Comparative Study of Mathematics Education in Bhutan and Japan

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ブータンと日本の数学教育に関する比較研究

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ABSTRACT

This comparative study reveals the similarities and differences in the education systems of the two nations in terms of their national education systems, school mathematics curricula and textbooks, and actual classroom practice through a review of previous literature and relevant government documents, seminars, and classroom teaching observations. There are striking differences in various areas, such as the academic year, assessment and promotion, textbook development and adoption process, actual classroom teaching through so-called "problem-solving," the professional development program known as "lesson study," etc. While Japan is continuously ranked in the top 10 and students' levels of achievement are found to be high, particularly in science and mathematics through international assessment like Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS), Bhutan has not yet to participated in such an international assessment program. The Bhutanese education system is comparatively younger than to that of Japan; however its success, especially in professional development through lesson study and student-centered classroom practices through "structured problem-solving" methods, which are gaining international attention for possible adoption in other countries.

1．Introduction

Bhutan is a small landlocked country, with China to the north and India to the south. It has a total land area of 38,394 sq. km and a population of 748,931 (NSB, 2020). The country followed a self-imposed isolation policy until the 1960s when the third king of Bhutan (1952-1972) introduced modern developments by linking the country to the outside world. This self-isolation

policy accounts for why Bhutan is one of the few countries in Asia that has never been colonized and hence, its unique cultures, traditions, and strong social values have remained intact and deeply rooted among all Bhutanese people. However, Bhutan is steadily gaining recognition all over the world as one of the happiest countries, with its development plans and policies driven by a unique developmental paradigm known as Gross National Happiness.

Until the 1950s, education in Bhutan was mainly monastic and hence, Buddhist monasteries were the only source of formal education available for Bhutanese children. However, a few private schools in Haa and Bumthang were established in 1913 and 1914.They provided a modern education, and the medium of instruction was Hindi. With the advent of planned developments in 1961, the formal education system expanded rapidly, and the medium of instruction also changed to English. Today, the education system in Bhutan consists of three main forms: general education, monastic education, and non-formal education.[18)]

Education in Japan dates back as early as the Edo era (1603-1868) and systematic education began during the Meiji era after the establishment of the Ministry of Education as part of central government in 1871. The homogeneous cultural and linguistic traditions in Japan made it easier to adopt Japanese as the sole medium of instruction from the very beginning of the education system. By 1900, a system of automatic progression had replaced examinations through grades. The 6-3-3-4 system was adopted after WWII together with a nine-year compulsory education.

In Japan, school enrollment for the compulsory period of 9 years, including 6 years of primary and 3 years of lower secondary education, reached 99.2% by 1950. Furthermore, adult illiteracy appears to have virtually disappeared by the early 20th century.[12)] In contrast, the net enrollment rate in the compulsory education period of 11 years (Classes pre-primary (PP) to tenth) is 90.6%, the youth literacy rate is 93.2%, and the adult literacy rate is 66.5% as of 2020 in Bhutan (Annual Education Statistics, 2020). While Japan is continuously ranked in the top 10 and students' levels of achievement were found to be particularly high in science and mathematics through international assessments like PISA and TIMSS, Bhutan is yet to participate in these types of international assessment programs. However, Bhutan participated in PISA-D in 2018 and had a significantly higher average percentage than that of other PISA-D countries in all three domains. However, it was significantly below the OECD average.[15)]

Therefore, this study aims to establish the differences and similarities in education systems, particularly in mathematics education, between Bhutan and Japan by comparing national education systems, mathematics curricula, textbooks and lessons, and other relevant educational issues, so that the good practices in Japanese mathematics lessons can be identified for possible adoption by Bhutanese mathematics educators.

2. Research Questions

- How does the Japanese education system, specifically mathematics education, differ from that of Bhutan in terms of

i) The national education system
ii) The mathematics curriculum
iii) Mathematics textbooks
iv) Mathematics lessons
v) Issues in the education system

- What are the good practices in the Japanese mathematics education system that could possibly improve the practices of Bhutanese mathematics teachers?

3. Objectives of the Study

This comparative study aims to achieve the following objectives:

- To find the similarities and differences in mathematics education between Bhutan and Japan by comparing the mathematics curriculum, textbooks, and lesson presentation in the classroom.
- To identify the good practices in the Japanese mathematics education system that might enhance the practices of Bhutanese mathematics educators.

4. Methodology

The study mainly involved the following methods:

- Collecting and analyzing existing data from primary sources, such as government documents, statistical data, research reports, textbooks, and other literature.
- Seminars and lectures.
- Observations of video-taped lessons.
- Observations of lessons in schools attached to Hokkaido University of Education.

The seminars had two main stages: first, gathering information and studying the Bhutanese education system, and second, comparing the Bhutanese education system with that of Japan in terms of the mathematics curriculum, textbooks, and actual lessons in the classroom.

