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Status of Mathematics Teachers' Espoused Beliefs about Nature and Teaching Learning Process of Mathematics

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Abstract

This study aimed to investigate the espoused beliefs held by secondary-level mathematics teachers about mathematics and its teaching and learning processes. The research employed a quantitative survey design, focusing on four districts (Chitwan, Makawanpur, Gorkha, and Parsa) as representatives of Nepal. The selection of 168 mathematics teachers from these districts utilized proportional allocation of stratified random sampling. A questionnaire, employing a Likert five-point scale, was designed to collect data on teachers' espoused beliefs. The results revealed a prevalent alignment of secondary-level mathematics teachers' espoused beliefs with the fallibilist philosophy of mathematics. Additionally, the findings indicated a strong inclination towards the use of the constructivist method in teaching mathematics. This research contributes valuable insights into the prevailing beliefs among mathematics teachers at the secondary level, providing a basis for understanding their perspectives on the nature of mathematics and preferred teaching methodologies.

Keywords: Philosophy of mathematics; traditional method of teaching mathematics; constructivist method of teaching mathematics; status of espoused beliefs.

Introduction

The beliefs that mathematics teachers publicly endorse reveal their views, perspectives, thoughts, and understanding of mathematical concepts, teaching methods, and various activities related to teaching mathematics. These beliefs are expressed when they talk about mathematics or the teaching learning process of the subject. Teachers' espoused beliefs refer to the spoken or written statements made by mathematics teachers regarding mathematics and process of its teaching and learning (Fives & Buehl, 2012). Students' academic accomplishments are contingent upon the learning environment created by teachers in the classroom and the various instructional activities conducted by them. These activities of teachers are influenced by their espoused beliefs. Calderhead (1996) has explained the importance necessity for further research related to teachers'

espoused beliefs, emphasizing the inconsistency between their beliefs and the different activities performing by them in for successful implementation of classroom practices.

Most discussions about teacher education and professional development in mathematics primarily center on how well teachers know the subject and how to teach it. However, several scholars also recognize the importance of considering teachers' beliefs and the connection between knowledge and beliefs (Ernest, 1988; Fennema & Franke 1992; Herrera & Carballo, 2010; Raymond,1997; Roesken et al., 2011; Staub & Stern, 2002 & Tiwari, 2004).

Raymond (1997) explains that mathematical beliefs encompass perspectives on mathematics as a field, encompassing how it is both learned and taught. The mathematical beliefs held by educators encapsulate their viewpoints, thoughts, and understanding of mathematical concepts, instructional methods, techniques, and various aspects of teaching mathematics. Pajares (1992) expresses mathematics teachers' beliefs as cognitive knowledge, reflecting personal theories regarding the nature of knowledge itself. These cognitive beliefs significantly influence teachers' decision-making in curriculum matters and their approaches to teaching.

Tiwari (2004) defines belief as an individual's sentiments about something or someone, with the conviction that these feelings are accurate. Various researchers have provided distinct definitions of beliefs, converging on the understanding that beliefs comprise both cognitive and affective knowledge. This knowledge encompasses a range of mental states such as attitudes, commitment, conceptions, dispositions, implicit theories, knowledge, opinions, perceptions, rumors, suppositions, stances, values, and mental images. It is essential to assess these multifaceted aspects when exploring beliefs in the context of education.

Researchers widely agree on the significant impact of mathematics teachers' beliefs on the teaching-learning process and student achievements (Yang, Kaiser, König & Blomeke; 2020; Berger, Girardet, Vaudroz & Crahay; 2018; Stemhagen, 2011). The recognition of this influence underscores the pressing need for research focused on understanding the status of mathematics teachers' beliefs, particularly in the context of Nepal. The term "status of espoused beliefs" in the context of mathematics education pertains to the current held convictions of mathematics teachers regarding both the fundamental nature of mathematics and the methodologies employed in the teaching and learning of the subject. It encompasses the prevailing perspectives and articulated stances of educators in these domains, reflecting their collective beliefs and attitudes

shaping the instructional landscape. Understanding the status of these espoused beliefs provides valuable insights into the prevailing ideologies guiding mathematics education, thereby informing educational strategies, curriculum development, and professional development initiatives within the academic community.

