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CRITICAL EVALUATION OF MATHEMATICS EDUCATION AT SECONDARY LEVEL IN INDIA AND FINLAND: A LITERATURE REVIEW.

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Abstract

The Finnish education system has received international interest and attention due to their excellent result on international test called Programme for International Student Assessment (PISA) test. Many emerging countries compare their education system with Finnish education. This article evaluates mathematics education at secondary level in India and Finland. It also compares some of their similarities and differences in the mathematics education. This article examines the curriculum, teaching methodology, learning material and assessment policy in the education system of the two countries. Although there is slight difference in the school structure, there are many notable systems to evaluate in these two countries in their mathematics education.

Keywords: PISA test, mathematics education, curriculum, critical evaluation, comparison, teaching methodology, assessment, learning material, literature review, secondary level.I. INTRODUCTION

Comparative education deals with a comparison of two or more education systems. It compares characteristics and attributes in one system with those of another system. Comparative Education is the comparison of various philosophies of education which is based not only on theories but the actual practices. International student assessments are required for bringing educational reform around the world. The assessment brings forth powerful information and data to help educators and policymakers identify strengths and weaknesses of their school systems. Program for International Student Assessment(PISA) is a test used for international student assessment which is conducted by the Organization for Economic Cooperation and Development (OECD). According to OECD, students in Finland usually score higher points than other countries. In 2018 PISA test, Finnish students of 15 year-old score 507 points mathematics which is quiet high compared to an average of 489 points in OECD countries. This has made the Finnish education system more attractive. Many educationists from different countries visited Finland to learn the secret of their success.

In 2012 PISA test, 73 countries participated in the competition. In this test, India was outperformed by 71 countries out of 73 countries. The only country behind India was Kyrgyzstan. India dropped out of PISA testing program from 2012. It may be due to the dismal performance in that year (Singh, 2019). However, India has also a long legacy of mathematics and has produced great mathematician like Aryabhata, Bhaskara, Ramanujan, C.R.Rao and Harish Chandra. Therefore, India has a strong mathematics tradition

which the world has expected to produce. However, the current mathematics education needs reform in order to meet modernity and challenges of new economy.

The current Secondary education in India begins at class 9 and last until class 12. The secondary education is divided into two stages, secondary school (Jr. High school) and higher secondary school. The secondary school consist of class 9 & 10 whereas the higher secondary school consists of class 11 & 12. Finnish secondary education is also divided into lower secondary and upper secondary school. The lower secondary school starts from class 7 and ends at class 9. The upper secondary school starts at class 10 and last until class 12.

Rationale of the study:

In order to find out the quality of one's educational practices, comparison and evaluation is essential. Critical evaluation of mathematics education will provide the current situation in the practice of mathematics teaching, and comparison with abroad countries will provide the merits and demits, the gaps in the practices. The study will broaden one's eyes to the educational practices, theories, and philosophies of other countries. The study will also assist in understanding the practices of other educational institutions. Realizing this, the researchers take a review study on "Critical Evaluation of Mathematics Education at Secondary Level in India and Finland: A Literature Review".

II. LITERATURE REVIEW AND FINDING

Literature review was conducted on the basis of: curriculum, teaching and learning method, teaching and learning materials and assessment policy.

After reviewing Mathematics education in secondary education in both India and Finland, the studies and comparison were as given below

Studies related to curriculum:

Mathematics is a compulsory subject in the Indian education system up to class 10, and therefore every student needs to learn mathematics till the secondary stage of schooling. The main goal of NCF 2005 in Mathematics education is 'the mathematisation' of a child thinking which means to think logically, to reason mathematically, and to visualize and handle abstraction by creative imagination. Besides its various applications in daily life, mathematics curriculum aims to develop a child's capabilities of reasoning mathematically. The NCF 2005 envisions children must learn to enjoy mathematics rather than fear it (NCERT, 2005). For this purpose, the curriculum framework emphasizes the language of mathematics learned in school should be in close relationship with the language spoken by children in their daily life so that the mathematics classroom should be lively and interactive (Dewan et al., 2012). As for the content of curriculum, the higher secondary school mathematics curriculum is quiet difficult and advanced than curriculum of lower secondary mathematics. Shirali & Ghosh (2012) observed that the recommendation of NCF 2005 has little impact on higher secondary mathematics curriculum. Most of the higher secondary mathematics topics are rich and vast in content which includes sets, function, complex numbers, combinatoric, trigonometric function, straight line and conic geometry, statistics and probability in class 11 to matrix algebra, differential and integral calculus, vector algebra and three-dimensional geometry in class 12. Shirali & Ghosh (2012) again mentioned that the curriculum largely emphasizes developing manipulative and computational skills, but little on visualizing concept and application.