The components considered during the observations of video-taped lessons and actual classroom teaching were teacher-student interactions, by noting teachers' questions and pupils' responses, the learning conditions of the pupils, positive points, and problems during the lessons.

5. Results and Discussion

5. 1. National Education System

5. 1. 1. Education System in Bhutan

Until the 1950s, the education system in Bhutan was mainly monastic and monasteries were the only source of formal literacy. Besides the practice of religion, they contributed greatly to advancing language, arts, literature, and philosophy. Modern education is said to have started with the establishment of some private schools in Haa and Bumthang in 1913/1914. Education went through a rapid development and expansion with the advent of the first five-year plan in 1961 and played a significant role in the political, cultural, environmental, and socio-economic development of the nation. Today, the education system mainly consists of three forms:

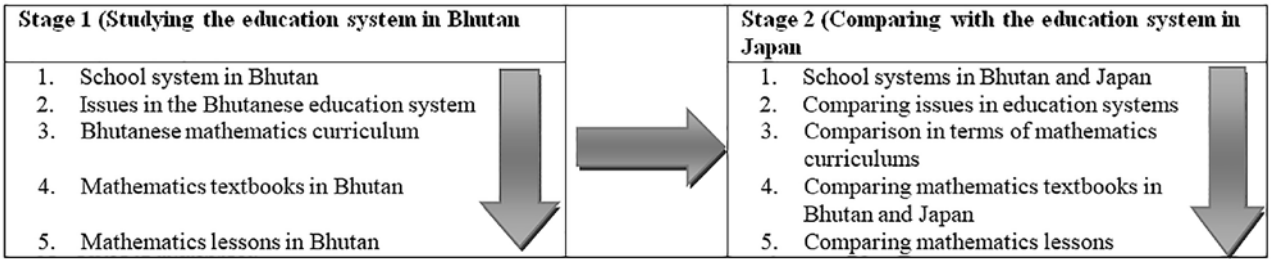

Fig. 1 Information and data gathering through seminar

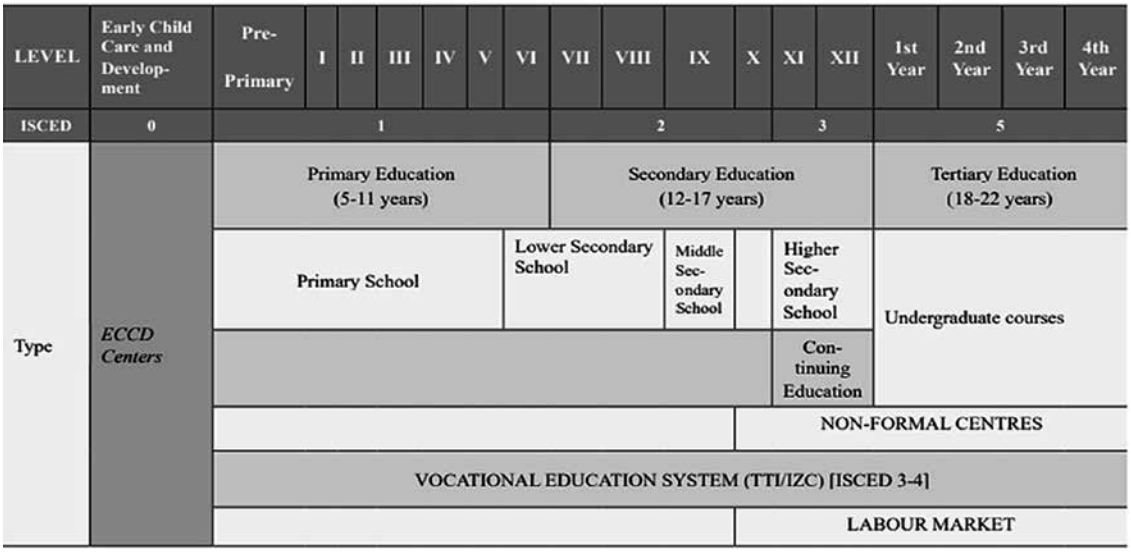

Fig. 2 General Education Structure (AES 2020)

general, monastic, and non-formal. The general education system is the most common and is considered as the formal educational structure.[18] The system aspires to prepare citizens who are nationally rooted and globally competent by aligning it with the unique values, culture, and traditions of the country and also with the values, knowledge, and skills necessary for the 21st century.[17]

Article 9, section 16 of the constitution of Bhutan states that "The State shall provide free education to all children of school age up to the tenth standard and ensure that technical and professional education is made generally available and that higher education is equally accessible to all on the basis of merit." The compulsory basic education, lasting 11 years, starts in the PP grade and continues until the tenth grade. It is free of charge and even the higher secondary and tertiary educational establishments are accessible to students who can reach the benchmark set by the government and other tertiary education institutes, based on their ranking. Other students who do not qualify to continue their studies using government funds can either choose to continue their higher education privately or various vocational and technical training options are made available.[17]

