Journal of Research and Advances in Mathematics Education

Volume 10, Issue 1, January 2025, pp. 15 – 27
DOI: 10.23917/jramathedu.v10i1.6374
p-ISSN: 2503-3697, e-ISSN: 2541-2590

Modeling the antecedents of integration of ethnomathematical perspectives into geometry teaching among faculty: A logistic regression analysis

Patrick Kyeremeh[1*], Francis Kwadwo Awuah[2], Daniel Clark Orey[3]

[1] *St. Joseph College of Education, Ghana*
[2] *Kwame Nkrumah University of Science & Technology, Ghana*
[3] *Universidade Federal de Ouro Preto, MG, Brazil*

Citation: Kyeremeh, P., Awuah, F. K., & Orey, D. C. (2025). Modeling the antecedents of integration of ethnomathematical perspectives into geometry teaching among faculty: A logistic regression analysis. *JRAMathEdu (Journal of Research and Advances in Mathematics Education),* 10(1), 15-27. https://doi.org/10.23917/jramathedu.v10i1.6374

ARTICLE HISTORY:
Received 19 August 2024
Revised 21 November 2024
Accepted 21 November 2024
Published 30 January 2025

KEYWORDS:
Ethnomathematics
Geometry teaching
Logistic regression model
Teacher educator
Higher education

ABSTRACT

The necessity for establishing links between school mathematics and students' personal lives and cultures, as enshrined in the ethnomathematics program, is being recognized and investigated in different regions across the globe. However, a comprehensive understanding of the antecedents that drive the integration of ethnomathematical perspectives into mathematics teaching among mathematics teachers is still limited. This cross-sectional survey aimed to address this gap by investigating whether the explanatory variables (such as gender, teaching experience, and religion) predict the mathematics teacher educators' incorporation of the mathematics found outside of school into geometry teaching. We included a sample of 128 mathematics teacher educators in the survey through cluster and quota sampling. A logistic regression model was employed to analyze the data garnered using a web-based questionnaire. Based on the findings, all three explanatory variables (gender, teaching experience, and religion) did not predict mathematics teacher educators' incorporation of mathematics found outside of school into geometry teaching. The findings would help key actors of mathematics education to re-examine their beliefs and practices about the incorporation of ethnomathematical perspectives into teaching that builds on students' socio-cultural experiences. Implications for teaching and future research are reported.

INTRODUCTION

In modern times, the need to forge a connection between school mathematics and students' personal lives and cultures, as articulated in the ethnomathematics program, is being acknowledged and investigated in different regions worldwide. This could partly be "due to the opportunities that ethnomathematics offers for students to learn mathematics in a more meaningful and engaging way by connecting academic mathematics to their experiences, culture, and environment" (Kyeremeh et al., 2023, p. 71). Ethnomathematics is a dynamic and holistic field that transcends traditional and cultural boundaries (D'Ambrosio, 2016). As a result, it progresses in a manner that is more closely aligned with reality and the individuals who are deeply engaged with it. Hence, its advancement will significantly enhance the field of academic mathematics in education.

The inclusion of ethnomathematics at all levels of mathematics education yields enduring advantages for students' mathematical performance, as it heightens the awareness that academic mathematics is value-and-culture laden and, as such, should be learned and taught in a way that

*Corresponding author: pkyeremeh39@gmail.com / pkyeremeh@joscobechem.edu.gh

shows connections. According to Orey and Rosa (2007, 2019), students see the connection of mathematics procedures and practices to their lived experiences when teachers' instructions encourage them to analyze mathematical activity within their social frameworks. By incorporating lived experiences and culture into mathematics education, students gain a deeper understanding of themselves, their culture, society, and reality. There exists inherent beauty in the understanding that arises when the cultural aspects of mathematics inside students' cultures are openly examined (Kyeremeh & Kwame, 2023).

Leveraging on the potentials of ethnomathematics, the new common Bachelor of Education [B.Ed.] mathematics program for Ghanaian colleges of education demands that teacher educators employ culturally relevant pedagogies (ethnomathematical perspectives) in teaching by considering and demonstrating respect for the sociocultural backgrounds of student teachers while designing and implementing their instructional strategies (Ministry of Education [MoE], 2018, 2017). This curriculum offers mathematics teacher educators the flexibility to adapt to local needs and contexts to help connect geometrical concepts to student teachers' culture, environment, and experiences, among other things, to make the course relevant/realistic to student teachers.

Ethnomathematics as a program delves into the interplay between mathematics and culture. In the pursuit of addressing human needs in a culturally sensitive and responsive manner, D'Ambrosio (2016) argues that individuals from different cultural backgrounds have consistently developed methods, processes, tactics, styles, arts, and techniques (techné/tics) for both practical and cognitive purposes. This is connected to the process of understanding and adapting to the natural, social, and cultural contexts (ethno). Ethnomathematics, therefore, pertains to examining the *tics*, which encompass the arts and techniques employed in mathematics, within diverse ethnos, encompassing both natural and societal contexts (Rosa & Orey, 2021).

It is agreed among the scientific community that a crucial element of mathematics instruction ought to reaffirm the individuality of students through social and cultural capital (Furuto, 2014; Rosa & Orey, 2023), which aligns with the principles of the ethnomathematics program. However, there is evidence of a notable absence of cultural relevance in the mathematics content and instruction (D'Ambrosio, 2001; MoE, 2017). However, a comprehensive understanding of the antecedents that drive the integration of ethnomathematical perspectives into mathematics teaching among mathematics teachers is still limited. This survey aimed to address this gap by investigating whether the explanatory variables (such as gender, teaching experience, and religion) predict the mathematics teacher educators' incorporation of the mathematics found outside of school into geometry teaching. Given this, we sought to answer the research question: Do explanatory variables (such as gender, teaching experience, and religion) predict mathematics teacher educators' incorporation of the mathematics found outside of school into geometry teaching?

