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Teachers' perspective on STEM curriculum in schools under Gasa Dzongkhag

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Keywords

STEM,
teacher's perception,
problem solving.

Abstract

Experiential, hands-on learning is used in STEM (Science, Technology, Engineering, and Mathematics) education to connect students with real-world knowledge and more genuine contexts for problem solving. It is critical to understand teachers' views and perspectives about STEM talent development in order for schools to provide high-quality STEM education. Teachers, being key figures in a student's development, have past perspectives and experiences that will impact STEM education. By evaluating current literature, this study seeks to determine what is known about teachers' opinions of STEM curriculum. Based on a survey of teachers at STEM model schools in Gasa Dzongkhag, this study looked at teachers' perspectives and practices of STEM curriculum. The majority of instructors in Bjishong, particularly experienced and male teachers, had a good opinion of the importance of STEM education, according to the findings. Simultaneously, school instructors in the Gasa Dzongkhag identified a number of obstacles to adopting STEM education, including finding time to conduct STEM programs, higher workloads, and a lack of administrative and financial assistance. To better promote STEM education, our findings imply that the government should provide enough funding, and make substantial modifications to the national evaluation system. Quality in-service teaching on STEM pedagogy best practices, as well as district support for collaborative time with peer teachers, are among the recommendations for practice.

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Introduction

Both primary and secondary classrooms are incorporating STEM curriculum and pedagogy into their school day in order to fulfill the demand for more science, technology, engineering, and mathematics (STEM) literate workers. STEM literacy, according to NAE & NRC (2014), entails (1) understanding of the roles of science, technology, engineering, and mathematics in modern society; (2) familiarity with at least some of the fundamental concepts in each area; and (3) a minimal degree of application fluency, defined as the capacity to critically analyze science or engineering content in news reports, do basic troubleshooting of common technologies, and execute fundamental mathematical operations applicable to daily life.

There are many vacant positions for every individual jobless with a STEM degree (National Science Board 2012). It is critical for our economy that schools produce students who are capable of making valuable contributions in STEM professions. Schools must simplify STEM education and optimize their teaching pedagogy in order to fully realize our kids' STEM potential. Gomez and Albrecht (2013) propose for using an interdisciplinary approach to anchor this education and instruction in STEM pedagogy. This method helps kids to create real-world connections while also preparing them for STEM jobs and paths. With the objective of better integrating engineering and technology into traditional math and science classes, reform attempts have begun (National Science Board 2007). One way to integrate the courses is to teach them through the engineering design process, which is a project-based method that challenges students to use content knowledge to solve issues. STEM pedagogy is built on this foundation. Students are encouraged to gain new understandings while refining their concepts as they learn by doing (Mooney and Laubach 2002). Teachers must be proficient in this unique student-directed methodology in order to provide in-depth problem solving via STEM curriculum with genuine experiences. To allow students to fail and continue, educators must grasp the importance and power of the engineering design process. These educators must be well-versed in not just their subject area, but also the substance of other disciplines. They must also believe they are capable of establishing an educational atmosphere in which students can tackle ill-defined challenges while expanding their understanding of the subject matter.

Bhutanese students are well-known for their exceptional performance on international student tests such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) (TIMSS). For example, in PISA test (i.e., 2012), neighboring country India received the thirteenth mean score in mathematics among the 64 PISA participating nations, but the highest among OECD countries (OECD, 2014). Bhutan students, on the other hand, are well-known for their lack of interest in and appreciation of science and mathematics. Bhutanese pupils, for example, showed the second lowest level of interest in learning science among the 57 nations that took part in the PISA 2006 survey (OECD, 2010). These contradicting findings prompted Bhutan educators to make an attempt to pique kids' interest in science and mathematics. In this context, the Ministry of Education (MOE) proposed a strategy in 2011 to rebuild STEM education by improving interdisciplinary learning and adding "Arts" to STEM, resulting in Science, Technology, Engineering, Arts, and Math (STEAM) (MOE, 2011). Since then, the Ministry of Education has worked hard to ensure that STEM curriculum is implemented successfully in primary and secondary schools. For example, the ministry has explicitly stated the relevance and necessity of STEM curriculum in the National Normal Curriculum (NNC, 2021) to guarantee a direct link to classroom lesson design. The NNC provides space for the teachers and students to explore and go beyond the classroom teaching. Furthermore, during this time, not only have the so-called STEM curriculum is being taken care providing opportunities for the formation of STEM groups of teachers, but it has also become mandatory for these schools to include 20% of STEM-related content in syllabi for science, mathematics, technology, and home economics, as well as music and art classes. Furthermore, at the national level, a variety of STEM teaching/learning methods and initiatives have been developed and provided to all schools around the country (MOE, 2011). Despite these attempts, little is known about the implementation of STEM curriculum in schools. We know very little about how teachers value and conduct STEM curriculum as a crucial agent of policy implementation. We are particularly interested in seeing how Bhutanese teachers put STEM instruction into reality in the classroom. We also look at how much Bhutanese teachers appreciate STEM curriculum and what obstacles they experience when presenting it to their students. As a result, our research intends to provide essential information about the state of STEM curriculum in Bhutan.