The general education structure comprises 7 years of primary education (classes PP-VI), 6 years of secondary education (classes VII-XII), and 3 or more years of tertiary education, depending on the field of study. The classification of schools is carried out depending on the final grade available in the school. A school that offers education up to class VI as the final grade is known as a primary school. Similarly, schools that have their last grade as VIII, X, and XII are called lower secondary schools, middle secondary schools, and higher secondary schools, respectively. The secondary schools' entry grades begin at either class PP, VII, IX, or XI. To enhance and ensure equity and access to education, extended classrooms (ECRs) have been introduced in remote and scattered settlements, which offer 4 years of education (Classes PP-III).[18]

The educational administration and management consist of the Ministry of Education (MoE), the Royal Education Council (REC), the Bhutan Council for School Examinations and Assessment (BCSEA), the Ministry of Labor and Human

Resources (MoLHR), tertiary education institutes, "dzongkhags/thromdes," "gewogs," and schools. The MoE is responsible for policy formulation, planning, and administration of school education (PP-XII), the REC for curriculum/textbook development and review, and the BCSEA carries out the national assessments. The MoLHR is responsible for technical and vocational training for students after their basic education, and tertiary education institutes for the provision of education programs for higher secondary school graduates. The dzongkhags/thromdes education office is responsible for construction and maintenance, the supply of teaching and learning materials, the deployment of teachers within the dzongkhag/thromde, and the implementation of national policies.[18)]

The education system strives to prepare young people with the right knowledge and skills to make them socially useful and economically productive citizens. Students in the primary education phase are required to study basic literacy and numeracy skills. They also gain knowledge about the country's history, geography, culture, and traditions, and the fundamentals of agriculture, health and hygiene, and the population. As students advance to higher secondary education, they are allowed to choose a course according to their interests and abilities, with arts, commerce, "rigzhung," and science as the main choices.[18)] The assessments comprise of continuous formative assessment, continuous summative assessment, and term-end summative examinations, and students' progression from one grade to the next is dependent on acquiring the minimum required benchmark from a combination of continuous summative assessments and term-end examinations.

Fig. 3 Typical classroom arrangements in Bhutan

The academic year consists of 880 instructional hours delivered over 180 instructional days and the ministry gives consent for a class size of 24 for primary level and 30 students for secondary level.[17)] According to the annual education statistics 2020, the student-teacher ratios in public schools are 16, 17, and 18 in primary, lower secondary, and middle and HSS respectively. To encourage communication, socialization, teamwork, peer teaching, and so on, the students in the classroom are usually arranged into teams of 4 or 5 members. The school year begins in February and ends in December in the same year and an academic year is divided into two terms. Term 1 is from February to June and Term 2 from August to December. English is the medium of instruction for all subjects except "Dzongkha," and hence is a compulsory subject from PP education onward.

5. 1. 2. Education System in Japan

Education in Japan dates back as early as the Edo era (1603-1868), focusing on Chinese classics, reading, writing, and practical skills required for daily living. Systematic education began during the Meiji era after the The Ministry of Education, Science, and Culture was established as part of central government in 1871. However, the Japanese education system went through major reforms after WWII, such as adopting the 6-3-3-4 system, extending compulsory education

