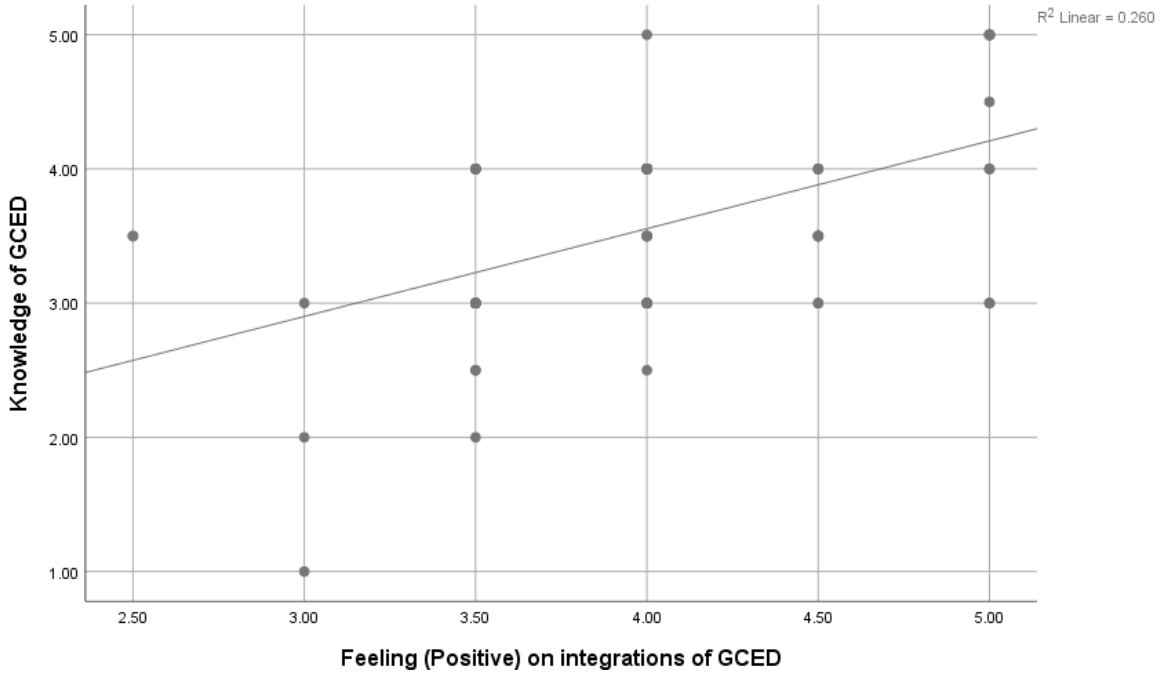

Figure 3. The relationship between GCEd knowledge (cognitive) and the feeling (affective) of IPGM mathematics students towards integrating GCEd into the mathematics curriculum

4. DISCUSSION

4.1. Student feelings for GCEd integration

Data analysis shows that the majority of students have a positive attitude towards the integration of GCEd into the math curriculum (M=4.01, SD=0.59). This reflects the students' positive reception and openness to global values and commitment to sustainability in mathematics education. Other studies show that positive acceptance of GCEd integration into the curriculum can enhance student global awareness and critical thinking [28], [29]. This aligns with the findings of Instefjord and Munthe [30], who observed similar patterns among preservice teachers. Banks [19] stated that multicultural education, which includes GCEd, helps students understand and appreciate cultural diversity, as well as complex global issues. Smith *et al.* [29] also affirmed that teachers who integrate GCEd into their teaching can help students become more responsible and ethical citizens of the world.

4.2. Student knowledge about GCEd integration

Despite the positive attitude of the students, their understanding of the GCEd concept was moderate (M=3.56, SD=0.76). This suggests there is room for improvement in the aspect of knowledge. This lack of knowledge may be due to a lack of exposure to the GCEd concept in existing curricula or a lack of relevant reference material. According to Corres *et al.* [22], in-depth knowledge of GCEd is essential to enabling

students to understand and appreciate cultural diversity as well as global issues. Corres *et al.* [22] also stressed that without adequate knowledge, efforts to integrate GCEd may not its objective of shaping critical thinking and social responsibility among students.