The differentiated model of giftedness and skill proposed by Gagne (2011) illustrates how a person's innate qualities, or gifts, may be developed into talents via learning and practice. The presence of catalysts, which may either impede or promote the talent development process, is a part of this paradigm. Intrapersonal catalysts, such as perfectionism or confidence, environmental catalysts, such as programs or people, and chance catalysts, such as genetic make-up and family, are all possibilities. Teachers are an example of people who act as catalysts in the development of ability (Gagne2011). They can either aid or hamper a student's development of STEM skill in this function. STEM (science, technology, engineering, and mathematics) programs are an example of an environmental catalyst. An excellent STEM curriculum in a student's education that will help them develop their skill in science, technology, engineering, and mathematics (MacFarlane 2016). In this paradigm, the teacher plays a significant role in this setting, and as a result, the individual and the environment collaborate to build STEM potential. Catalysts, according to Gagne (2011), are neither part of the original gift or the final skill; rather, they are a component of the developmental route that connects the two. Teachers and STEM programs give students with the resources, support, and experiences they need to attain their full potential during the study and practice necessary to develop STEM talent (MacFarlane 2016).

Literature Review

According to recent studies on learning and the brain, how students are taught has a significant influence on their ability to comprehend, think about, and apply course knowledge (Bransford et.al. 2000). As a result, many educators have attempted to redesign learning spaces and pedagogies in order to make them more relevant and meaningful. STEM curriculum arose as a form of practical, hands-on learning based on real-world information in more realistic settings (Rockland, Bloom, Carpinelli, Burr -Alexander, Hirsch, & Kimmel, 2010). Other structural biases that legitimize assertiveness and arguing as academic talents and favor standardized evaluations of learning have not been eradicated by STEM curriculum systems (McIntosh et.al. 2012). Overly prescriptive curriculum actually create hurdles to inclusion (Sharma & Loreman, 2014), failing to meet the emotional and varied needs of minorities (Boylan, 2009), special education pupils (Bucalos & Lingo, 2005), and women (Cooper & Heaverlo, 2013).

Other research looked into the obstacles and problems that instructors have while implementing STEM instruction. Finding time to prepare STEM curriculum, insufficient instructional resources, and a lack of instructors' competence in STEM curriculum have all been cited as important issues in implementing STEM courses, according to research (Lim & Oh, 2015; Shin, 2013). Implementing STEM classes has also been hampered by a lack of awareness of the relationships between STEM curriculum areas and problems coordinating with other instructors (Lee, Park, & Kim, 2013; Noh & Paik, 2014).

The open-ended creative processes found in the arts require the necessary dispositions or habits of mind to transform thinking - the ability to shift views, critically examine alternative options, and design feasible and sustainable solutions (Eisner, 2002). The present need for graduating innovators and entrepreneurs in STEM domains necessitates the strengthening of such a natural transformational thinking process, which provides a larger, more inclusive set of cognitive skills for all learners (Wagner, 2012; Zhao, 2012).

According to Park et al. (2016), have identified a number of problems in adopting STEM education, including finding time to deliver STEM classes, higher workloads, and a lack of administrative and financial assistance. STEM curriculum was seen positively by the instructors, who believed it would improve students' learning results. However, how STEM education can be effectively applied within the present educational system, which is heavily focused on test preparation, remains unanswered. Teaching STEM classes may be perceived as excessive work load unless there is increased administrative and financial support, a rewrite of the national curriculum, and substantial changes in the national evaluation system, according to the research.