Demographic factors that predict teachers' incorporation of ethnomathematical perspectives into teaching

Effective mathematics instruction establishes a strong connection between mathematics and students' real-life experiences and cultural background. Ethnomathematical techniques aim to enhance the relevance of classroom mathematics for learners by leveraging the surrounding environment to reinforce comprehension of mathematical concepts (Gerdes, 2014; Kyeremeh et al., 2024b). Exploring the socio-cultural milieu in which mathematics learning occurs is crucial for facilitating effective learning. This exploration is necessary to benefit students and teachers in learning.

Teachers' instructional decisions, including the selection of effective teaching perspectives in mathematics teaching, are influenced by demographic factors such as teaching experience, gender, religion, and so on. This supports Mabotja's (2022) assertion that demographic variables, including ethnicity and experiences, could influence teacher educators' integration of ethnomathematics. Hence, it is posited that these variables would exert a substantial impact on the comprehension of mathematics teacher educators about the incorporation of ethnomathematical perspectives into geometry teaching within the educational setting. The topics of gender, culture, and ethnomathematics were examined by Gilsdorf (2015). He observed the enduring pattern in Western culture of marginalizing women and their pursuits in the field of mathematics. He also noted that the marginalization of women in the field of mathematics within Western society has persisted for a considerable duration, spanning several centuries.

Women have historically faced both formal and informal exclusion from Western mathematics. For instance, until the early 21st Century, women were prohibited from attending Western universities. Additionally, there have been documented instances where women were specifically excluded from formal mathematical activities solely based on their gender (Gilsdorf, 2015). Gilsdorf lamented the persistence of those in contemporary society who maintain the belief that women and mathematics are incompatible. This phenomenon is prevalent throughout various domains of mathematical development, encompassing the topic of ethnomathematics as well. Consequently, gender possesses the inclination to impact how teacher educators integrate extracurricular mathematical concepts into their geometry instruction within the classroom setting.

In a mixed methods study conducted by Pradhan (2023), they examined the knowledge of ethnomathematics and the perception of Nepalese in-service teachers regarding the incorporation of ethnomathematics approaches in their teaching. The study also considered demographic characteristics such as gender, academic status, and teaching experience. The results of the study indicated that there was no statistically significant correlation between the gender of teachers and their comprehension of ethnomathematics. This finding indicates that there is a comparable level of comprehension among male and female mathematics educators regarding the ethnomathematics approach. Also, the study revealed a noteworthy correlation between the teaching experience of educators and their comprehension of ethnomathematics methodologies. Teachers' assessment of the usage of the ethnomathematics approach is influenced by their years of teaching experience.

In their study, Aikpitanyi and Eraikhuemen (2017) surveyed to examine the utilization of an ethnomathematics method by mathematics teachers in Nigeria. Although a considerable proportion of mathematics teachers indicated their utilization of the ethnomathematics approaches in their instructional practices, Aikpitanyi and Eraikhuemen observed no statistically significant disparity between male and female mathematics teachers in their adoption of ethnomathematics techniques. Khalil’s (2023) mixed-method study sought to present a comprehensive overview of educators' perceptions of ethnic mathematics, a pedagogical approach to school mathematics. It encompassed four primary dimensions: understanding of ethnic mathematics, the present degree of its incorporation in education, attitudes towards it as a pedagogical method, and barriers that hinder its integration. The findings showed that there are no statistically significant disparities in ethnomathematics integration related to gender or teaching experience. Khalil (2023) ascribed these findings to the uniformity of professional development programs received by all teachers.

Thakur (2019) conducted a cross-sectional study to investigate the notable variations in teachers' perspectives on the incorporation of ethnomathematics in secondary education across several categories of independent variables, including gender, religion, and teaching experience. The results indicated that there was no statistically significant variation found between the demographic variables and teachers’ perspectives on the incorporation of ethnomathematics. Nevertheless, the dearth or absence of study in this domain concerning the incorporation of ethnomathematics suggests that further investigation should be undertaken, focusing on the religious inclination of educators. In South Africa, Mutodi and Ngirande (2014) conducted a study to examine the perspectives of mathematics teachers about the utilization of tangible materials in the process of constructing mathematical significance. The results validated statistically significant disparities in the perception of concrete materials between male and female teachers. Nevertheless, the teacher's expertise did not exert a substantial influence on their perspectives regarding the utilization of tangible resources.

Existing literature suggests a scarcity of studies (Aikpitanyi & Eraikhuemen, 2017; Pradhan, 2023; Thakur, 2019) that examine the impact of demographic factors on mathematics teachers' integration of ethnomathematical perspectives (mathematical forms found outside of school) into school geometry in the classroom. Furthermore, these limited studies have specifically concentrated on examining mathematics teachers in secondary schools. This study aimed to address the existing knowledge gap by presenting empirical evidence from the standpoint of mathematics teacher