4.3. Student tendency to implement GCED integration

Students showed a high readiness to integrate GCEd into their mathematics teaching (M=4.07, SD=0.49). This trend suggests that students see the potential of GCEd values in enriching mathematics teaching and shaping critical thinking as well as social responsibility among their future students. According to Reimers [20], integrating GCEd into teaching can help shape knowledgeable, responsible, and ethical global citizens. Reimers [20] states that education that integrates GCEd can help students understand the relationship between global and local issues, as well as encourage them to take positive action in their communities.

4.4. Lack of resources and training

Based on finding, there is a shortage of effective resources and training for the integration of GCEd in mathematics teaching (M=3.47, SD=0.96). This is a major obstacle that educational institutions need to overcome. Without adequate resources and training, efforts to integrate GCEd may not be effective. According to Instefjord and Munthe [30], the provision of adequate resources and training is the key to the successful integration of GCEd into the curriculum. Instefjord and Munthe [30] stressed that teachers should be given relevant resources and training to help them teach GCEd in mathematics teaching effectively and build a deeper understanding of global issues.

4.5. Needs for professional development and institutional support

Students also stated the need for professional development and support from educational institutions related to the integration of the values of global citizenship in mathematics education (M=4.20, SD=0.65). This shows that students are aware of the importance of continued support on the part of the institution to ensure the successful implementation of the GCEd. Professional development can include specialized training, workshops, and seminars that focus on the integration of GCEd in mathematics education. According to Reimers [20], continuous professional development is essential in ensuring that teachers can teach GCEd effectively. Reimers [20] insists that without continuous professional development, teachers may not have the skills and knowledge necessary to integrate GCEd into their teaching effectively.

4.6. Relationship between knowledge and student attitude to GCEd

Data suggests that students who have a deeper understanding of the GCEd concept tend to have a more positive attitude towards the integration of these values into the mathematics curriculum ($r(145)=0.65$, $p<0.001$). This strong positive link emphasizes the importance of increasing students' understanding of GCEd in order to build a more positive attitude and better acceptance of GCEd integration into mathematics education. According to the literature, an in-depth understanding of global citizenship education (GCEd) is associated with increased awareness of global issues and a stronger tendency to act in positive ways toward societal challenges [31]. Greater comprehension of GCEd conceptual foundations has also been found to correlate with a higher appreciation of cultural diversity and stronger commitment to community action among learners [32].

5. CONCLUSION

Although this study shows that IPGM mathematics students have a positive attitude toward GCEd and are willing to integrate it into math teaching, there are some challenges to address. Lack of effective resources and training is a major issue that needs to be addressed. Furthermore, increased student understanding of the GCEd concept through continued professional development and institutional support is key to the successful integration of the values of global citizenship into mathematics education. Educational institutions should actively provide adequate resources and training to support students in effectively integrating GCEd into mathematics teaching. These findings are consistent with broader calls for sustainable education and ethical practices as promoted through GCED frameworks.

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AUTHOR CONTRIBUTIONS STATEMENT

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Siti Ainor Mohd Yatim		✓				✓		✓	✓	✓	✓	✓		
Norhafizah Miswan	✓			✓		✓				✓	✓			
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest, financial, personal, or institutional that could have influenced the outcomes or interpretation of this research. All authors have approved the manuscript and agree with its submission.

INFORMED CONSENT

Informed consent was obtained from all participants involved in the study. Prior to the data collection, participants were briefed on the research purpose, their rights as respondents, and the voluntary nature of their participation. No personally identifiable information was collected or reported.

ETHICAL APPROVAL

This study received ethical clearance from the Educational Research Application System (eRAS) of the Ministry of Education Malaysia and was approved by the Research Ethics Committee of Institut Pendidikan Guru Malaysia. All procedures involving human participants adhered to the institutional and national ethical guidelines, in accordance with the principles of the Declaration of Helsinki.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [SAMY]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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