Purpose statement

His Majesty the 5th King of Bhutan released a Royal Kasho in 2021, focusing on the need of educational reforms and emphasizing the inclusion of STEAM subjects in all Bhutanese schools. To address this issue the researchers made a study to check out to study of teachers' attitude on function of STEM curriculum in schools under Gasa Dzongkhag. The researcher also believe that by restructuring STEM curriculum to engage students with technologies through open-ended, arts-based assignments that address relevant real-world engineering problems, students will develop a sense of creativity and confidence, as well as other dispositions to meet the needs of the future. The goal of this instrumental case study (Stake, 1995) is to look at how arts-based strategies can help students learn STEM content, transform their thinking, develop interest and confidence in learning, and cultivate the dispositions or habits of mind they need to pursue a STEM curriculum and career. Teachers are the agents who will institute and carry out the function of STEM curriculum in school if timely supports are provided by schools, parents, Dzongkhag and MoE.

Research questions

Three major questions guided this project:

1. What are the best ways and times for instructors to present STEM lessons to their students?
2. What are teachers' thoughts on STEM curriculum and how it could affect student learning?
3. What are the difficulties that instructors encounter while adopting STEM curriculum?

Hypothesis

Ho1: There is no significant difference in teachers' perception of the potential impact of STEM curriculum at different school level

Ho2: There is no significant difference in teachers' perception of the potential impact of STEM curriculum by year of teaching experiences

Ho3: There is no significant difference in teachers' adoptions of STEM curriculum in schools by genders.

Research Methodology

Data and Sample

We used data from the Bhutanese STEM curriculum Project, which attempted to investigate the existing state of STEM curriculum, to answer these study objectives. During the fall of 2021, 84 instructors (49 females, 35 males) who practiced STEM teaching in various schools (ECR, primary and central) under Gasa Dzongkhag were polled for this research. Each participating teacher spent about 30 minutes completing an on-line survey (developed by our research team) that included 38 questions about how often they used STEAM, their attitudes toward STEAM curriculum, the challenges and difficulties they faced when implementing STEAM, and their expectations and satisfactions with STEAM curriculum. Teachers who took part in the study were also asked about their demographics (e.g., gender, years of teaching experiences). Select multiple-choice responses (providing numerous assertions from which instructors were asked to choose one) or open-ended questions were used as item forms. We omitted 10 instances from the current research because their demographic information was unavailable. As a consequence, the analytic sample size was increased to N = 84.

Sample Frame

Name of Schools	Male	Female	Total
Bjishong Central School	18	24	42
Laya Central School	7	14	21
Gasa Primary School	4	7	11
Lunana Primary School	2	2	04
Mendrethang ECR	1	1	02
Lungo ECR	1	1	02
Thangza ECR	2	0	02
Total *N*	35	49	84

N=84/ ECR= Extended Classroom (class PP-III), Primary= Class PP-VI, Central School= Class VII-XII

Research Design

In this finding the researcher used quantitative methods. The research's approach was chosen because it is a field study conducted in a natural environment at schools, with teachers given set of questionnaires to fill in and finally used SPSS software to find mean, median, t-test and other.

Procedure

Before it was finished and disseminated to the target set of respondents, the researchers made changes to the questionnaire. Previously, each investigator completed questionnaires that were sent to all respondents. The papers were gathered in two weeks by random distribution, and specific surveys were sent to responders via email and printed copies. The chosen respondents had roughly 3-5 days to complete the questionnaire and return it to the investigator for data analysis. After the specified weeks, all completed questionnaires were gathered for further data analysis in order to enhance the study output and outcomes.