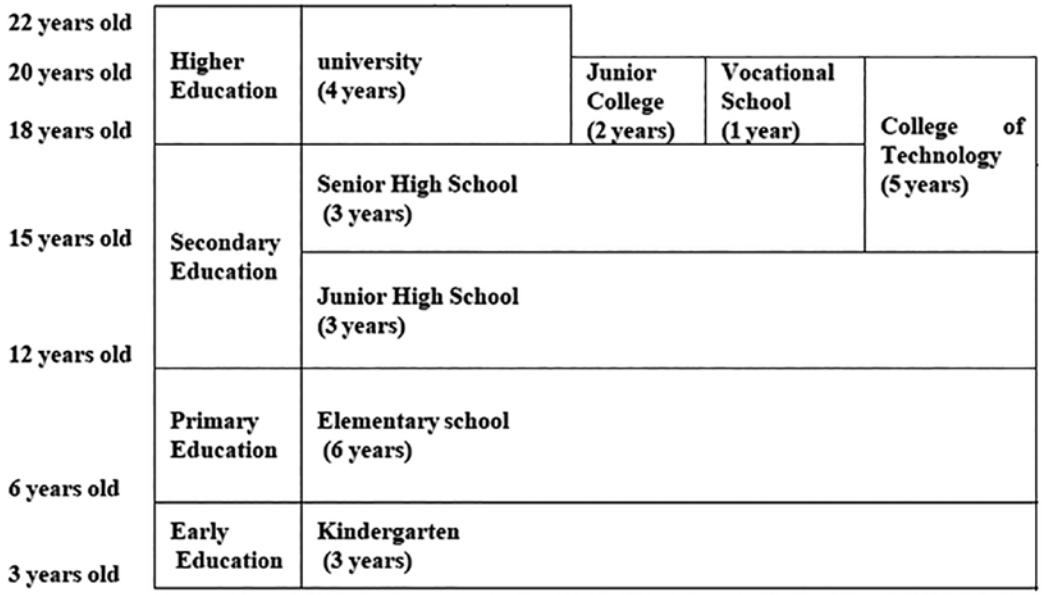

Fig. 4 General Education Structure

to 9 years, and the establishment of boards of education at prefectural and municipal levels. The education system went through such rapid expansion and development that school enrollment for the compulsory education period of 9 years through first grade to ninth grade reached 99.2% by 1950 and adult illiteracy virtually disappeared by the early years of the 20th century.[12] Today, the level of Japanese education is high, even by world standards, as is evident from international assessments like PISA and TIMSS, indicating a high level of achievement, particularly in science and mathematics.

The constitution of Japan provides guidance as regards the establishment of the right to education and compulsory education. The "Basic Education Act," in accordance with the constitution, establishes the fundamental visions and principles for education and the education system. The education system is administered and managed by national, prefectural, and municipal governments. The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) provides guidance, advice, and funding to the prefectural government and also sets the minimum standards for and closely supervises the curriculum, textbooks, and classes to maintain a uniform level of education throughout the country. Each prefectural government has its own education board that offers direction, counsel, and subsidies for the prefecture's public and private schools. These boards have an assortment of obligations including, yet not restricted to, picking textbooks, employing teachers, and drawing up the budget along with the governor. Both MEXT and the prefectural governments give direction to municipal governments, whose own boards similarly guide local schools.[29]

The basic education of 9 years through first to ninth grade is compulsory and free. However, pre and post compulsory education is dominated by the private sector, and this is costly in terms of tuition fees, which is a burden on household income. For example, 80.8% of kindergartens, though not compulsory, are privately owned. Furthermore, 73.4% of university enrollments, and 93.8% of junior college enrollments are in private institutions.

The Japanese school system consists of 6 years of elementary school, 3 years of junior high school, 3 years of senior high school, and 4 years of university (6-3-3-4 system). At primary and lower secondary education levels, a general education is provided, which is common for all. Students in elementary school generally study Japanese, mathematics, social studies, science, music and arts, handicrafts and homemaking, and physical education. Junior high school students' courses include English, field trips, and clubs, in addition to the subjects studied in elementary school. Senior high schools have courses in general or highly specialized subjects (agriculture, industry, commerce, fishing, home economics, nursing, and social services, etc.)[22] depending on the type of school, such as elite academic, non-elite academic, or vocational high schools.

The system of progression through the grades by examination was replaced with automatic promotion based on age from 1900 onward. Therefore, gifted students are not allowed to skip a grade and slow learners are not forced to repeat a grade.[22] However, students must pass two rigorous entrance examinations (high school and university entrance examinations) to be able to enroll in prestigious schools or the university of their choice. The academic year in the Japanese school system follows a trimester system, which begins on April 1 and ends on March 31 of the following year.[29] The number of instructional hours in a year ranges from 850 to 1015 hours depending on the grades. The class size in public elementary schools is 35-40 and in junior high schools is 40 students (Japan Times, Dec 17, 2020). The teacher-pupil ratio, as of 2017, is 15.66 in primary education and 11.12 in secondary education (Statista, 2021), and classrooms are usually arranged in rows and columns with one student per table.

Fig. 5 Typical Japanese classroom arrangement

5. 2. Mathematics Curriculum

The curriculum, which certainly forms the core of education, may be known as a syllabus, textbook or some other teaching materials, which, in essence describe the course that students follow. According to TIMSS, a curriculum is defined as three levels of intended, implemented, and attained programs, which correspond to each other but are not necessarily equivalent. The first includes the national policy, which is prepared at national level in terms of the syllabus and the textbooks, the second is the implementation of the intended curriculum in schools by teachers, and the last is what is acquired by learners through the implementation.