Comparison based on curriculum

According to the Finnish national core curriculum framework, "The skills that Finland wants its student to acquire are (a) communication of mathematical ideas, (b) the ability to solve application-type problems by making connections between mathematics and other topics, and (c) improvement of their calculation and problem-solving skills" (Mendaglio, 2014). The Finnish mathematics curriculum aims at inculcating

confidence and positive attitude toward mathematics in students. Finnish mathematics curriculum promotes mathematical thinking and logical thinking. In the lower secondary level, the specific objectives of teaching mathematics is to strengthen general mathematics education and to understand mathematical concept thereby inspiring students to discover and use mathematics in their daily lives and encouraging student to work in a goal-oriented fashion. At upper secondary level, the curriculum aims to stress the role that mathematics plays in society, such as in economy, daily life, science and technology and to prepare students for further studies or future profession (Hemmi et al., 2017). In the upper secondary school, mathematics is divided into Advance Mathematics and Basic Mathematics. Advanced curriculum enables students to be critical towards mathematics and be able to use mathematics for the development of science and technology whereas the Basic curriculum is concerned with preparing its students for everyday life (Mendaglio, 2014). Finnish mathematics curriculum has also some drawback which includes organization of content and scheduling. According to Martio (2009), "The most serious drawbacks in the Finnish mathematics curriculum are the order and time allocated to different concepts and skills".

Developing mathematical thinking is the heart of both Indian and Finnish mathematics curricula. Both curricula stress on the importance of developing creativity, logical thinking, and everyday life mathematics. But Finnish mathematics curriculum emphasizes more on everyday life mathematics in the real-life situation. Finnish mathematics curriculum emphasizes the use of mathematics in societal activities whereas there is not much awareness of societal perspectives in Indian mathematics curriculum. The teachers in Finland are wholeheartedly involved in curriculum planning (Krzywacki et al., 2016), whereas Indian mathematicians does not play active part in curriculum planning. In India mathematics curriculum, selected content are arranged in appropriate sequence whereas organization of content is not properly planned. For example, function and continuity are first learnt before learning calculus, whereas in Finnish mathematics, functions and calculus are learnt simultaneously. Upper secondary school mathematics of Finland offered basic and advanced mathematics which is absent in Indian higher secondary school mathematics.

Studies related to teaching and learning method:

Mathematics teachers in India know mathematics well, and they have a deep understanding in Mathematics. Indian mathematics teachers has been using traditional method i.e. lecture method, for teaching mathematics till today and this traditional method apply deductive reasoning which does not encourages student's participatory learning process (Donnipad, 2009). Problem-solving approach is also commonly used in their teaching. However, the National Curriculum Framework (NCF) 2005 recommended that teacher should apply a variety of teaching method so that student can have a richer toolkit and they could able to learn which approach is the best. Indian mathematics teachers are more concerned about the knowledge of content than the knowledge of how to teach. At the time of studying new topics, Borikar & Seikdar (2019) observed that teacher introduces the topic and explains the concept and spent the first part of the period demonstrating the type of problems and then, in the second part student applies whatever they learned from the teacher. The teacher, then assigns problems to students to solve under his or her supervision, and help those having troubles. Homework is given to student after each lesson and the teacher usually check whether student does their homework or not.

Finnish mathematics classroom is a learner-centred, and therefore students are expected to construct their own learning activities and study plans under the guidance of their teacher. Finnish mathematics teachers avoid teaching hurriedly with excessive speed (Pehkhonen, 2007). This has helped student to have more time to learn, to think, and to construct their own idea. "It has been a tradition for decades that a short time, about a 5 minutes session at the beginning of mathematics lesson is devoted to mental calculation or some other orientation activity" (Krzywacki et al., 2016). Modern Finnish mathematics teacher has combined traditional teaching method with new approaches. Finnish National curriculum recommended constructivist approach of learning mathematics and student are encourages to construct their own knowledge and skills