Research Instruments

The main instrument in this study was a survey questionnaire with a total of 30 items that was used to examine teachers' perceptions on teaching STEM curriculum in different schools. A total of 86questionnaires were delivered but could collect back only 84 correctly filled questionnaires. 2 questionnaires got rejected due to inappropriate filling or missing responses. The questionnaires contain instruction to the respondent asking to read the items and select their response based on a 5- Likert scale ranging from 5 = Strongly Agree to 4 = Agree to 3 = Neutral. 1=Strongly Disagree, 2=Disagree. The questions were divided into three sections. The demographic background of the respondents is covered in Section A, which contains five categories such as gender, teaching experience, school levels, and highest academic qualification. The other two parts are primarily concerned with teachers' perceptions about teaching STEM courses in schools and the challenges encountered while carrying out STEM curriculum in schools. The questionnaire for this study was accepted and adapted from Jang & Tsai (2012) and Schmidt, Thompson, Koehler, & Shin, (2009).

Reliability of the scale

The two parts could not be similar since the scale was heterogeneous and the objects were ordered rationally. As a result, the test-retest reliability criterion was shown to be the most appropriate for establishing the scale's dependability.

Validity of the scale

The investigator worked hard to ensure and confirm the tools' substance and face validity. The scale was also demonstrated to notable psychologists and sociologists to ensure face validity. According to them, the test's wording, structure, and instructions have a reasonable amount of face validity.

Method Used

The researcher employed descriptive methods to test the hypothesis and theoretical model of the study. To examine, the study uses several search engines (Google Scholar, and ERIC) to discover the notion of teacher capability on teaching STEM subjects, and the challenges encountered in teaching STEM curriculum. Quantitative approaches was carried out in carrying out the study. The descriptive static were employed in finding frequency, percentage, mean, SD, and regression.

Results and Discussion

Table 1. The teacher's distribution as per school level, gender, and years of teacher experiences.

		School Level			Total (% of row)
		ECR	Primary School	Central School	
Gender					
Male	N	4	6	25	35
	% (column)	66	40	39.7	41.6
Female	N	2	9	38	49
	% (column)	33	60	60.3	58.4
Total	N	6	15	63	84
	% (column)	7.4	17.8	75	100.0
Years of teaching experiences					
1-5 years	N	2	5	29	35
	% (column)	33.3	33.3	46	41.7
6-10 years	N	2	6	14	22
	% (column)	33.3	40	22.2	26.2
11-15 years	N	1	5	11	17
	% (column)	16.7	33.3	17.5	20.2
15 years above	N	1	2	7	10
	% (column)	16.7	13.3	11.1	11.9
Total	N	6	15	63	84
	% (column)	7.2	17.8	75	100.0

* ECR- Extended Classroom (class PP-II)

Table 1 shows the percentage of teachers by school level, gender, and years of experience in the classroom. To summary, nearly 75% of the 84teachers were central school teachers, 17.8% were primary school teachers, and just 7.4 % were ECR school teachers. Females made up 58.4% of the total. Primary school teachers (40%) and central school teachers (39.7%) had a larger proportion of male instructors. In terms of years of teaching experience, 11.9% had 15 or more years of experience, while 46% had 1 to 5 years. Compared to primary school teachers (33.3%) and ECR alone, the proportion of teachers who taught for 1-5 years was substantially greater among central school (46%) and 6-10 years (40 %) primary school teachers against central school (22.2 %).

Table 2. Teachers' practice of STEM lesson at different levels.

		School Level			Total (% of row)	x^2
		ECR	Primary school	Central School		
Frequency						89.23**
Every lesson per week	N	2	7	38	47	
		33.3	46.6	60.3	60	
1-2 lesson per week	N	2	4	11	17	
	% (column)	33.3	26.7	17.4	20.2	
3-4 lesson/ week	N	2	4	14	20	
	% (column)	33.3	26.7	22.3	23.8	
Types of curriculum						128.32***
Extracurricular Activity	N	1	1	0	2	
	% (column)	16.7	6.8	0	2.4	
After School Program	N	1	2	14	17	
	% (column)	16.7	13.3	22.2	20.2	
Regular Curriculum	N	3	10	44	67	
	% (column)	50	66.6	69.8	80.8	
Special Activities	N	1	2	5	8	
	% (column)	16.7	13.3	7.9	9.5	
Subjects						154.18***
Science	N	4	12	55	71	
	% (column)	80	80	87.3	84.5	
Mathematics	N	0	1	1	2	
	% (column)	0	6.7	1.6	2.4	
Dzongkha	N	0	1	2	3	
	% (column)	0	6.7	3.2	3.6	
Social Studies	N	0	1	3	4	
	% (column)	0	6.7	4.7	4.8	
Environmental Studies	N	2	00	2	4	
	% (column)	20	00	3.2	4.8	

