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Recent Trends of Early Grade Mathematics Curricula

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Abstract- The main objective of this paper is to explore the curricula practices of selected countries from different parts around the world. Rather than providing the historical trends, effort is made to explore the contemporary trends of early grade mathematics curricula. In this paper, the curricula practices of early grade mathematics of Japan, Singapore, Finland, South Korea and Nepal have been examined through the analysis of documents, and contemporary researches. During the analysis and interpretation process focus had been given on intended, implemented and attained curricula. Critical perspective is acknowledged for the meaning making process. Two general trends in intended and implemented curricula that affect the attained curricula have been explored. Moreover, this paper provides comparing and contrasting views of the contemporary trends of early grade mathematics curricula that flourish the grounds for critically re-evaluating their respective practices and thus help to transform conventional mathematics education practices towards more authentic and empowering ones by incorporating emerging trends.

Keywords: Early grade mathematics curriculum; intended curriculum; implemented curriculum; attained curriculum; and critical perspective.

1. INTRODUCTION

Mathematics is highly recognized as one of the most significant subjects in early grade curricula almost all countries around the world. Most of the curricular documents acknowledge that mathematics is one of the subjects that provide necessary knowledge, skills and techniques useful for natural sciences, social sciences and personal lives as well. Besides having the omnipresent roles and importance of mathematics in every sector of our society, nation and the world at large, the formal mathematics education programme in schools has not able to draw a deep attention and credibility from the stakeholders. Mathematics education program itself provides a ground for critiquing as being unable to prepare a creative, imaginative and critical thinker. Schools are generally blamed to produce rote learners in which they are only able to solve the formal routine problems by using certain rules and procedures.

Many researchers (Stinson, Bidwell, & Powell, 2012; Tutak, Bondy, & Adams, ,2011) argue that teaching learning activities in mathematics rely on one-size-fit-all approach in which learners voices are silently discarded for the name of providing standard or universal knowledge and skills. Teaching learning activities are largely guided by behaviourist approaches in which learning is regarded as an externally deterministic Endeavour. Similarly, behaviourist approach of teaching-learning activity adopts a reductionist approaches. Reductionist approaches of teaching learning activities pervasive in school level mathematics teaching in which teachers present mathematical concepts by breaking in small parts and students are urged to remember these facts and the algorithmic procedure to solve the routine problems (Luitel, 2009).It emphasizes on procedural understanding and intentionally ignores a conceptual and relational understanding. Procedural understanding does not incorporate the multidimensional and multifaceted nature of teaching-learning activities in mathematics. Its deductive nature tends to ignore a contextual and individualistic attribute that affects the teaching-learning activities. Many scholarly articles and research reports indicate that most of primary school teachers are unable to use humanistic approaches in teaching-learning activities (Cobb, 2006) as they always hurry to accomplish the pre-assigned course contents within a given time framework (Wang et al., 2012). It indicates that mathematics curriculum is overcrowded by discrete tasks and contents.

Determination or selection of contents is under discussion in early grade mathematics curriculum. Mathematics is an emerging and evolving subject. New mathematical knowledge has been explored rapidly that makes some confusion among the curriculum designers, experts and educators regarding how to select appropriate contents to be taught in early grade. Selection of learning experiences is influenced by objectives or goals of mathematics education. Determination of objectives or goals of mathematics education depends upon many factors. Some of them are national needs, economic conditions, socio-cultural background, political scenario, availability of human and physical resources, learners' needs, aspirations, cognitive level, development of science and technology and

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international practices. It indicates that mathematics education is not an isolated Endeavour. It has multifaceted effects on society and modern science and technology as well. That is profound knowledge and skills in mathematics contribute for the development of science and technology, and advancement of science and technology helps to demonstrate complex mathematical problems in a simple and easiest way so that the essence of mathematical meaning can be explored.

The importance of school mathematics curriculum was heavily realized when United State of America (USA) reached at a conclusion that United State of Soviet Russia (USSR) was able to launch first space satellite 'Sputnik'in 1957 as the outcome of school mathematics curriculum (Alexander, 2010).Early grade mathematics education should not be restricted to developing only mechanical or technological knowledge and skills. It should focus on developing a critical and creative thinker so that they become conscious citizens and contribute for social justice and deep democratic practices. In this regards, I think that early grade mathematics curriculum should pay its attention for developing a habit of reading, writing, reasoning and arts of communicating within immediate environment among the schools' age children so that they can be ready for further education and be able to perform daily life activities independently. In this connection, I have some thrilling questions in my mind: what should be the early grade mathematics curriculum in our context and what are the international practices regarding the early grade mathematics? Our nation is in the last stage of transitional phase for transforming the unitary centralized system to decentralized federal system.

In our federal republic constitutional provision, local governments have the right to provide school level educations for their pupils according to their local needs, and contexts. For providing an appropriate education to their pupils, it needs to formulate the new curriculum within the national framework so that it helps to foster peace and prosperity of their people and thus ensure the local development and national development at large. In this connection, first we will focus our attentions on preparing a suitable and empowering curriculum for school level so that it incorporates a local cosmological knowledge system and global knowledge system as well. If we are not able to maintain rational balance between local and global systems, it might hinder educational progress, thus create havoc in our educational institutions, and ultimately affect development process. In my opinion, it is the most appropriate time to open a discourse about a school level curriculum and primary level curriculum particularly. If we are be able to formulate an appropriate curriculum by minimizing the criticisms that have been posed upon the present curriculum by addressing the local needs, students' aspirations, socio-economic and linguistic backgrounds and ensure an involvement of teachers, parents and local agencies. In this regards, the paper tries to compare our early grade mathematics curriculum practices with top performing countries: Singapore, Japan, Korea and Finland in Trends in International Mathematics and Science Study [TIMSS] and Programme for International Students Assessment [PISA].