The Curriculum Development Centre (CDC) of Nepal want to increase in the quality of education by including innovation and technology in secondary level curriculum (NCF, 2007). Innovation will succeed if teachers' beliefs about innovation are positive, and teachers teach according to their beliefs. So, there needs to be some research on the teachers' beliefs. The acknowledgment of the crucial role played by teachers' beliefs in shaping educational outcomes emphasizes the importance of delving into the specific dynamics within the Nepalese educational landscape. This emphasis on context-specific research is crucial for developing targeted interventions and improvements in mathematics education. By exploring and assessing the current state of mathematics teachers' beliefs in Nepal, researchers can contribute valuable insights that inform educational policies, teacher training programs, and instructional strategies, ultimately fostering a more effective and tailored approach to mathematics education in the country. Considering these things, this study aims to address to the following research questions.

i. What is the current state of mathematics teachers' espoused beliefs regarding the fundamental nature of mathematics?
ii. Is there a discernible distinction in the espoused beliefs of mathematics teachers when categorized according to fallibilist and absolutist philosophical perspectives?
iii. What is the prevailing status of mathematics teachers' espoused beliefs concerning the process of teaching and learning mathematics?
iv. Is there a noticeable variance in the espoused beliefs of mathematics teachers based on their orientation towards the constructivist method versus the traditional method of instruction?

Conceptual Framework

While there is ample research on teachers' beliefs in mathematics education in developed nations, there has been a lack of emphasis on this topic in developing countries (Adam, 2012). Consequently, there is a significant demand to explore the beliefs and classroom practices of teachers in developing countries (Adam, 2012;

Bimbola & Daniel, 2010). Different researchers in mathematics education categorize the beliefs in different ways and these researchers provide different theories. The philosophy guiding both mathematics and mathematics education is a fundamental aspect (Ernest, 1988; Perry, 1970). Consequently, it is essential for researchers to examine and understand teachers' expressed beliefs by considering mathematical philosophies. This is crucial because these beliefs and attitudes of teachers are indicative of their views on the nature of mathematics and the process of teaching and learning it (Sawyer, 2018).

Lerman (1983) distinguished between two contrasting views regarding the essence of mathematics, labeling them as the absolutist philosophy of mathematics and the fallibilist philosophy of mathematics. The absolutist standpoint posits that mathematics is grounded in universal and indisputable foundations, portraying it as an exemplar of knowledge characterized by certainty, absoluteness, objectivity, and abstraction. Conversely, the fallibilist perspective suggests that mathematics evolves through the interplay of conjectures, proofs, refutations, and an inherent element of uncertainty.

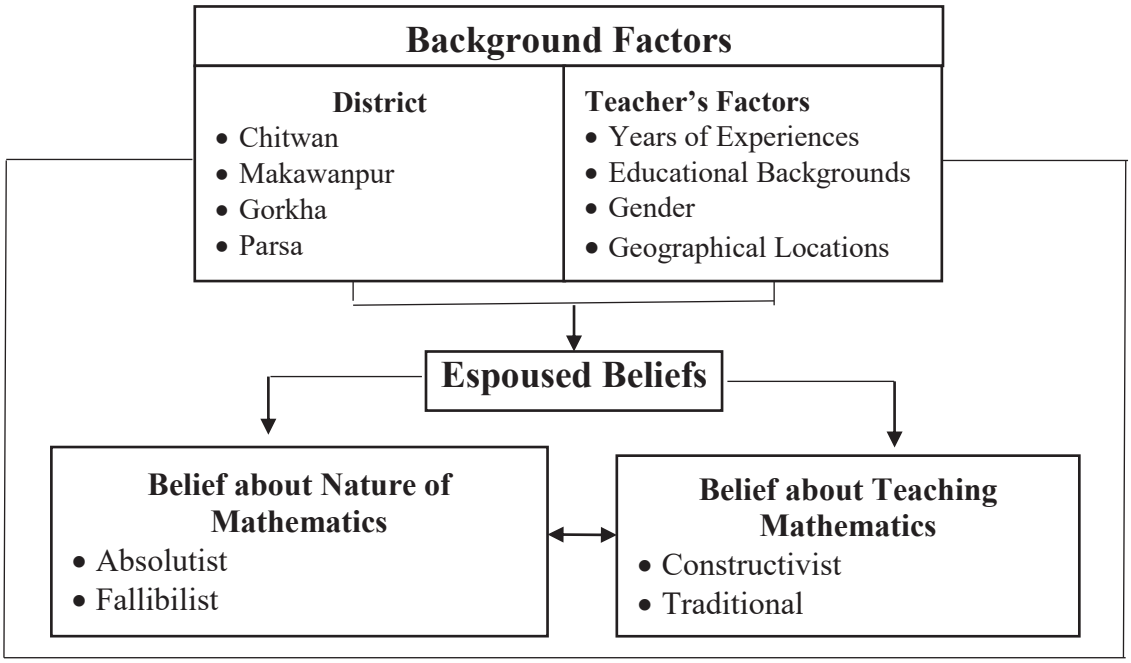
In the realm of beliefs associated with the teaching and learning of mathematics, Lerman (1983) outlined two distinct orientations. The first, termed traditional belief, proposes that teaching entails the transmission of information, clear explanation of ideas, and the transfer of knowledge from an expert to a novice (as cited in Chan & Elliott, 2004). On the other hand, the second orientation, known as constructivist belief, contends that teaching involves facilitating the learning process, empowering learners to construct and acquire knowledge through reasoning and justification (as cited in Chan & Elliott, 2004).