MEXT prepares the guidelines containing the objectives and contents of each subject for each grade, which is called the National Course of Study and it is revised once every 10 years.[7] In Bhutan, the REC is an independent professional body and has responsibility for educational innovation and transformation, and also national school curricula and teacher professional development programs in collaboration with relevant national and international stakeholders.[21]

The origins of Bhutanese mathematics

education can be found in curricula borrowed from India and textbooks designed for Indian students and taught by Indian teachers. In 1986, major curriculum reforms focused on making content relevant to the Bhutanese context were initiated with the launch of the New Approach to Primary Education. The new PP to 12th grade mathematics curriculum was developed based on "social constructivism." Its design was influenced by the USA's National Council of Teachers of Mathematics (NCTM) standards in 2005 and was implemented from 2008. The new mathematics curriculum aims to facilitate an in-depth understanding of mathematical patterns, with an emphasis on why mathematical patterns are true rather than simply accepting that they are true. It also focuses more on reasoning and contextualization in the local setting by demanding more student-student and teacher-student communications.[4), 5)]

The mathematics curriculum in Japan consists of three parts: overall objectives for the level (primary, lower secondary or higher secondary), objectives and content for each grade, and syllabus design and content. Methods and materials are specified to some extent in the objectives and content for each grade, as well as in the construction of teaching plans and observations on the content. Mathematics is a required subject in primary, lower secondary, and the first year of upper secondary school. "Mathematics activities" is a part of the curriculum objectives at every grade. In addition, enjoying mathematics is an objective at primary and lower secondary levels, while fostering creativity in mathematics is an objective at upper secondary level.[27)] The curriculum framework developed by REC in Bhutan provides a broad outline of content areas, implementation procedures, and assessment for a particular subject.[21)] It consists of key stage competency standards, class competencies, learning objectives and content, and essential skills for each strand. Mathematics is a compulsory subject and is offered as one subject from key stage I to key stage IV. It is differentiated into pure and business mathematics and is optional in key stage V. The learning is based on concrete materials in the students' immediate surroundings (classroom, home, school), and the principle of learning through play is adopted in key stage I. The content of key stage II focuses on achieving the learning outcomes based on concrete and abstract content by using more contexts immediate to the students and allowing them to explore a little further. More abstract concepts are learned using personnel, national, and international contexts, with increasing depth from key stage III.[20)]

The curriculum of both countries focuses on almost the same process and content strands. Japanese mathematics education prioritizes three pillars in order to achieve mathematics targets: knowledge and skills; thinking, judgment, and expressiveness; and capability and human qualities. Bhutan's curriculum has three strands: formulating situations mathematically; applying mathematical concepts, facts, and procedures; and interpreting, reasoning, and evaluating mathematical

Table 1 General mathematics content

Japan	Bhutan
A. Numbers and Calculations	I. Numbers and Operations
B. Figures	II. Patterns and Algebra
C. Measurement (grades 1–3)	III. Geometry
D. Change and Relations (grades 4–6)	IV. Measurement
E. Utilization of Data	V. Data Management and Probability

outcomes.[20] Table 1 shows the general mathematics content strands in the two countries.

5. 3. Mathematics Textbooks

"The quality of mathematics textbooks could influence the quality of classroom mathematics teaching, and it is also an important factor in determining the extent to which mathematics curriculum reform could be implemented" (Cao et al., 2017, p.63). In Japan, a textbook is not simply one of many tools for learning, as most teachers rely on textbooks as the only tool for teaching and learning. Indeed, article 21 of Japan's Basic Education Law states that a textbook should be used as the primary source for classroom instruction.[26] Independently owned and operated publishers develop and produce textbooks based on the National Course of Study, and these are submitted to the MEXT for evaluation and authorization. There are six authorized private publishing companies who develop new textbooks with an editorial committee consisting of college professors, classroom teachers, and administrators. Multiple textbooks for the same grade published by different companies undergo this adoption process. The authority to decide which one to adopt is vested in the competent local board of education for public schools and in the principal for national and private schools, and hence, the textbooks used are different depending on the prefecture. The textbooks at compulsory education level are supplied free of charge to all students at the expense of the government in both public and private schools. The textbooks are usually revised every 4 years.[13), 26)]

In contrast to Japan, the REC, as the only independent organization in Bhutan, is responsible for curriculum, professional development, education research and development of teaching learning materials (TLMS), including textbooks. The textbooks, student workbooks, teacher manuals, etc., are designed and developed by the REC. School teachers and other experts, such as relevant national and international stakeholders, are involved. The finalization of textbook implementation is done in collaboration with the MoE and is distributed to all schools free of charge.[17), 21)] Therefore, the textbooks are uniform in all schools throughout the nation. However, mathematics textbooks used in higher secondary education (classes XI and XII) are revised versions of Indian School Certificate (ISC) mathematics published by Indian publishing companies, and are strictly based on the Bhutanese curriculum released by the MoE.

Japanese mathematics textbooks are gaining in popularity all over the world owing to the fact that they explain the underlying concepts needed to solve mathematical problems, rather than simply superficial content that often focuses on memorizing information and completing exercises. Mathematics textbooks in Japan include more resources to help teachers teach and students learn through "problem-solving." The books contain alternative approaches to a problem, provide diagrams to help students solve problems independently, and include pages that teach students how to take notes effectively.[24] Some of the distinct features of Japanese mathematics textbooks include the use of cartoonlike characters to suggest ways of moving away from providing clear explanations of the concept in order to prompt critical thinking, the inclusion of open-ended questions, real-world problems, and hands-on activities, samples showing learners how to maintain a math diary, and the abundant use of colorful, non-textual elements, like

pictorial illustrations and visual representations, to help students solve problems independently.