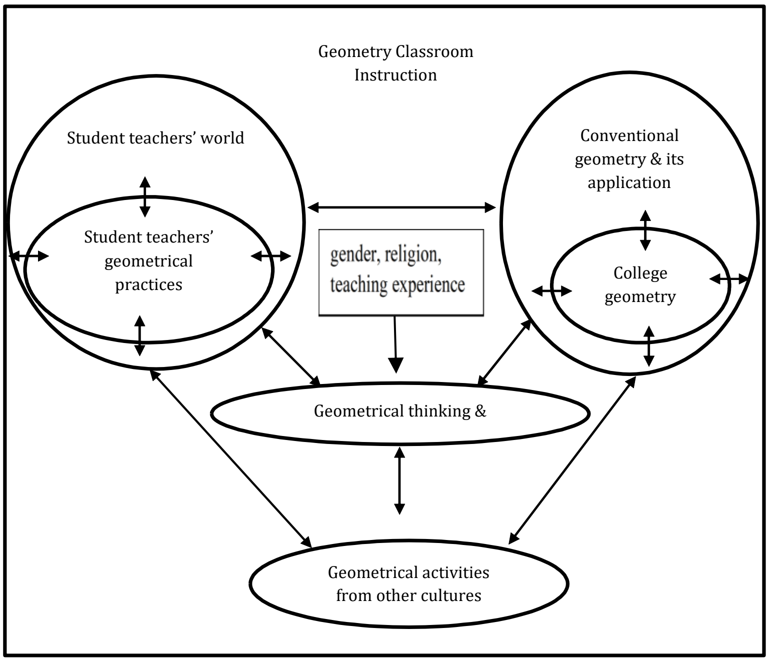

Figure 1. Conceptual Framework

educators regarding the demographic factors that predict the incorporation of ethnomathematical perspectives into school geometry instruction.

Conceptual framework

From an ethnomathematical standpoint, it is assumed that classroom instructions are inherently intertwined with the communities in which they are situated. Students enter school with pre-existing beliefs, conventions, and notions that they have acquired during their formative years. The implication is that students start from their own geometrical experiences and contexts they have from their own diverse cultures or environments; therefore, teachers are required to help students build upon these experiences and come to appreciate the need for more formal or classical applications in school geometry connected to real-life situations.

The framework for the geometry classroom framed by ethnomathematical perspectives that link geometrical activities in the students' culture and other cultures to conventional geometry (refer to Figure 1) used in this study is an adaptation of the ideas of both Adam (2004) and Alangui (2017). In Figure 1, the arrow between student teachers' world and conventional geometry and its application characterizes the relationship between college geometry and student teachers' geometrical experiences from their own culture and vice versa. Also, the arrows connecting the contextual framework of the student teachers' world and their geometrical practices serve to illustrate the reciprocal interaction between the practice and the context. The arrows connecting college geometry and conventional geometry, as well as their applications, illustrate the connection between the practical application of geometry at college and the broader context of conventional geometry and vice versa.

The arrow between student teachers' world, including their geometrical practices in their culture and geometrical activities from other cultures, characterizes the relationship between their cultural practice and the practice in other cultures and vice versa. The arrow between conventional geometry and its application and geometrical activities from other cultures characterizes the relationship between college geometry and geometrical activities from other cultures and vice versa. Mathematics teacher educators engage in geometrical thinking and practices by leveraging this rich knowledge to link geometrical activities in the students' culture and other cultures to conventional geometry. This ethnogeometric thinking is believed to be influenced by demographic factors such as gender, religion, and years of teaching experience (Pradhan, 2023; Thakur, 2019). Given this framework, it is possible to connect student teachers' geometrical experiences from their own culture and other cultures to college geometry during classroom instruction and that such connectedness is straightforward.

Although it is conceivable that the correlation between geometrical activities in culture and conventional geometry may be apparent, Alangui (2017) contends that these actions are inherently linked to established concepts in conventional mathematics. The framework facilitates the examination of cultural activities for their intrinsic geometrical elements, which are subsequently analyzed in connection to established geometry. The purpose of employing ethnomathematical perspectives in geometry classroom instruction, according to Adam (2004), is to among other things enable students to establish connections between their understanding of geometry and similar contexts beyond their personal experiences or culture through the use of geometric reasoning. This perspective enables students to cultivate a sense of worth and appreciation for the present knowledge.

METHODS

Study design

In this present study, a cross-sectional survey was employed. We chose to employ a survey on the viewpoint it allows for the collection of quantitative data on an extensive sample from a predetermined population in an attempt to determine the contemporary status of the phenomena being investigated for one or more variables (Asenahabi, 2019; Mathers et al., 2009). In this survey, we used the collected data from explorations to make inferences about the population of interest by employing statistics. Specifically, the survey was used to investigate whether the explanatory variables (such as gender, religion, and teaching experience) predict the outcome variable 'incorporation practices' using the logistic regression model.

Context and participants

This present study was carried out in 22 out of 32 Ghanaian public colleges of education affiliated with four traditional universities that teamed up to develop new teacher education curricula as part of Ghana's teacher education reforms. These colleges run a common B.Ed. curriculum developed by these four traditional universities supported by Transforming Teacher Education and Learning [T-TEL] under the supervision of the NCTE in Ghana. The purposive selection of these *sites is* because these colleges run the common B.Ed. program that demands that teacher educators employ culturally relevant pedagogies [ethnomathematical perspectives] (MoE, 2017, 2018), such as the incorporation of mathematics found outside of school into mathematics teaching.

The estimated population for the study was 192 mathematics teacher educators who teach in the 32 public colleges of education. To obtain a representative sample, we relied sample size adequacy recommendation by Gill et al. (2010) with a 95% confidence level and 5% confidence interval to obtain 128 mathematics teacher educators for the study. We clustered the 32 colleges of education by three belts (Coastal, Forest, and Savannah) and selected 22 using quota sampling to obtain a population-representative sample. Of these selected colleges of education, 18 had six mathematics teacher educators, while four had five mathematics teacher educators. Among these selected teacher educators, 73 participated in the web survey.