This study is intended to find out the status of mathematics teachers' espoused beliefs. The status of mathematics teachers' espoused beliefs has been based on the information collected from Chitwan, Gorkha, Makawanpur and Parsa districts. Years of experiences, educational backgrounds, gender, and geographical locations have been taken as affecting factors for their status of beliefs. This study has explained the status teachers' espoused beliefs based on absolutist philosophy and fallibilist philosophy of mathematics (Lerman, 1983) for categorization of mathematics teachers' beliefs about the nature of mathematics. It has also used traditional methods of teaching mathematics and constructivist method of teaching mathematics (ibid) for categorization of mathematics teachers' espoused beliefs on the teaching learning process of mathematics.

The espoused beliefs have been based on the information obtained from the questionnaire. The conceptual framework of this study is shown in the following figure.

Figure 1

Conceptual Framework of Mathematics Teachers' Espoused Beliefs.



Research Methodology

This research focused on mathematics teachers' beliefs at the secondary level in Nepal. To conduct the study, a quantitative survey design, as outlined by Creswell (2013), was employed. The entire secondary level mathematics teachers in Nepal were target population. The Chitwan, Parsa, Makwanapur, and Gorkha districts for the study were purposefully selected, representing the varied topographical divisions of Nepal, including mountainous, hilly, and terai regions. The Teacher Service Commission employs a uniform examination process for appointing secondary level mathematics teachers across Nepal. As a result, teachers from these four districts are deemed representative of all secondary level mathematics teachers in the country. The study included mathematics teachers from all community schools in Chitwan, Makawanpur, Gorkha, and Parsa districts as the sampled population. A stratified random sampling

method with proportional allocation, as advocated by Kothary (2009) and Cohen, Manion, and Morrison (2010), was applied. This method led to the selection of 27 schools from Chitwan, 16 from Gorkha, 20 from Makawanpur, and 21 from Parsa.

Among 196 mathematics teachers from 84 schools participated in the survey, complete information was provided by only 168 teachers from 81 schools. Consequently, these 168 mathematics teachers, comprising 54 from 26 schools in Chitwan, 31 from 16 schools in Gorkha, 44 from 19 schools in Makawanpur, and 39 from 20 schools in Parsa, were considered the final sample for analyzing the status of mathematics teachers' espoused beliefs.

Data Collection of the Study

This study delved into understanding the status of espoused beliefs held by mathematics teachers. To capture these beliefs, a questionnaire was deemed appropriate, drawing on insights from Gable (1986), Colton and Covert (2007), and Gable, McCoach, & Madura (2013). The questionnaire, structured with Likert scale items, aimed to gauge mathematics teachers' beliefs on absolutist and fallibilist philosophies of mathematics, as well as their status about espoused beliefs on constructivist and traditional teaching approaches in mathematics.

Ensuring the reliability and validity using multifaceted approach of the questionnaire was crucial for the accuracy of the study's outcomes, particularly in the affective domain of quantitative research (Gable, 1986; Colton & Covert, 2007). The conceptual and operational definitions were used for content validity, and confirmatory factor analysis was applied for construct validity. For reliability of the questionnaire, Cronbach's alpha (α) measured internal consistency, while the test-retest method assessed the stability of the questionnaire. If the reliability coefficient is 0.7 or more then the tool is valid otherwise it is invalid.