through innovative practices. So, Finnish mathematics classroom is such a way that student learned how to think and how to reason. "A large proportion of mathematics lesson are devoted to silent, individual work. The pupils can practice at their own pace and teachers help those who need support" (Krzywacki et al., 2016). Discussion and interaction are commonly used in Finnish mathematics classroom at the time of introducing new lesson and reviewing the previous lesson learned. Social interaction and communication in mathematical language really help Finnish students to develop their conceptual understanding of mathematics. According to Savola (2010) students are expected to justify and elaborate on their answers, thereby promoting strict socio-mathematical classroom norms which help them to generate more learning opportunities for their students. Homework has an important role in the teaching-learning process and it is seen as an extension of learning beyond classroom. Homework is usually given to the students at the end of each lesson to continue the learning process and to assess the learning outcomes. "Teachers check each student and make a quick round of the classroom and make sure that all the pupils have completed their homework. Usually, difficult or complicated tasks are explained by selected pupils to the rest of the class. The pupils are regularly given plenty of feedback about their homework. Parents are informed if they do not do their homework" (Krzywacki et al., 2016).

Comparison based on teaching and learning method

Both the Indian and Finnish teacher emphasizes the effectiveness of problem-solving method to teach mathematics thereby encouraging the student to solve problem at their own understanding. Finnish students are taught to construct their knowledge and to learn how to think whereas Indian mathematics teacher gives more effort for student to understand the concept. Both Indian and Finnish teacher assign student class works during the class and home works at the end of the lesson to promote learning process, but Finnish mathematics classroom offer more time for reviewing previously learned and feedback on the classwork and homework. Finnish mathematics classroom is a learner-centered whereas Indian mathematics classroom is a teacher-centered. Social interaction of content knowledge is commonly used in Finnish mathematics classroom whereas the Indian mathematics makes no specific mention about the role of social interaction and discussion among students in mathematical language.

Studies related to teaching and learning material:

In Indian school education system textbook is an importance learning material. Almost all the teachers and students are relying on textbook in the teaching learning process. "The present day classroom practices are, in almost all schools of the country, totally dominated by textbook" (NCERT, 2016). In Indian education system, mathematics textbooks provide guidelines for the teachers as well as for the students. Mathematics book contain clear explanations, examples, exercise for practice, sets of problems, and summaries of key points (Borikar & Seikdar, 2019). The National Council for Educational Research and Training (NCERT) and State Council for Education, Research and Training (SCERT) are involved in various tasks like curriculum renewal, textbook creation, and creation of supplementary study material for student and teachers. In some school technology also play an important role as a teaching-learning material. Some private authors write and published books as guidebooks for students. Teachers sometimes use audio and visual learning materials like charts, maps, projectors, etc. to enhance the teaching-learning process. Resources such as textbooks, reference books, good infrastructure, well set Mathematics laboratory, etc., are available in majority of schools (Beena, 2021). But many schools in India do not have adequate teaching-learning resources due to lack of funding.

In Finland, learning materials are produced by teachers who develop and modified it according to the needs of their student. Textbook as learning material have an important role in Finnish Mathematics education. The use of textbooks was seen as a means for teachers to keep their teaching logical and coherent (Krzywacki et al, 2016). But teachers do not solely depend on textbook, they rely on their deep understanding of mathematics, proficiency in content knowledge and pedagogical skills. Technology and digital tools also play an important role as a supplement in the teaching-learning process. Spreadsheet and

dynamic geometry programs are commonly used tools to support learning, production, and evaluation of work in lower secondary school mathematics (Hemmi et al., 2017). It is noteworthy that the quality of the learning materials is not directly equivalent to the quality of teaching, as the teacher can use all kinds of materials either appropriately or otherwise (Krzywacki et al, 2016). Teacher guide are also extensively used by mathematics teacher to support their teaching. According to Koljonen (2020), all Finnish teacher had chosen the curriculum materials themselves and they all used the teacher guides a lot. The Finnish teachers' guides seem to be manual instructing how to use students' textbook and at the same time, it focus on every lesson to be learnt.

Comparison based on teaching and learning materials

Finnish mathematics teacher has various autonomous roles in the teaching-learning process and so learning materials are also produced by teachers, whereas Indian teacher rarely produced such materials by their own. Both Indian and Finnish mathematics textbooks play an important role as a guideline for teachers and students, but Finnish mathematics teachers rely much on their specialized content knowledge in mathematics rather than textbook and learning material. Indian textbooks tend to be simply about showing an example, followed by a practice of items and thus the emphasis is on procedure rather than concept (Aziz, 2015) whereas Finnish mathematics, textbooks serve as a source of knowledge, motivation, and exercises showing procedure as well as mathematical concept to student.