The Bhutanese textbook series known as "Understanding Mathematics" published up to tenth grade by the REC has in each unit a "getting started" section, regular lessons, at least one explore lesson, games, connection activities, and revision units. Each unit begins with the "getting started" section, which is, in fact, a set of questions to be solved by students individually or in groups to revise prior knowledge and build on new concepts. A new topic is presented with a problem, a detailed exposition of the lesson, followed by solved examples presenting two or more alternative solutions, and a set of "practice and apply" questions. The "explore lessons," "connection activities," and "game" sections of the textbook are usually real-world problems or situations where students investigate problems using math. However, eleventh and twelfth grade mathematics textbooks, which are revised versions of ISC mathematics, contain clear textual explanations of concepts followed by a large number of solved examples and exercises, which include a variety of questions, ranging from easy to tricky to very difficult.

According to the study conducted by Cao, Wu and Dong (2017) comparing the difficulty level of junior secondary school mathematics textbooks in five nations (China, Korea, Singapore, USA, Japan), it was found that the breadth of content in Japanese textbooks was the lowest while the depth of content was second, revealing that it seems to be more focused. In contrast, Bhutanese textbooks and curricula, particularly from fourth to twelfth grade, were found to be taxing in terms of content for both students and teachers. In fact, teachers would often have to accelerate the teaching pace, put in place numerous extra classes, and use a theory-driven lecture method of teaching simply to complete the syllabus. The reasons for adopting such methods to complete the syllabus were the highly prescriptive curriculum and the exam-driven assessment and promotion system (Dorji & Tshering, 2020). The other problem is that while the Japanese textbook series focuses on alternative approaches to solving a problem,[24] Bhutanese mathematics educators are not in favor of presenting a multitude of methods to solve a single problem. They do not wish to have a rule in the mathematics curriculum that mandates the use of multiple methods to ascertain underlying mathematical patterns.[5]

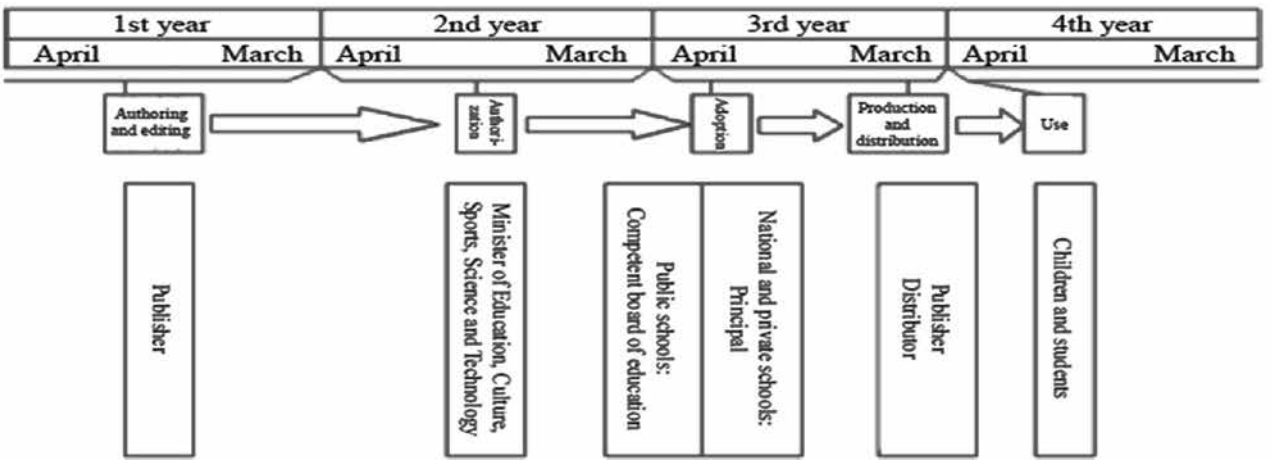

Fig. 6 Textbook development and adoption flowchart in Japan (MEXT)

5. 4. Mathematics Lessons

The intended curriculum may not be delivered if implementation problems remain due to a misalignment between intentions and teachers' actual classroom practice. The Bhutanese mathematics curriculum is based on the United States' NCTM standards and social constructivism, according to which meaningful learning will take place only when students are actively engaged in sharing ideas and discussing concepts and problems. However, most Bhutanese citizens are Buddhists who hold the firm belief that respect for the teacher and obedience are inevitable, and hence, teachers perceive their role as an authoritative source of mathematics knowledge, which students will acquire by attentive listening and following procedures.[4] Thus, student-centered classroom practice has seen little progress. Dolma et al. (2017) also revealed that the majority of Bhutanese mathematics educators lacked ideas in terms of designing activities to encourage students to think critically and to share and justify their ideas.