To collect data, necessary permissions were obtained from District Education Offices followed by selected schools. The researcher actively engaged with subject teachers, distributing the questionnaire accompanied by a consensus-seeking letter. The filled questionnaires were collected the next day, and permission was secured from both the Head teacher or Principal and the mathematics teacher for subsequent classroom observations. This comprehensive methodological approach ensured the reliability and validity of the data collected, providing a robust foundation for analyzing and understanding the espoused beliefs of mathematics teachers in the study.

Ethical Considerations

Ethical considerations in research involve moral concerns related to the people participating in the research process. Permission to collect data was granted by the Dean's Office, Faculty of Education, Tribhuvan University. Upholding ethical standards, a letter expressing commitment to ethical principles was sent to the District Education Office and related schools, securing permission for data collection and research use. Ethical commitments were conveyed to mathematics teachers through personal communication and the questionnaire request letter. The letters covered ethical aspects like the sensitivity of research activities, maintaining respondent confidentiality during data analysis, and specifying information usage. Participants were fully informed about the study's purposes and had the freedom to decide whether to participate or withdraw at any point. To ensure confidentiality, the study avoided disclosing school and teacher names.

Researchers adhered to ethical standards by not altering participants' information and obtaining consent from both participants and authorities. Valid and reliable tools and techniques were used in the study, ensuring the credibility of the conclusions. The questionnaire underwent validation through content and construct validity methods, and reliability was assessed using Cronbach's alpha and test-retest methods. These procedures effectively fulfilled the ethical requirements of social science research.

Analysis of Quantitative Data and Interpretation of the Result

The analysis of the data began with analysis of demographic profiles of mathematics teachers. Frequency and percentage were used for analyzing the demographic profiles. Afterwards, the means and z-test for means were presented for each of the categories of the nature of mathematics and teaching learning process of mathematics to figure out the status of mathematics teachers' espoused beliefs.

Demographic status of mathematics teachers

The questionnaire was the main tool for this study. There were mainly three sections in the questionnaire. The first section of the questionnaire is the demographic profile of the teachers. The demographic profile included name, age, sex, training status, qualification, years of experiences and types of services (permanent, temporary, contract). The following table shows the total demographic status of mathematics teachers.

Table 1

Demographic status of the mathematics teachers

Districts	Status	Sex		Training Status		Years of Experience		
		Male	Female	Trained	Untrained	< 5	5 to 10	> 10
Chitwan	Numbers	40	14	41	13	10	20	24
	Percentage	74.07	25.93	75.93	24.07	18.52	37.04	44.44
Gorkha	Numbers	20	11	26	5	12	8	11
	Percentage	64.52	35.48	83.87	16.13	38.71	25.81	35.48
Makawanpur	Numbers	34	10	34	10	14	17	13
	Percentage	77.27	22.73	77.27	22.73	31.82	38.64	29.55
Parsa	Numbers	30	9	28	11	12	12	15
	Percentage	76.92	23.08	71.79	28.21	30.77	30.77	38.46
All Districts	Numbers	124	44	129	39	48	57	63
	Percentage	73.81	26.19	76.79	23.21	28.57	33.93	37.50

Table 1 presents the gender distribution among mathematics teachers in various districts of Nepal. In the Chitwan district, 74.07 percent of mathematics teachers were male, while 25.93 percent were female. Similarly, in the Gorkha district, 64.52 percent of mathematics teachers were male, and 35.48 percent were female. The Makawanpur district exhibited a distribution of 77.27 percent male and 22.73 percent female mathematics teachers, while the Parsa district had 76.92 percent male and 23.08 percent female mathematics teachers. Across the entire sample of 168 mathematics teachers surveyed in these four districts, 73.81 percent were male, and 26.19 percent were female. These findings underscore a notable gender disparity, indicating a higher prevalence of male mathematics teachers compared to their female counterparts at the secondary level in Nepal.

The second column of Table 1 delineates the professional development status of secondary-level mathematics educators in Nepal. In the Chitwan district, approximately 75.93 percent of mathematics teachers underwent training, while 24.07 percent remained untrained. Similarly, in the Gorkha district, 83.87 percent of mathematics teachers received training, with 16.13 percent being untrained. In the Makawanpur district, 77.27 percent of mathematics teachers underwent training, leaving 22.73 percent untrained. Meanwhile, in the Parsa district, 71.79 percent of mathematics teachers were trained, while 28.21 percent were untrained. Aggregate statistics derived from a sample of 168 mathematics teachers across the four districts reveal that 76.79 percent have received

training, whereas 23.21 percent remain untrained. This empirical snapshot underscores the prevalence of trained educators surpassing their untrained counterparts at the secondary level in Nepal.