Data collection

Due to the lack of existing instruments to measure the construct "incorporation practices", the web-based questionnaire was self-developed. The existing body of literature on integrating ethnomathematical perspectives (e.g., Putra & Mahmudah, 2021; Rosa & Orey, 2012, 2020) provided valuable insights into the constructs of incorporation practices. To provide evidence on content validity, we presented the draft of the questionnaire to two other experts in the field of ethnomathematics for their expert judgment. Based on their suggestions, four items were revised. After the expert reviewers' comments on the instruments, we engaged four mathematics teacher educators in one-on-one interviews to share their thoughts and clarify issues while responding to the questions in the web-based survey. This was to help find out if respondents may understand the questions and choice of terminology used in the instruments. Based on the findings from the interview, we revised three items and returned them to the interviewees to determine if the revised questions were better.

We pre-tested the instruments among 20 selected mathematics teacher educators who were part of the sampling frame but not the sample to estimate its reliability. In estimating the reliability of the questionnaire based on the responses, Tayakol and Dennick (2011) recommend Cronbach's Alpha as the most suitable method for assessing the internal consistency of an instrument. In light of this, the study employed Cronbach's Alpha in measuring the internal consistency of scales for the questionnaire. The Cronbach's Alpha coefficient for the questionnaire sections was .80, indicating the acceptability of the instrument (Taber, 2018). The web-based structured questionnaire comprised of two sections: A, and B. Section "A" included three demographic questions. Section "B" consisted of 17 Likert-type items measured on four points ranging from strongly disagree to strongly agree, related to mathematics teacher educators' practices of incorporating mathematics found outside of school into geometry teaching.

In garnering data for this present study, we employed a web-based survey to reach out to participants to respond to questionnaires without our presence. The decision to use web-based surveys was to leverage its viability to reach out to large samples over a wide geographical area within a relatively short space of time (Callegaro et al., 2015). After securing permission from the Principals of the selected colleges of education to access mathematics teacher educators for study, we reached out to the heads of department with a cover letter, consent forms and link to a Google form inviting mathematics teacher educators to participate in the online survey. In line with this, the heads of the mathematics department were tasked to share the links to the survey on their various WhatsApp platforms and convince participants of the relevance of their voluntary participation in the study.

Data analysis

We first downloaded the Excel spreadsheet of the web-based survey responses and imported the data file into SPSS version 26. These extracted web-based questionnaires were edited for completeness and consistency. In analyzing the data, a logistic regression model was utilized to evaluate the prediction of explanatory variables (including gender, teaching experience, and religion) on the likelihood of mathematics teacher educators incorporating mathematics found outside of school into geometry teaching. The logistic regression model was employed due to its high permissibility regarding the inclusion of predictor variables (Pallant, 2016). This model allowed for the assessment of the suitability of explanatory variables, such as demographic factors, for predicting the outcome variable, which is 'incorporation practices' by differentiating between participants who integrate mathematics found outside of school in geometry teaching and those who do not. The dichotomous outcome variable in the logistic regression analysis was recoded as either 0 or 1. The outcome variable assumed a value of 1 when a mathematics teacher educator integrates the mathematics found outside of school into geometry teaching, whereas a value of 0 was assigned if a mathematics teacher did not integrate those forms of mathematics. The equation for the logistic regression model is given as follows:

$$p\,(y)=\frac{1}{1+e^{-(b_0+b_{1x1}+b_{2x2})}}$$

where p(y) stands for the likelihood of mathematics teacher educators incorporating mathematics found outside of school into geometry teaching, b is the coefficients of the predictors, and x is the predictor variables such as gender, teaching experience, and religion.

FINDINGS

In this present study, descriptive statistics (involving percentage, frequency, mean and standard deviation) were used to examine mathematics teacher educators' practices of incorporating the forms of mathematics found outside of school into geometry teaching. Participants' responses to each item in the web survey are shown in Table 1.

As shown in Table 1, the mathematics teacher educators' responses had mean and standard deviation scores that ranged from 1.68 to 1.99 and 0.00 to 0.47, respectively, with a mean of means

Table 1
Descriptive statistic of mathematics teacher educators' practices of incorporating the mathematics found outside of school into geometry teaching

Items	D	A	*M*	*SD*
	f (%)	*f* (%)		
1. I explore mathematical ideas from the student teacher's cultural background and environment to convey geometric concepts in the classroom.	6 (8)	67 (92)	1.92	0.28
2. I guide student teachers to examine the history of geometrical development in different cultures.	17 (23)	56 (77)	1.77	0.43
3. I engage in geometrical practices that originate from the student teacher's culture with those of school geometry.	9 (12)	64 (88)	1.88	0.33
4. I adjust geometry concepts to make classroom context more suited to the cultural backgrounds and environment of the student teachers.	8 (11)	65 (89)	1.89	0.32
5. I situate the teaching of geometry concepts in the classrooms in a cultural context involving the cultural values, norms, and beliefs of student teachers.	13 (18)	60 (82)	1.82	0.39
6. I engage the geometry teaching holistically through concrete experience.	6 (8)	67 (92)	1.92	0.28
7. I make concrete comparisons between school geometric concepts and local culture or environment in a classroom situation.	4 (6)	69 (94)	1.95	0.23
8. I make connections/links to student teachers' familiar practices and geometry concepts	3 (4)	70 (96)	1.96	0.20
9. I explain the relevance of learning each geometric concept to the student teachers' real lives in the classroom.	1 (1)	72 (99)	1.99	0.12
10. I elaborate geometric model in its different applications and contexts.	5 (7)	68 (93)	1.93	0.25
11. I provide an overview of student learning progress drawn from real activities, both inside and outside the classroom by employing various forms of assessment.	6 (8)	67 (92)	1.92	0.28
12. I explore the geometrical forms and patterns of traditional objects that constitute mathematical knowledge.	10 (14)	63 (86)	1.86	0.35
13. I prepare geometry teaching and learning materials from the local culture and student teachers' environment.	7 (10)	66 (90)	1.90	0.30
14. I lead student teachers to explore within the local culture some activities that have geometric aspects, such as students visiting building and carpentry sites, metalsmiths, etc. to observe and gather information by asking questions and experiencing these activities.	23 (32)	50 (68)	1.68	0.47
15. I encourage participation in school geometric activities related to perimeter, area, and volume, that were outside their experiences and culture to learn about and to use conventional mathematical systems, notations, and techniques.	5 (7)	68 (93)	1.93	0.25
16. I explore the local language or expressions that have geometric connotations.	23 (32)	50 (68)	1.68	0.47
17. I generate school geometry from cultural ideas and environment.	16 (22)	57 (78)	1.78	0.42
Mean of means			**1.87**	