Table 2 shows the frequency with which STEM classes are used, as well as the kind of curriculum and the school topic, at various levels of the educational system. Overall, around half of the instructors polled said they taught one or two STEM sessions every week. Furthermore, nearly 20.2% said they teach one to two classes each week, while approximately 23.8% said they teach three to four sessions per week answering ***Q1 "What are the best ways and times for instructors to present STEM lessons to their students?".*** Furthermore, 60 % stated that STEM curriculum was incorporated into every course. There were, however, some variations in the frequency of STEM classes used by school level, x^2 = 89.23, p =.000.

About seven out of ten instructors said they used regular curricular time for STEM courses when it came to the sort of curriculum they used to implement STEM curriculum. However, there were some differences in the sort of STEM curriculum employed across school levels, x^2 = 128.32, p =.000. For example, 66.6% and 69% of primary and central school teachers said they offered STEM subjects during normal classes, respectively, although just roughly 50% of ECR instructors said they did. Furthermore, only around 16.7% of ECR school instructors used extracurricular activity time for STEM instruction, compared to 6.8% of primary school teachers and none of the central school teachers who used to educate during extracurricular events. Furthermore, the percentage of instructors using after-school hours for STEM classes was around 22.2% for central school teachers, compared to 13.3% and 16.7% among primary and ECR school teachers, respectively.

Finally, roughly seven out of ten instructors applied STEM curriculum in science classrooms, according to the distribution of school subjects in which teachers delivered STEM lessons. However, there were significant variations by school system level, x^2 = 154.18, p =.000. Science was chosen as the key topic in which 87.3 % of Central school teachers delivered STEM classes, although 80% for both primary and ECR school teachers did so, respectively. It's worth noting that STEM subjects were taught alongside science in all of the schools. Furthermore, elementary school instructors have the option of teaching STEM subjects such as mathematics, social studies, and Dzongkha science. ECR and central school teachers also offer STEM lessons to the children through environmental studies.

Table 3. Teachers' perception of STEM curriculum by school level.

	School Level						**Total**	
	ECR		Primary School		Central School			
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
STEM curriculum	4.22	0.67	3.27	0.78	3.24	0.86	4.32	0.72
Potential impact of STEM curriculum	4.73	0.78	2.34	0.67	3.92	0.71	4.71	0.86
Challenges								
A lack of administrative and financial support	3.98	1.07	3.21	0.70	3.27	0.81	3.44	1.09
Difficult in finding time for preparing STEM lessons	3.97	1.02	3.33	0.86	3.09	0.71	3.81	1.09
Increase workloads	3.61	1.04	3.29	0.86	3.21	0.97	3.77	0.93
Difficulties in using new media and experimental equipment	3.40	1.88	3.45	0.82	3.69	0.85	3.98	1.07

Table 3 shows descriptive statistics per school level for teachers' perceptions of STEM curriculum. Overall, the majority of instructors (M = 4.32, SD =.72) believed that STEM curriculum is necessary. Furthermore, the majority of instructors thought that STEM curriculum might benefit student learning in areas such as convergent thinking, creativity, and character development (M = 4.71, SD =.86). However, many instructors claimed that they were having trouble finding time to prepare STEM classes (M = 3.81, SD = 1.09) and that STEM curriculum was increasing their workload (M = 3.77, SD = 0.93).

Table 4. Showing regression analysis table of teachers' perception on STEM curriculum