Mathematics teachers' espoused beliefs about the nature of mathematics.

The teachers' beliefs related to the nature of mathematics were included in the second section of the questionnaire. There were twenty-two statements in this section. Among these statements, twelve belief statements were related to the fallibilist philosophy of mathematics, and ten statements were related to the absolutist philosophy of mathematics. The tables stand for the mean scores with corresponding z-values and P-values of Chitwan, Makawanpur, Gorkah and Parsa districts' mathematics teachers in the absolutist philosophy of mathematics and the fallibilist philosophy of mathematics.

Table 2

Espoused beliefs of mathematics teachers about nature of mathematics

Areas	Philosophy of Mathematics	Mean	SD	Level of Sig.	n	z-value	p-value	Result
All	Absolutist	2.33	1.38	0.05	168	-6.2996	0.0000	S
	Fallibilist	4.06	0.91	0.05	168	15.1383	0.0000	S
Chitwan District	Absolutist	2.45	1.41	0.05	54	-2.8637	0.0041	S
	Fallibilist	4.02	0.98	0.05	54	7.6844	0.0000	S
Makawanpur District	Absolutist	2.31	1.39	0.05	44	-3.3014	0.0010	S
	Fallibilist	4.06	0.90	0.05	44	7.8115	0.0000	S
Gorkha District	Absolutist	2.30	1.33	0.05	31	-2.9351	0.0033	S
	Fallibilist	4.10	0.83	0.05	32	7.4212	0.0000	S
Parsa District	Absolutist	2.21	1.37	0.05	39	-3.6346	0.0003	S
	Fallibilist	4.09	0.88	0.05	39	7.6721	0.0000	S

The average score derived from the evaluation of ten statements reflecting the absolutist philosophy of mathematics among secondary level mathematics teachers was 2.33, with a standard deviation of 1.38. The calculated p-value, when compared to the hypothesized population mean of 3, fell below the predetermined level of significance, indicating a statistically significant result. Consequently, it can be inferred that the espoused beliefs of secondary level mathematics educators in Nepal do not align with the absolutist philosophy of mathematics.

In contrast, the mean score resulting from the analysis of twelve statements representing the fallibilist philosophy of mathematics was 4.06, with a standard deviation of 0.91. Like the absolutist philosophy assessment, the p-value, when compared to the hypothesized population mean of 3, was below the chosen level of significance, signifying statistical significance. This outcome implies that the espoused beliefs of secondary level mathematics teachers in Nepal lean towards the fallibilist philosophy of mathematics.

Furthermore, the examination of individual data from Chitwan, Makawanpur, Gorkha, and Parsa districts, as presented in table 2, indicates the same results as national-level findings. Therefore, the comprehensive analysis indicates that the beliefs held by Nepalese secondary level mathematics teachers regarding the nature of mathematics are rooted in the fallibilist philosophy. This suggests a prevalent inclination towards the acceptance of the fallibility and uncertainty inherent in mathematical knowledge among these educators.

Comparison of espoused beliefs about the nature of mathematics

Table 3 presents a comparison of the beliefs held by mathematics teachers regarding the fallibilist and absolutist philosophies of mathematics. It highlights the differences in their stated views on these philosophical perspectives.

Table 3

Comparison between espoused beliefs on fallibilist and absolutist view of mathematics

Areas	Fallibilist Mean	Absolutist Mean	n	z-value	P-value	Remarks
Chitwan	4.02	2.45	54	6.7249	0.0000	S
Gorkha	4.10	2.30	31	6.4127	0.0000	S
Makawanpur	4.06	2.31	44	7.0292	0.0000	S
Parsa	4.09	2.21	39	7.2190	0.0000	S
All Districts	4.06	2.33	168	13.58	0.0000	S

The average score for mathematics teachers' espoused beliefs in the absolutist philosophy is 2.05 in Nepal, noticeably lower than the mean score of 4.02 for their espoused beliefs in the fallibilist philosophy. The p-value, which is below the 0.05 significance level, suggests a statistically significant difference in means. Z-test results confirm this significant difference in beliefs between the fallibilist and absolutist

philosophies, both on a nationwide scale and within individual districts. These findings suggest a prevailing inclination among secondary-level mathematics teachers in Nepal towards embracing the fallibilist philosophy when considering the nature of mathematics. In essence, the data reveals a distinct preference for an acknowledgment of mathematical fallibility rather than a strict adherence to absolutist viewpoints among Nepalese mathematics teachers.