Note. D–Disagree, A–Agree, *f*– frequency, *M*–Mean, *SD*–Standard Deviation; Mean value interpretation: 1.0–1.50 and 1.51–2.0 as not incorporated and incorporated, respectively

Table 2
Descriptive statistics of the number of cases in each categorical variable and their codings

			Parameter coding	
		Frequency	(1)	(2)
Years of teaching experience	1-5 years	22	.00	.00
	6-10 years	11	1.00	.00
	Over 10 years	40	.00	1.00
Religion	Christianity	58	.00	
	Islam	15	1.00	
Gender	Male	62	.00	
	Female	11	1.00	

Table 3
Collinearity statistics of the explanatory variables

		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		*B*	Std. Error	Beta	*T*	*p*-value	Tolerance	*VIF*
1	(Constant)	.98	.06		16.90	.00		
	Gender	-.04	.09	-.06	-.48	.63	.95	1.06
	Teaching experience	-.04	.04	-.12	-1.00	.32	.95	1.05
	Religion	.01	.06	.02	.18	.86	.98	1.02

Note. Dependent Variable: Practice_Category; *B*-intercept/coefficient of the constant, Std.-standard, *p*-probability, *t*- t-value, *VIF*- variance inflation factor

of 1.87. This means that mathematics teacher educators at the colleges of education, on average, incorporate the forms of mathematics found outside of school into geometry teaching. For example, 63 (86%) of the participants agreed with the statement 'I explore the geometrical forms and patterns of traditional objects that constitute mathematical knowledge', whereas 10 (14%) of them disagreed with the mean and standard deviation scores of 1.86 and 0.35, respectively. This suggests that most mathematics teacher educators explore the geometrical forms and patterns of traditional objects that constitute mathematical knowledge when teaching geometry in the classroom.

To investigate whether the explanatory variables (such as gender, teaching experience, and religion) predict mathematics teacher educators' practices of integrating mathematics found outside of school into geometry teaching using a logistic regression model. As with most parametric tests, preliminary analyses of the dataset are needed to ensure no violation of the assumptions underlying logistic regression analysis. In this direction, we conducted assumption testing to check for sample size, multicollinearity, and outliers where no serious violations were noted. To check for sample adequacy for each case in the predictors, we run descriptive statistics on each of the predictors. The results showed a limited case in the African Traditional category of the Religion predictor. As a result, we decided to collapse the African Traditional and Islam categories to form a single category in line with Pallant's (2016) recommendation. Table 2 presents the descriptive statistics showing the number of cases in each categorical variable and their codings.

From Table 2, it can be observed that out of the 73 mathematics teacher educators who participated in the online survey, 62 of them were males, while 11 were females. This shows that there were more male staff than we have females in the study. This finding is not surprising because of the vast disparity between male and female participation in mathematics programs in higher education in favor of males (Ibrahim et al., 2022; Vooren et al., 2022). We also performed a check to ensure that there was no multicollinearity among the explanatory variables. Table 3 presents the collinearity statistics of the explanatory variables.

From Table 3, it can be observed that the tolerance value for the explanatory variables ranged from 0.95 to 0.78, which is not less than 0.10; therefore, we have not violated the multicollinearity assumption. This is also supported by the *VIF* value, which ranged from 1.02 to 1.06, which is well below the cut-off of 10 (Pallant, 2016). Now, the model (set of predictor variables) was tested using

Table 4
Hosmer and lemeshow test goodness of fit for the model

Step	Chi-square	*df*	*p-value*
1	1.51	5	*.91*

Note. df- degree of freedom, *p*-probability

Table 5
How the model predicts the correct category

			Predicted		
			Practice Category		Percentage
	Observed		Low score	High score	Correct
Step 1	Practice	Low score	0	5	.0
	Category	High score	0	68	100.0
	Overall Percentage				93.2

Note. The cut value is .500

Table 6
Logistic regression predicting the likelihood of integrating mathematics found outside of school in geometry teaching

								95% *C.I.* for Odds Ratio	
		B	*S.E.*	Wald	*df*	*p*-value	Odds Ratio	Lower	Upper
Step 1[a]	Gender(1) [0=Male, 1=Female]	-.55	1.24	.20	1	.66	.58	.05	6.57
	Teaching experience [1-5 years]			.65	2	.72			
	Teaching experience(1) [6-10 years]	18.04	12094.53	.00	1	1.00	68410873.35	.00	.
	Teaching experience(2) [Over 10 years]	-.96	1.19	.65	1	.42	.38	.04	3.93
	Religion(1) [0=Christianity, 1=Islam]	.04	1.19	.00	1	.98	1.04	.10	10.60
	Constant	3.22	1.16	7.67	1	.01	24.92		

Note. Variable(s) entered on step 1: Gender, Teaching experience, Religion; **B**-intercept/coefficient of the constant, **S.E.**- standard error, **df**- degree of freedom, **p**-probability

the Hosmer and Lemeshow Goodness of Fit Test. Hosmer and Lemeshow's Goodness of Fit Test is considered the most reliable test of model fit (Pallant, 2016). Table 4 presents the Hosmer and Lemeshow Goodness of Fit Test results.