	STEM Curriculum		*A potential impact of STEM curriculum*		*a. Lack of administrative and financial support*		*b. Difficulties in finding time for preparing STEM lesson*		*c. Increased workload*		*d. Difficulties in using new media and experimental equipment*	
Variable	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
School Level												
ECR (ref.)												
Primary	-0.53***	0.08	-0.49***	0.09	-0.07	0.08	0.07	0.21	0.09	0.08	0.00	0.08
Central	-0.49***	0.07	-0.47***	0.06	0.21	0.09	0/.18	0.19*	0.10	0.08	0.08	0.11
Female	-0.12**	0.07	-0.08	-0.06	0.07	0.08	0.07	0.22*	0.08	0.43	0.22*	0.08
Years of Teaching												
1-5 years (ref.)												
6-10 years	0.02	0.08	0.02	0.09	0.21	0.11	0.17	0.15	-0.05	0.13	0.18	0.16
11-15 years	0.08	0.08	0.08	0.09	0.87	0.11	0.09	0.15	-0.03	0.13	0.16	0.16
16 years above	0.19*	0.06	0.19*	0.06	-0.06	-0.18	0.17	0.10	-0.12	0.10	0.07	0.12
Constant	4.78***	0.09	4.56***	0.76	2.56***	0.12	3.45***	0.12	3.47	2.34***	3.21***	0.23
R-squared	0.109		0.089		0.018		0.019		0.029		0.017	
N	84											

The STEM regression results are shown in Table 4. The above table shows teachers' perceptions on STEM curriculum varied by school level, gender, and years of experience teaching. There were substantial discrepancies in teachers' perceptions of STEM curriculum based on school level, gender, and years of teaching experience, according to the findings. Primary and central school teachers, in particular, had a more favorable attitude toward STEM curriculum than ECR school teachers. In other words, ECR had the lowest favorable opinion of STEM curriculum. Furthermore, as compared to male instructors, female teachers had a more unfavorable impression of STEM curricula rejecting ***Ho3 "There is no significant difference in teachers' adoption of STEM curriculum in schools by genders".*** Finally, when compared to instructors who had only been teaching for one to five years, teachers who had been teaching for 16 years or more showed a more optimistic outlook. Teachers' perceptions of the potential benefit of STEM curriculum varied significantly by school level and years of teaching experience. When compared to ECR school instructors, primary school and central school teachers had a more favorable opinion of the potential influence of STEM curriculum on student learning thus rejecting the ***Ho1 "There is no significant difference in teachers' perception of the potential impact of STEM curriculum at different school level".*** There is significant differences in the perception of adopting STEM curriculum among the different levels of school under Gasa Dzongkhag. Furthermore, as compared to teaching experiences who had only been teaching for one to five years, teachers who had been teaching for 16 years more had a more positive perspective of the potential influence of STEM curriculum in the schools thus rejecting the ***Ho2: "There is no significant difference in teachers' perception of the potential impact of STEM curriculum by year of teaching experiences".***

There were considerable disparities in teacher perceptions of obstacles based on school level and gender. Instructors at central schools, for example, were more concerned about growing workloads than teachers in ECR schools. Furthermore, female instructors were more concerned than male teachers about growing workloads. In addition, female instructors were more likely than male teachers to cite challenges with new media and experimental technology. It answers ***Q2 "What are teachers' thoughts on STEM curriculum and how it could affect student learning?".***

Findings and Discussion

To highlight a few major findings, we discovered that central school teachers were the most likely to implement STEM curriculum in their classes, followed by primary and ECR teachers. Furthermore, compared to primary school teachers, we discovered that a substantially larger proportion of central school teachers delivered STEM curriculum during science class.

Second, we discovered that the majority of teachers in Gasa Dzongkhag had a favorable opinion of STEM education. Furthermore, the majority of Gasa Dzongkhag school teachers stated that STEM curriculum will aid in the development of convergent thinking, creativity, and character among students. The biggest conviction in the potential positive function of STEM curriculum in improving student learning was held by central school teachers. These findings back with previous studies of Bhutanese teachers' favorable attitudes toward STEM education (Han & Lee, 2012; Lee, Park, & Kim, 2013; Lim & Oh, 2015; Shin & Han, 2011).

Third, we discovered that the most significant hurdles for Gasa teachers in implementing STEM curriculum were a lack of time and increased workload. Teachers at central schools, in particular, expressed more anxiety about growing workloads than teachers in ECR schools. Furthermore, we discovered that a significant number of teachers cited a lack of administrative and financial support for adopting STEM classes, these answered research ***Q3 "What are the difficulties that instructors encounter while adopting STEM curriculum?"***

Finally, we discovered that, when compared to their more experienced and male peers, starting instructors and female teachers had a more unfavorable impression of STEM curriculum.