Japan's major reforms in teaching and learning mathematics in the 1970s and 1980s included a shift from traditional teacher-centered instruction to student-centered education that focuses on students' active engagement in mathematical activities.[25] Today, Japanese mathematics lessons are known to be learner-centered, involving a "structured problem-solving" approach that encourages students to construct their own knowledge through extensive discussion of multiple solutions to a single problem. This has been an extensive topic of interest in educational research. Problem-solving in many countries, including Bhutan, is often viewed as a strategy that focuses on the process of solving the problem, which ends when students come up with a solution. This process does not necessarily focus on developing mathematical concepts and skills. But in Japan, problem-solving is considered as an excellent approach to developing mathematical concepts and skills that does not end once students have found solutions. The teacher facilitates a prolonged presentation and discussion of students' solutions, irrespective of whether they are right or wrong, highlighting the similarities and differences of the different approaches adopted by the students.[24]

Some of the distinct features of Japanese mathematics lesson include student-centered instruction using structured problem-solving methods. This involves carefully selected word problems and activities, with an emphasis on the extensive discussion of possible alternative solutions to a single problem. When mathematical thinking is the main goal of the lesson, Japanese mathematics lessons are often designed around solving a single problem to achieve a single objective[25] for the entirety of a 45- to 50-minute lesson as noticed during the lesson observations. Despite Japan being an advanced country, Japanese classrooms rarely use modern equipment like overhead projectors, computers, and electronic whiteboards, but rather emphasize the extensive use of blackboards.[3] A large-sized board is divided neatly into three vertical columns (presentation of problem, pupils' ideas, summarization), and the board is never cleaned

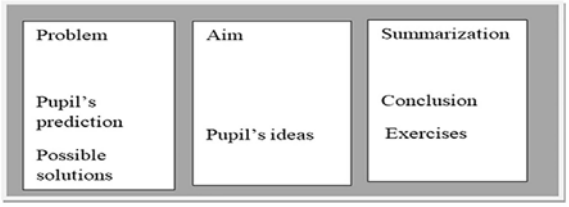

Fig. 7 Blackboard management in a Japanese classroom

during the lesson.

Planning and preparation in the Bhutanese school system usually consists of an annual plan and daily lesson plans. The annual plan is a broad plan with a statement of overall goals, aims, objectives, strategies, and a division of topics according to the instructional days available in an academic year. The components taken into consideration in an effective lesson plan include the identification of the prior knowledge of the students, choosing the right resources and materials, a statement of lesson objectives and how to assess the objectives, and lesson introduction, development, and closure. A typical Bhutanese mathematics lesson, although it may vary from teacher to teacher, begins with revision of prior knowledge by providing an activity or questions, a presentation of the topics and objectives of the lesson, followed by the teacher providing explanations of the topics, solving some examples, and then students are assigned with problems to be solved either individually or in a group. In contrast, the widely practiced structured problem-solving strategy in Japanese classrooms begins with a review of the previous lesson, the presentation of a problem, individual students solving the problem, extensive discussion by students of different approaches to solutions, and the teacher summarizing the concepts and skills.[16)]

Unlike Bhutanese teachers who have to prepare detailed daily lesson plans on their own, Japanese teachers do not write daily lesson plans. They can easily obtain access to sample lesson plans for any particular topic, including students' expected responses to a problem. In fact, both the MoE and private companies publish a variety of support materials for teachers, including lesson plans. However, Japanese educators devote themselves to "kyozai-kenkyu," which means analyzing the topic carefully in accordance with the objective (s) of a lesson. This includes analyzing the mathematical connections between previous and current topics, anticipating students' approaches to the problem, and planning the instructional activities accordingly.[23)]

Another notable characteristic of the Japanese education system is teachers' professional development through the practice of "lesson study," which is gaining in popularity around the world. Lesson studies in Japan, which are neither funded nor mandatory, are primarily school-based and conducted by teachers. A lesson study cycle has four phases: planning, teaching a research lesson, lesson reflection, and acting for improvement. The lesson planning phase is not like planning a regular lesson plan but more like a research proposal.[6)] Teachers gather together to plan a lesson that includes selecting appropriate tasks and anticipating

Fig. 8 Image of a board in a Japanese second grade classroom at the end of a lesson