It is apparent from Table 4 that the model is acceptable and fits the data [Chi-Square=1.51, *df*=5, and *p*=0.91 (>0.05)]. Therefore, we conclude that the model containing all predictors was statistically significant, $\chi 2$ (5, N = 73) = 1.51, $p > 0.05$, indicating that the model was able to distinguish between participants who integrate mathematics found outside of school in geometry teaching and those who do not. Table 5 provides information about how well the model can predict the correct category (low practice score/high practice score).

As evident in Table 5, 68 cases are observed to have high scores and are correctly predicted to have high scores. However, 15 cases are observed to have low scores but were predicted to have high scores. The model correctly predicted 93.2% of the cases overall. The logistic regression results predicting the likelihood of mathematics teacher educators integrating mathematics found outside of school in geometry teaching are presented in Table 6.

As shown in Table 6, all three explanatory variables (gender, teaching experience, and religion) made no statistically significant contribution to the model (p>0.05). Thus, the model found all three explanatory variables not to be viable predictors [(gender, p = 0.66; 95% *C.I.* 0.05, 6.57), (teaching experience, p = 0.42; 95% *C.I.* 0.04, 3.93), (religion, p = 0.98; 95% *C.I.* 0.10, 10.60)] when it comes to predicting who integrates mathematics found outside of school into geometry teaching or not. This indicates that all three explanatory variables do not predict mathematics teacher educators' incorporation of mathematics found outside of school into geometry teaching.

DISCUSSION

This study examined whether the explanatory variables (such as gender, teaching experience, and religion) predict mathematics teacher educators' practices of integrating mathematics found outside of school into geometry teaching. It is postulated that teachers' instructional decisions within the classroom, including the use of ethnomathematical perspectives in teaching mathematics and specifically geometry, are subject to the influence of demographic variables such as teaching experience, gender, religion, and other relevant aspects. This claim was influenced by Gilsdorf's (2015) findings, which revealed that women were deliberately barred from formal mathematical activities exclusively based on their gender.

The findings showed that mathematics teacher educators at the colleges of education, on average, incorporate the forms of mathematics found outside of school into geometry teaching. Some mathematics educators bemoaned the lack of clarity on integrating ethnomathematical perspectives (mathematics found outside of school) into geometry teaching in the curriculum (Kyeremeh et al., 2024a). This suggests that mathematics teachers may end up not employing ethnomathematical perspectives in teaching geometry in the classroom, which contradicts the present study's findings. Orey and Rosa (2016), in contrast, noted that "connections are often done superficially because of a teacher's inexperience in ways of connecting to deep ideas" (p. 167). Educator preparation and training in sociocultural-based pedagogy are essential for the effective implementation of ethnomathematics in the classroom.

In this study, the logistic regression model results revealed that the explanatory variable gender is not a viable predictor for mathematics teacher educators' incorporation of mathematics found outside of school into geometry teaching. This result corroborates some previous studies (e.g., Aikpitanyi & Eraikhuemen, 2017; Pradhan, 2023; Thakur, 2019) on demographic factors that predict ethnomathematics integration. Aikpitanyi and Eraikhuemen (2017), for instance, observed no significant disparity between male and female mathematics teachers in their adoption of ethnomathematics approaches. This is consistent with Mosimege and Egara's (2022) study. Among Mosimege and Egara's (2022) findings, it was revealed that there is no significant difference between male and female mathematics teachers in their incorporation of ethnomathematical perspectives. These findings are inconsistent with a previous study (e.g., Ayalew et al., 2024). For example, Ayalew et al. (2024) reported no statistically significant relationship between mathematics teachers' self-reported practice of culturally responsive pedagogy and their gender.

The present study's results also revealed that the explanatory variable teaching experience did not predict mathematics teacher educators' incorporation of mathematics found outside of school in geometry teaching. These findings concur with that of Khalil's (2023) study, which found that teachers' gender and teaching experience do not predict the integration of ethnomathematics in mathematics teaching. The results of these studies are inconsistent with a prior study showing a notable correlation between educators' teaching experience and their use of ethnomathematics approaches in teaching (Ayalew et al., 2024; Pradhan, 2023). For instance, Ayalew et al. (2024) reported that teachers' years of teaching experience predict their practice of culturally responsive pedagogy, an aspect of ethnomathematics.

As societies become more diversified, urbanized and international, integrating ethnomathematical perspectives into mathematics teaching enhances teachers' intellectual and professional development. The ethnomathematics program requires teachers to have both flexibility and proficiency in mathematics since they must select examples pertinent to students' sociocultural environments (Kyeremeh et al., 2024c; Orey & Rosa, 2016). Teachers who employ ethnomathematical perspectives take into account students' sociocultural backgrounds and make mathematics learning more engaging and relevant. Teachers must understand their students' demographics (culture, environment, and experiences) to relate classroom mathematics to their lives (Acharya et al., 2021; Hendriyanto et al., 2023). It is essential to acknowledge the contributions of diverse knowledge systems, various cultures, and the dynamics of cultural interactions to comprehend the genesis and evolution of mathematical concepts throughout human history. According to D'Ambrosio (2017), ethnomathematics denounce inequality, arrogance, and bigotry, focusing on rehabilitating historically marginalized individuals and empowering excluded societal groups. Ethnomathematics aids in restoring cultural dignity and provides intellectual resources for everyone to practice citizenship comprehensively.