Conclusion and Recommendation

Our findings reveal that many Bhutanese teachers viewed STEM education positively, believing that it would improve students' learning results. Given the importance of teachers in curriculum implementation, this conclusion is quite encouraging. However, how STEM education can be implemented effectively within the present school system, which is heavily focused on test preparation, remains unanswered. Our findings suggest that unless greater administrative and financial support is provided, the national curriculum is reconstructed, and major changes in the national evaluation system, Bhutanese teachers may regard providing STEM subjects as an additional work burden. In conclusion, while there were significant disparities among instructors at various levels of the educational system, the majority of Bhutanese teachers agreed on the necessity of STEM curriculum. They agreed that STEM curriculum will help children develop an interest in science and mathematics, increase their convergent thinking and creativity, and improve their comprehension of core subject material. Teachers, on the other hand, underlined the challenges and restrictions of implementing STEM curricula in Bhutan. As a result, increased governmental and institutional support, as well as revisions to the national curriculum and assessment, are required for STEM education to flourish in Bhutan. Our study has larger implications for STEM curricular practice outside Gasa Dzongkhag, despite the fact that we concentrated on this Dzongkhag. Our findings show that Gasa teachers may view STEM education as extra labor, and that they will be less motivated to incorporate STEM curricula unless it is included in their usual teaching load. Teachers in other Dzongkhag are probably in the same boat. In other words, until STEM coursework is integrated into the school curriculum, instructors elsewhere may not have a justifiable motive to implement STEM teachings. STEM curriculum would be more successful and durable in this sense if it were included into the normal curriculum.

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Appendices

Instructions: *Please answer each question to the best of your knowledge. Your thoughtfulness and candid responses will be greatly appreciated. Your individual identification will not at any time be associated with your responses and will remain confidential. Thank you for taking time to complete this questionnaire.*

Gender: Male / Female

Year of experience: 0-5 years/6-10 years/11-15 years/16 and above

School level: ECR/ Primary/ Central

Academic Qualification: PTC/Bed/PGDE/Med

Frequency of STEM lesson plan prepared: Every lesson per week/ 1-2 lesson per week/ 2-3 lesson per week

Types of STEM curriculum practiced: Extracurricular activities/ after class program/ Regular curriculum/ Special activities

Subject of STEM inclusion: Mathematics/ Science/ Dzongkha/ Social Studies/ Environmental studies

No	Questions	SD	D	N	A	SA
	STEM Curriculum					
1	I know how to assess students' performance in a classroom					
2	I can adapt my teaching based upon what students curriculum understand or do not understand					
3	I can adapt my teaching style to different learners					
4	I can use a wide range of teaching approaches in classroom setting					
5	I am familiar with common student understanding and misconceptions					
6	I can assess student learning in multiple ways					
7	I know how to organize and maintain classroom management					
8	I can select effective teaching approaches to guide student thinking and learning in mathematics					
9	I can select effective teaching approaches to guide student thinking and learning in literacy					
10	I can select effective teaching approaches to guide student thinking and learning in Science					
11	I can select effective teaching approaches to guide student thinking and learning in Dzongkha					
12	I can select effective teaching approaches to guide student thinking and learning in Social Studies					
13	I can select effective teaching approaches to guide student thinking and learning in Environmental Studies					
14	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what student learn					
15	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom					
16	I can provide leadership in helping others to coordinates the use of content, technology, and teaching approaches at my school and/or district					
17	I can choose technologies that enhance the content for a lesson					
18	I can create a classroom setting to promote student's interest for learning STEM concepts					
19	I am familiar with common student understandings and misconceptions of the STEM content I am teaching					
20	I use a variety of teaching approaches or strategies to raise students' confidence in their capacities to perform successfully STEM activities					
	Challenges in carrying out STEM curriculum in schools					
21	There is lack of administrative and financial support from my school					
22	I have difficulty in finding time for preparing STEM lesson					
23	STEM curriculum is the increase of work load for teachers					

24	To carry out STEM curriculum in classes it's difficult to use new media and experimental equipment					
25	I will continually find better ways to teach STEM content in my class					
26	Even if I try very hard, I do not teach STEM as well as I do in most subjects					
27	I am not very effective in monitoring STEM concept effectively					
28	I generally teach STEM content ineffectively					
29	I find it difficult to explain to students why STEM experiments work					
30	I wonder if I have necessary skills to teach STEM content					

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