Mathematics teachers' espoused beliefs about teaching learning process of mathematics

The questionnaire's third segment focused on espoused beliefs associated with the teaching and learning process of mathematics, comprising twenty-four statements. Within this section, thirteen statements reflected beliefs linked to the constructivist approach to teaching mathematics, while the remaining eleven statements pertained to the traditional teaching method. The subsequent tables illustrate the average scores of mathematics teachers' espoused beliefs regarding the teaching methods, along with their corresponding z-values and P-values.

Table 4

Espoused beliefs of mathematics teachers about teaching learning process of mathematics

Areas	Method of Teaching Mathematics	Mean	SD	Level of Sig.	n	z-value	p-value	Result
All	Constructivist	4.31	0.79	0.05	168	21.3087	0.0000	S
	Traditional	2.40	1.39	0.05	168	-5.5689	0.0000	S
Chitwan District	Constructivist	4.36	0.77	0.05	54	12.9280	0.0000	S
	Traditional	2.56	1.44	0.05	54	-2.2559	0.0241	S
Makawanpur District	Constructivist	4.22	0.81	0.05	44	9.9855	0.0000	S
	Traditional	2.40	1.39	0.05	44	-2.8568	0.0043	S
Gorkha District	Constructivist	4.33	0.79	0.05	31	9.3961	0.0000	S
	Traditional	2.27	1.30	0.05	31	-3.1258	0.0018	S
Parsa District	Constructivist	4.31	0.81	0.05	39	10.1620	0.0000	S
	Traditional	2.29	1.38	0.05	39	-3.2043	0.0014	S

The average score derived from eleven statements assessing the espoused beliefs of secondary level mathematics teachers regarding the traditional teaching method of

teaching mathematics was 2.40, accompanied by a standard deviation of 1.39. The p-value, when compared to the hypothesized population mean of 3, fell below the significance level of 0.05, indicating statistical significance of the result. This implies that the espoused beliefs of secondary level mathematics teachers in Nepal are not aligned with the traditional teaching approach of teaching mathematics.

On the other hand, the mean score resulting from thirteen statements gauging the mathematics teachers espoused beliefs related to the constructivist method of teaching mathematics was 4.31, with a standard deviation of 0.79. The p-value, compared to the hypothesized population mean of 3, was below the significance level, signifying statistical significance of the result. This suggests that the espoused beliefs of secondary level mathematics teachers in Nepal predominantly align with the constructivist method of teaching mathematics.

Moreover, individual data from districts such as Chitwan, Makawanpur, Gorkha, and Parsa, as presented in table 4, further support the collective data for Nepal. The analysis reveals a notable shift among Nepalese secondary level mathematics teachers, indicating a transition from traditional teaching methods to a preference for the constructivist approach in their espoused beliefs about the teaching-learning process of mathematics.

Comparison of espoused beliefs about the teaching learning process of mathematics.

Table 5 displays the average values representing mathematics teachers' espoused beliefs on the effectiveness of the constructivist method in teaching mathematics and traditional method in teaching mathematics. The findings indicate that, according to teachers' espoused beliefs, the mean scores for the constructivist approach surpass those for the traditional method across various districts, within the specific context of Nepal.

Table 5

Comparison between espoused beliefs on constructivist view of teaching mathematics and traditional view of teaching mathematics

Areas	Constructivist Mean	Traditional Mean	N	z-value	P-value	Remarks
Chitwan	4.36	2.56	54	8.0986	0.0000	S
Gorkha	4.33	2.27	31	7.5373	0.0000	S

Makawanpur	4.22	2.40	44	7.5152	0.0000	S
Parsa	4.31	2.29	39	7.9001	0.0000	S
Nepal	4.31	2.40	168	15.4110	0.0000	S

In Nepal, the mathematics teachers' espoused beliefs regarding the constructivist approach to teaching mathematics revealed a mean score of 4.31, while the mean score for the traditional teaching method was 2.40. This comparison indicates that, on average, mathematics teachers express stronger support for the constructivist method than for the traditional approach. Significance testing using p-values from a z-test further confirms the meaningfulness of this difference.