CONCLUSION

This study examined whether the explanatory variables (such as gender, teaching experience, and religion) predict mathematics teacher educators' practices of integrating mathematics found outside of school into geometry teaching. Based on the findings, we concluded that mathematics teacher educators at the colleges of education employ ethnomathematical perspectives by integrating the forms of mathematics found outside of school into geometry teaching. The use of this approach was not predicted by explanatory variables such as gender, teaching experience, and religion. These findings would help key actors of mathematics education to re-examine their beliefs and practices about what counts as legitimate school mathematics, specifically geometry, and propel them to tailor mathematics curriculum and instruction in such a way that builds on students' socio-cultural experiences. In this present study, we developed an interest in studying the viability of the demographic variables (such as gender, teaching experience, and religion) in predicting mathematics teacher educators' practices of integrating mathematics found outside of school into geometry teaching. Therefore, future studies could explore the viability of other demographic variables (such as geographical location of institutions, academic qualifications, and training) in predicting mathematics teachers' practices of integrating ethnomathematical perspectives into mathematics teaching.

ACKNOWLEDGEMENT

We wish to acknowledge all mathematics teacher educators in the colleges of education in Ghana who accepted and partook in this study. This article is based on the principal author's doctoral thesis under the co-authors' supervision. The study also received approval from the Humanities and Social Sciences Research Ethics Committee of Kwame Nkrumah University of Science and Technology for using human subjects with approval number: HuSSREC/AP/104/VOL.1.

AUTHOR'S DECLARATION

Authors' contributions	PK: conceived, conducted the literature review, designed the instrument, analyzed data, reported the results and discussions, and wrote and proofread the write-up. FKA contributed to the literature review, peer debriefing, and proofreading of the write-up, DCO: contributed to the validation of the research instruments, peer debriefing, literature review and proofreading of the write-up. All authors read and approved the final manuscript.
Funding Statement	This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Availability of data and materials	All data are available from the authors.
Competing interests	The authors declare that the publishing of this paper does not involve any conflicts of interest. This work has never been published or offered for publication elsewhere, and it is completely original.

BIBLIOGRAPHY

Acharya, B.R., Kshetree, M.P., Khanal, B., Panthi, R.K., & Belbase, S. (2021). Mathematics educators' perspectives on cultural relevance of basic level mathematics in Nepal. *Journal on Mathematics Education*, *12*, 17-48. https://doi.org/10.22342/jme.12.1.12955.17-48

Adam, S. (2004). Ethnomathematical ideas in the curriculum. *Mathematics Education Research Journal, 16*(2), 49-68. https://doi.org/10.1007/BF03217395

Aikpitanyi, L. A., & Eraikhuemen, L. (2017). Mathematics teachers' use of ethnomathematics approach in mathematics teaching in Edo state. *Journal of Education and Practice, 8*(4), 34-38.

Alangui, W. V. (2017). Ethnomathematics and culturally relevant mathematics education in the Philippines. In M. Rosa, L. Shirley, M. E. Gavarrete & W. V. Alangui (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education*, ICME-13 Monographs (pp. 183-208), Springer International Publishing AG. https://doi.org/10.1007/978-3-319-59220-6_8

Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches,* 6(5), 76-89.

Ayalew, B., Tamiru, A. B., & Mengistie, S. M. (2024). Examining the practice of culturally responsive pedagogy in upper primary school mathematics: Perceptions and competencies of teachers in North Wollo zone, Ethiopia. *Bahir Dar Journal of Education, 24*(3), 166-182. https://dx.doi.org/10.4314/bdje.v24i3.11

Callegaro, M., Manfreda, K. L., & Vehovar, V. (2015). *Web survey methodology*. Sage Publications Ltd. https://doi.org/10.4135/9781529799651

D'Ambrosio, U. (2001). What is ethnomathematics, and how can it help children in schools? *Teaching Children Mathematics*, *7*(6), 308-312. https://doi.org/10.5951/TCM.7.6.0308

D'Ambrosio, U. (2016). An overview of the history of ethnomathematics. In M. Rosa, U. D'Ambrosio, D. C. Orey, L. Shirley, W. V. Alangui, P. Palhares & M. E. Gavarrete (Eds.), *Current and Future Perspectives of Ethnomathematics as a Programme* (pp. 5-10). Springer. https://doi.org/10.1007/978-3-319-30120-4_2

D'Ambrosio, U. (2017). Ethnomathematics and the pursuit of peace and social justice. *Campinas, SP, 19*(3), 653-666. https://doi.org/10.20396/etd.v19i3.8648367

Furuto, L. H. L. (2014). Pacific ethnomathematics: pedagogy and practices in mathematics education. *Teaching Mathematics and Its Applications*, 1-12. https://doi.org/10.1093/teamat/hru009

Gerdes, P. (2014). *Ethnomathematics and education in Africa* (2nd ed.). Higher Institute for Technology and Management.

Gill, J., Johnson, P., & Clark, M. (2010). *Research methods for managers*. SAGE Publications.

Gilsdorf, T. E. (2015). Gender, culture and ethnomathematics. In S. Mukhopadhyay & Breer, B. (Eds.), *Proceedings of the Eighth International Conference on Mathematics Education and Society* (MES-8), pp. 531-542.