Studies related to assessment policy:

A very important concern in school education system in India is assessment of student's learning. Both formative and summative evaluation is applied in Indian secondary school. Internal assessment is conducted which included class tests and home assignments. The class test is usually conducted at the end of each lesson. Since mathematics is a compulsory subject in secondary level, all summative evaluations must take into account the concern of universalization. Class X & XII summative evaluation is board examination conducted by Central Board of Secondary Education (CBSE) and respective state board. Since certificate is issued by Government in Class X & XII Board examination, implication of certified passed is considered very important. However, according to Kauts & Kaur (2018) the quality of the present board examination is low and calls for too many rote memorizations and it fails to test the higher order thinking skills like reasoning and analysis. NCF 2005 suggests examination system to be more flexible, reducing stress and to shift from content-based testing to problem-solving and competency-based testing.

In Finland, the National Board of Education (NBE) is responsible for developing secondary school assessment policy. However, Finnish teacher receives a significant trust and thus they have a high responsibility in conducting assessment and they are also free to choose and design their own assessment tools. According to Krzywacki et al. (2016), all Finnish teachers are taught to design and implement assessment in Mathematics during their pre-service teacher education. For internal assessment in upper secondary, Galloway (2008) reported that it is a requirement that students are informed about their schoolwork and progress on a 'sufficiently frequent basis'. She also observed that the purpose of assessment is to give the students feedback on their achievement of the objectives of the course and on their overall progress in the subject concerned. The student's knowledge and skills in each subject are assessed by a teacher or a group of teachers, and the final assessment is decided by the principal in consultation with the subject teachers. For external assessment, matriculation examination is conducted twice a year in spring and autumn, for class 12 students. According to Sahlberg (2014), the only high-stakes external standardized test and school leaving examination in Finland is the National Matriculation Examination. Matriculation Examination is administered by Matriculation Examination Board and those who pass the examination are eligible for tertiary education. It is the only high-stake external examination in secondary education. But, Isaacs et al. (2016), mentioned that there are also national assessments in mathematics which are conducted every two years for a 5% sample of students in lower secondary education (grade 9). However, this national assessment is not for all students and it is not a high-stakes assessment.

Comparison based on assessment policy

Both Indian and Finnish mathematics assessment used formative and summative evaluation. Both emphasized continuous assessment but the assessment section of Finnish mathematics is much shorter. Student self-assessment plays an important role in Finnish mathematics, whereas there is no such self-assessment program in Indian mathematics education. Observational assessment of students by teachers is emphasized in Finnish mathematics classroom whereas Indian mathematics education mostly relies on assigning grades to students for assessment. External high-stakes assessment such as board examination for class 10 and class 12 is conducted in India, whereas in Finland, only matriculation examination for class 12 students is conducted by external agency.

III. CONCLUSION AND SUGGESTION

There will be various advantages and disadvantages in the education system of India and Finland. The Indian mathematics curriculum is one of the best in the world, but there is a lack of innovative teaching strategies and creative learning programs which results in low achievement among students. Therefore, there is a need for improvement of innovative practices in the teaching-learning system. The most significant difference between the education systems of the two countries is that Finnish mathematics curriculum is divided into basic curriculum and advanced curriculum which is absent in India. Another notable difference between the education systems of the two countries is the education of their teacher. Finnish teacher are well trained and it is mandatory to have a master's degree in their primary teaching subject in all the secondary schools which is not the case in India. Teachers also have a comparatively autonomous role in teaching mathematics in their classrooms. For improvement in their mathematics education, both India and Finland can learn from each other. And since Finland is much more successful at the international level such as PISA test, India can adopt some of the remarkable practices in the Finnish education system. But we cannot say India should adopt all the good practices of the Finnish education system since there are significant differences between their societies, culture, economy and political condition. Besides, there is no 'one-size-fits-all' education system in the world. It might be best if the two countries could learn how to bridge between their good practices and learn from each other.

The findings suggested that inclusion of innovative strategies and creative learning programmes is required to increase students' academic scores. It also suggested that in order to score high in international student assessment test, India can adopt good practices from the Finnish education system in the curriculum.

Some of the major educational implications of the study are as follows:

- The findings of the study can be used for updating mathematics education in India.

- The findings of the study can be used for other researchers to compare mathematics education in India with other countries.

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