When considering specific districts within Nepal, such as Chitwan, Gorkha, Makawanpur, and Parsa, the mean scores for teachers' espoused beliefs regarding the constructivist method remain consistently higher than those for the traditional method. The application of a z-test at a significance level of 0.05 establishes that these differences are statistically significant.

These findings underscore a prevailing trend among Nepalese secondary level mathematics teachers, revealing a predominant inclination towards the constructivist method in their espoused beliefs about the teaching and learning process of mathematics. The statistical significance of these results emphasizes the widespread adoption of constructivist principles in these districts. In essence, the study suggests a notable preference among Nepalese secondary level mathematics teachers for the constructivist approach, indicating a prevailing mindset that prioritizes student-centered and interactive methods in the teaching and learning of mathematics.

Summary and Findings of the Study

The research aimed to investigate the espoused beliefs held by secondary-level mathematics teachers regarding mathematics and its teaching-learning process. The study involved 168 mathematics teachers from 81 schools in various districts, including Chitwan, Gorkha, Makawanpur, and Parsa. The data collection relied on questionnaires as the primary source. After meticulous analysis, several key findings emerged:

i. Secondary-level mathematics teachers revealed their espoused beliefs about the nature of mathematics, aligning with the fallibilist philosophy of mathematics.
ii. The espoused beliefs of secondary-level mathematics teachers regarding the teaching and learning process of mathematics predominantly reflected a constructivist approach.

iii. The average score of the mathematics teachers' espoused beliefs related to the absolutist philosophy was lower than those aligned with the fallibilist philosophy. A z-test demonstrated the significance of this difference in the context of Nepal.

iv. The mean score of mathematics teachers' espoused beliefs associated with the traditional method of teaching mathematics was lower than those linked to the constructivist method. A z-test affirmed the significance of this contrast in the context of Nepal.

In summary, the study unveiled that secondary-level mathematics teachers in Nepal tend to endorse a fallibilist philosophy in their espoused beliefs concerning the nature of mathematics and favor a constructivist approach in their espoused beliefs about the teaching and learning process of mathematics. Additionally, the findings suggest a significant preference for fallibilist philosophy over absolutist philosophy and a preference for the constructivist method over the traditional method in the context of Nepal.

Discussion of Results

The current research aimed to explore the beliefs of secondary level mathematics teachers, with a specific focus on their espoused beliefs about the essence of mathematics and their strategies for teaching and learning the subject. The findings revealed a higher representation of male mathematics teachers compared to females in Nepal. This observation aligns with the 2020 World Bank report, indicating that the percentage of female teachers at the secondary level in Nepal increased from 21.873 percent in 2016 to 24.332 percent in 2019. Consequently, it is inferred that there is a growing recruitment of female teachers at the secondary level in Nepal.

The study also disclosed that the number of trained mathematics teachers exceeds that of untrained teachers. However, as per the 2020 World Bank report, 83.26 percent of secondary level teachers were trained in 2019, compared to 90.48 percent in 2016. These results suggest a decline in the proportion of trained teachers in Nepal. The Government of Nepal has implemented a flexible recruitment policy for certain secondary level subjects, including mathematics, where training is not mandatory (Teachers Service Commission Rules, 2000, 11th Amendment). This policy has led to an increase in the presence of untrained teachers in schools. It underscores the need for the government to reconsider the recruitment policy for secondary level teachers and prioritize their training.

The study found that secondary-level mathematics teachers in Nepal generally agree with the fallibilist philosophy of mathematics. Interestingly, when looking at beliefs linked to the absolutist philosophy of math, teachers' average scores in alignment with this philosophy were much lower compared to those aligned with the fallibilist philosophy. A statistical test confirmed this, indicating a strong preference for fallibilism among these teachers in Nepal. Fallibilism in mathematics suggests that knowledge is subjective, historical, changeable, and always open to revision and correction (Ernest, 1988). It rejects the idea that mathematical knowledge is purely abstract and objective. According to this perspective, math is shaped by social processes. This means secondary level mathematics teachers tend to think that mathematical knowledge can change and be revised, recognizing the uncertainties in the subject. Therefore, secondary-level math teachers in Nepal hold a re-conceptualized view of the nature of mathematics, rejecting the notion that mathematical knowledge is inherently pure, abstract, and objective.