Hendriyanto, A., Priatna, N., Juandi, D., Dahlan, J. A., Hidayat, R., Sahara, S., & Muhaimin, L. H. (2023). Learning mathematics using an ethnomathematics approach: A systematic literature review. *Journal of Higher Education Theory and Practice, 23*(7), 59-74. https://doi.org/10.33423/jhetp.v23i7.6012

Ibrahim, A., Adusei, M. S., & Mereku, D. K. (2022). Access, successful completion and learning achievement of female undergraduate students studying mathematics at the University of Education, Winneba. *African Journal of Educational Studies in Mathematics and Sciences,18*(2), 43-53. https://dx.doi.org/10.4314/ajesms.v18i2.5

Khalil, I. A. (2023). Mathematics teachers' attitudes towards integrating ethnic mathematics in teaching mathematical topics: A mixed methods study. *International Journal of Instruction*, *16*(4), 1061-1080. https://doi.org/10.29333/iji.2023.16458a

Kyeremeh, P., Awuah, F. K., & Dorwu, E. (2023). Integration of ethnomathematics in teaching geometry: A systematic review and bibliometric report. *Journal of Urban Mathematics Education, 16*(2), 68-89. https://doi.org/10.21423/jume-v16i2a519

Kyeremeh, P., Awuah, F. K., & Orey, D. C. (2024a, July 27). *Challenges regarding the integration of ethnomathematical perspectives into geometry teaching: The faculty reflection*. SocArXiv. https://doi.org/10.31235/osf.io/4q9m8

Kyeremeh, P., Awuah, F. K., & Orey, D. C. (2024b, July 27). *Exploring geometry found outside of school: Insights from faculty perspective*. SocArXiv. https://doi.org/10.31235/osf.io/zhpt5

Kyeremeh, P., Awuah, F. K., & Orey, D. C. (2024c, July 27). *From cultural awareness to integration: Faculty attempt to incorporate the outside-of-school geometry into geometry teaching*. SocArXiv. https://doi.org/10.31235/osf.io/dhq52

Kyeremeh, P., & Kwame, E.L. (2023). Promoting student solid geometry concept understanding through the application of ethnomathematics learning approach. In N. Wonu (Ed.), *Mathematics and science education: pedagogical perspectives* (pp. 24-35). Silver-Top Printers and Publishers.

Mabotja, K. S. (2022). *The affordances of ethnomathematical perspectives in pre-service Mathematics teacher education at selected universities in South Africa* [Doctoral Thesis, Potchefstroom Campus North-West University].

Mathers, N., Fox, N., & Hunn, A. (2009). *Surveys and questionnaires*. The NIHR RDS for the East Midlands / Yorkshire & the Humber.

Ministry of Education (2017). *National teacher education curriculum framework: The essential elements of initial teacher education*. Author.
Ministry of Education (2018). *Learning and teaching and applying geometry and handling data: A Four-Year B.Ed. Course manual.* Author.
Mosimege, M. D., & Egara, F. O. (2022). Perception and perspective of teachers towards the usage of ethno-mathematics approach in mathematics teaching and learning. *Multicultural Education, 8*(3), 288-298.
Mutodi, P., & Ngirande, H. (2014). Perception of secondary school teachers towards the use of concrete materials in constructing mathematical meaning. *Int J Edu Sci, 7*(3), 449-461.
Orey, D., & Rosa, M. (2007). Cultural assertions and challenges towards pedagogical action of an ethnomathematics programme. *For the Learning of Mathematics*, *27*(1), 10-16.
Orey, D. C., & Rosa, M. (2016). Reflecting on ethnomathematics as pedagogical action in the mathematics curriculum. *RIPEM, 6*(1), 157-177.
Orey, D. C., & Rosa, M. A. (2019). Cultural approach to mathematical modelling: An ethnomathematical perspective. *Comunicación, XV CIAEM-IACME.* Medellín.
Pallant, J. (2016). *SPSS survival manual: A step by step guide to data analysis using SPSS* (6th ed.). Open University Press.
Pradhan, J. B. (2023). Integrating ethnomathematics approach in teaching school mathematics: inservice teachers' perception. *PROMETEICA-Revista de Filosofiay Ciencias, 27*, 400-409. https://doi.org/10.34024/prometeica.2023.27.15321
Putra, E. C. S., & Mahmudah, F. N. (2021). The Implementation of Ethnomathematics Based-Learning for Students. *SJME (Supremum Journal of Mathematics Education), 5*(2), 162-169. https://doi.org/10.35706/sjme.v5i2.4827
Rosa, M., & Orey, D. C. (2012). The field of research in ethnomodelling: emic, ethic and dialectical approaches. *Educ. Pesqui., 38*(4), 865-879. https://doi.org/10.1590/S1517-97022012000400006
Rosa, M., & Orey, D. C. (2020). Principles of culturally relevant education in an ethnomathematical perspective. *Revista de Educação Matemática, 17*, 1-24. https://doi.org/10.37001/remat25269062v17id306
Rosa, M., & Orey, D. C. (2021). An ethnomathematical perspective of STEM education in a glocalized world. *Bolema, Rio Claro (SP), 35*(70), 840-876. http://dx.doi.org/10.1590/1980-4415v35n70a14
Rosa, M., & Orey, D. C. (2023). Considerations about ethnomathematics, the culturally relevant pedagogy and social justice in mathematical education. *Educ. Matem. Pesq., 25*(2), 145-165. http://dx.doi.org/10.23925/1983-3156.2023v25i2p145-165
Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ, 48*, 1273-1296. https://doi.org/10.1007/s11165-016-9602-2
Tayakol, M., & Dennick, R. (2011). Making sense of Cronbach's Alpha*. International Journal of Medical Education, 2,* 53-55.
Thakur, S. K. (2019). Integration of ethnomathematics in secondary level: a survey on teachers' perceptions [Master's dissertation, Kathmandu University].
Vooren, M., Haelermans, C., Groot, W., & van den Brink, H. M. (2022). Comparing success of female students to their male counterparts in the STEM fields: An empirical analysis from enrollment until graduation using longitudinal register data. *International Journal of STEM Education, 9*. Article number 1. https://doi.org/10.1186/s40594-021-00318-8