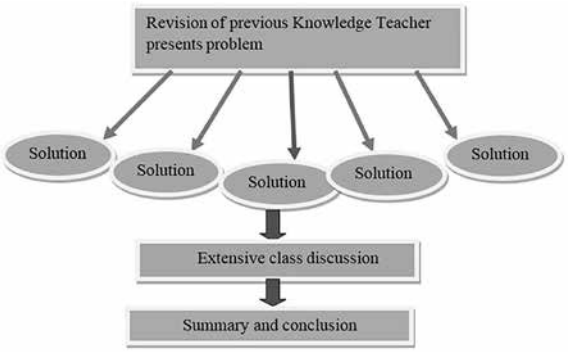

Fig. 9 Japanese structured problem-solving

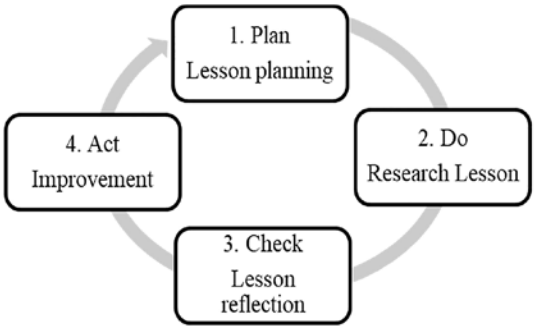

Fig. 10 Japanese lesson study cycle (adopted from seminar)

students' responses and approaches through a great deal of research. A lesson is then taught by one teacher with observers either from the teacher's own school or teachers and academics from a range of schools, with some research lessons being open to teachers from all over Japan. Finally, the research lesson is discussed among teachers and observers, focusing on the learning that has taken place and ways to plan for potential future improvements.[3)]

5．5．Issues in the Education System

Despite both nations striving for quality education through various initiatives such as shifts in educational policy and development, curriculum improvements based on current needs, and teacher professional development programs, etc., there are numerous challenges. Some issues in the two countries are similar while others are unique.

In Japan, educational expenditure remains a high burden on households due to the increasing number of private schools and private funding needed for education, especially before and after compulsory schooling. Japanese students rarely get homework and the time spent on homework outside of school hours is shorter than the international average. Also, elementary school students' interests in arithmetic and junior high school students' interests in mathematics and science are lower than the international averages. Moral education has also been a cause for concern because there seems to be more extreme individualism, a loosening of social ties, and a decrease in interchanges and experiences with people of different cultures and values.[14)] Although the Japanese education system does not have a system of promotion through examination grades, students' entry to the university of their choice is entirely decided by the result of entrance examinations. Hence, students who are anxious about the entrance examinations have to dedicate their free time to attending cram schools. Another pertinent issue is large class size, especially in high schools, which consist of approximately 40–45 students in a classroom.[11)] Poor English communication skills among students and the population at large has also been a matter of great concern and debate.

The Bhutanese education system, despite a great deal of success in modern educational developments in little more than a century since its first introduction, is challenged by numerous issues. Access to educational opportunities has been difficult due to barriers such as socio-economic background, economic status, and the rigid geographical nature of the country. The education system also faces challenges with resource constraints such as inadequate financial and human resources, and basic, modern infrastructures.[9), 28)] The quality of education is also a matter of concern with the education system focused on securing good grades in examinations, which encourages rote memorization of content rather than understanding concepts. There is also a concern about competency in English as it is the medium of instruction and hence impacts all other areas.[28)] Another issue is apathy toward the

teaching profession among Bhutanese people and teacher motivation.[9)]

6. Conclusion

The quality of education is a global concern. The application of knowledge and skills in mathematics and science plays an even greater role today in the world of rapid information and technology-based modernization. Hence, the right curriculum, textbooks, and classroom practice are all necessary in playing a vital role to enhance the quality of education. Otherwise, students' interest, particularly in learning mathematics, which is already perceived as one of the toughest subjects, will decline, as witnessed in both nations and other parts of the world.

Besides these similarities, significant differences were also found in mathematics education. For example, the textbooks in Japan are published by various private companies in line with the National Course of Study prepared by MEXT, hence offering a range of choices for schools to adopt the best textbook. In contrast, schools in Bhutan follow a uniform textbook prepared by the REC. Unlike the automatic promotion through the grades in Japan, Bhutanese students are promoted from one grade to the next by obtaining a set benchmark combined with continuous summative assessments and term-end examinations. While Japanese classroom practice adopts a learner-centered approach through "problem-solving" strategies when teaching the concepts of a topic, Bhutanese educators are still striving to see a complete shift in the direction of this method. Despite these similarities and differences, the education systems in both countries are striving for quality through various initiatives to put in place the right curriculum and classroom practices.

Definition of Bhutanese local terms

"Dzongkha" is Bhutan's official and national language which is closely related to Tibetan. The word dzongkha means "the language of the fortress"; dzong means "fortress" and kha is language.

"Dzongkhags" are the primary subdivisions of Bhutan. The kingdom of Bhutan is divided into 20 districts (dzongkhags).

"Thromdes" (municipalities) are third-level administrative division in Bhutan.

"Gewog" is an administrative division below *dzongkhag*, composing a group of villages. Bhutan comprises 205 *gewogs*.

"Rigzhung" is the field of study which specializes on Bhutanese language, arts, literature and philosophy.

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