Moreover, our study sheds light on the prevalent constructivist approach embraced by secondary-level mathematics teachers in their espoused beliefs related to the teaching and learning process. Furthermore, our investigation into the espoused beliefs related to teaching methods revealed a substantial difference between the mean scores associated with traditional and constructivist approaches. Mathematics teachers expressed stronger alignment with the constructivist method, as reflected in their beliefs about effective instructional strategies. The significance of this disparity was corroborated by a z-test, further reinforcing the dominance of the constructivist paradigm in the teaching practices of secondary-level mathematics educators in Nepal. Constructivist method of teaching mathematics focuses on active, cooperative, collaborative, and problem-based learning (Ernest, 1988). The teachers' perspectives align with the constructivist method of teaching mathematics, emphasizing the importance of active student engagement, collaborative learning, and the construction of knowledge through meaningful experiences. They stress using games, manipulative, differentiated instruction, and technological devices to enhance the teaching of mathematics. Mathematics teachers believe that students must actively participate in the teaching learning process and the teacher must observe and help them in their necessity. This finding underscores the influence of contemporary pedagogical theories on mathematics education at the secondary level in Nepal.

This study provides a comprehensive examination of the espoused beliefs held by secondary-level mathematics teachers in Nepal. The alignment with fallibilist

philosophy and the prevalence of a constructivist approach underscore the evolving landscape of mathematics education in the region. The observed differences in espoused beliefs related to philosophical orientations and teaching methods offer valuable insights for educational policymakers, curriculum developers, and teacher training programs seeking to enhance the effectiveness of mathematics education in secondary schools.

Conclusions

This research sheds light on the espoused beliefs of secondary-level mathematics teachers, particularly focusing on their perspectives on the nature of mathematics and the teaching-learning process. The findings reveal a prevalent alignment with the fallibilist philosophy of mathematics among the participating educators. This indicates a recognition and acceptance of the dynamic and evolving nature of mathematical knowledge, emphasizing a willingness to embrace uncertainty and potential revisions in mathematical understanding. Significantly, the research demonstrates a noteworthy difference in the average scores related to absolutist and fallibilist philosophies, with a lower score associated with absolutism. This suggests a departure from rigid and inflexible views towards a more open-minded and adaptable stance, particularly relevant in the context of Nepal.

Furthermore, the study highlights a strong inclination towards a constructivist approach in the espoused beliefs of mathematics teachers concerning the teaching and learning process. This underscores the importance placed on active student engagement, collaborative learning, and the construction of meaning through hands-on experiences within the mathematics classroom. Additionally, the espoused beliefs for the constructivist method over traditional approaches signifies a shift towards more student-centered and experiential pedagogies, emphasizing the need for innovative teaching strategies to enhance mathematics education.

Implications

The implications of this research are significant for both educators and policymakers in the field of mathematics education. Firstly, the alignment of secondary-level mathematics teachers with the fallibilist philosophy of mathematics suggests a collective recognition of the evolving and dynamic nature of mathematical knowledge. This realization has implications for curriculum development, emphasizing the need for flexible and adaptive instructional materials that reflect the fallibilist perspective.

Secondly, the predominance of constructivist approaches in the espoused beliefs of teachers regarding the teaching and learning process underscores the importance of fostering student engagement, collaboration, and hands-on experiences in mathematics classrooms. Educators should be encouraged to incorporate these pedagogical strategies, promoting a shift from traditional, teacher-centered methods to more student-centered and interactive learning environments.

The observed lower average score related to the absolutist philosophy, as demonstrated by the z-test, highlights the necessity for professional development programs that address and challenge rigid beliefs among mathematics teachers. This can contribute to a more open-minded and adaptable teaching approach, fostering a positive impact on students' learning experiences.

Similarly, the significance of the contrast between the mean scores associated with traditional and constructivist teaching methods indicates a clear preference for the latter in the context of Nepal. Policymakers should consider these findings when designing and implementing educational policies, promoting the integration of constructivist methodologies in teacher training programs and curriculum development.

In summary, the implications of this research emphasize the importance of aligning mathematics education practices with the fallibilist philosophy, encouraging constructivist approaches, addressing, and challenging absolutist beliefs, and promoting the adoption of innovative, student-centered teaching methods in the context of Nepal. These insights can guide efforts to enhance the quality of mathematics education and contribute to the professional development of mathematics teachers in the region.

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