To compare different components of curriculum practices I acknowledged tri-partite model of curriculum analysis that has been employed by many international comparative studies under the supervision and supports of International Association for the Evaluation of Educational Achievement [IEA].In this approach curriculum is largely divided into three board categories: intended, implemented and attained (Schmidt, & McKnight, 1998). Many researchers involved in this filed largely focus on any one of the components of the curriculum that yielded partial outcomes. From such results we would not able to grasp the holistic picture of mathematics education of respective countries or regions. So this paper intends to provide an analysis of integrated efforts made by the selected countries for educating their pupils. Intended curriculum largely focuses on what students should learn in their national, social, and educational context. Implemented curriculum largely focuses on teaching learning activities, and attained curriculum describes the student outcomes and characteristics. To provide a comprehensive picture of curriculum practices of the selected countries, I select curricular documents, their implementation process and achievement records on mathematics based on contemporary available researches, national and international achievement tests to provide a comprehensive picture of curriculum practices of the selected countries.

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2. INTENDED MATHEMATICS CURRICULA

The intended mathematics curricula describe the expectation from the educational institutions. It starts from the determination of aims or goals, which is generally done by an expert involved in the curriculum design process. It reflects the power relations, socio-political scenarios and worldviews of the personnel or stakeholders involved in curriculum development process (Ernest, 2001). It indicates that curriculum development process itself is a complex and multifaceted Endeavour through which the vested interest of political ideological groups and mainstream cultural capitals (Bourdieu, 1991) are being served and it works as a hidden curriculum (Slattery, 1995). Whatever be the socio-political scenario, every nation values the mathematics education as an incomparable discipline that helps to foster development of the respective countries. In this regards, my attention has

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been turned toward the curriculum development process, its focuses and contents.

Through the minute review of the curricular documents and its development processes of selected countries, I captured largely two trends of curriculum development process, namely technical (largely centralize) and practical (largely decentralize). Japan and Nepal adopt technical approaches for curriculum development. The technical approaches largely based on deductive method. Its scientific managerial procedures have been dominated by bureaucratic thoughts. Under this assumption curriculum is regarded as an object, blue print, accumulation of discrete contents and subject matters (Schubert, 1986) largely prepared by curriculum experts, university professors, educators and mathematicians. Control and management are the major attributes of this curriculum or what Habermas (1972) called technical interest.

Technical interest tries to maintain 'status quo' in educational institutions and society. Only some people who have an access to power are felt to be autonomous and all others are muted followers. It hardly brings awareness among the learners about the disempowering nature of the culture and coercive forces that produce some sort of oppression in society. It gives rise to instrumentalist thinking in mathematics education in which students are urged to memorize the standard rules, formulae, and theorems without profound conceptual and relational understanding. It indicates that the focus of the centralized curriculum development process is to produce the robotically skilled manpower appropriate for industrial and physical work.

The rigor of centralization differs between these two countries. Nepal fully adopts technical approach whereas Japan acknowledges some of the humanistic approaches for developing the curriculum and focuses on enriching mathematical literacy and mathematical thinking (Isoda, 2011).The centralized curriculum development is more rigid and static that would not able to incorporate the emerging situations and contexts in which teaching and learning activities occur. To minimize the shortcomings of the technically oriented curriculum many countries concede practical or humanizing approach for developing mathematics curriculum.

In recent curriculum revision and development process, Singapore, Korea and Finland acknowledge the practically oriented approach. This approach regards curriculum as experiences (Schubert, 1986) that incorporate the humanitarian aspects. It appeals for deep involvement of the stakeholders in the curriculum development process. Rather than imposing the views of experts, it deploys consensual understanding approach for the selection and organization of experiences that need to be included in the curriculum that encourages the stakeholders to take an ownership and responsibility of the curriculum. Practically informed curriculum interests reject a notion of curriculum as a predesigned body of knowledge that have to be transmitted into learners' mind. It describes curriculum as emergent subject in which inter subjective process of interpretation, reflective deliberation and personal judgment (Taylor & Williams, 1992) play a vital role to produce inter subjective consensual knowledge.

Finland largely tries to adopt the practically oriented curriculum practices as compared to other two countries in which teachers are free to choose the contents and appropriate teaching learning strategies(Ministry of Education, 2004) based on immediate environment and classroom culture. Finland focuses on collaborative culture in mathematics teaching-learning activities in which teacher and students simultaneously engage in mathematical meaning making process. Teachers want to develop creative and imaginative thinking rather than imparting objective knowledge of the world, so that they can enable to improve their judgmental skills for an overall development of their personal and social life. Most of these features of indented curriculum have also found in early grade mathematics curricula of Singapore and Korea.

Singapore adopts the pentagonal model of curriculum in which problem solving resides in center and five sides represent concepts, process, met cognition, attitudes, and skills,(Ministry of Education, 2012). It indicates that Singapore early grade mathematics curriculum focuses on enriching critical self-reflecting practices, confidences, and positive disposition towards mathematics. Similarly, Korean early grade mathematics curriculum paid more attention for fostering the creative power and character building in their pupils (Ministry of Education, Science, & Technology [MEST], 2011).Mathematical creativity consists major three components: problem solving, communication and reasoning(Pang,2014). From these discourse, it is clear that most of the top performing countries shift their focus from acquisition of mathematical facts, formulae, rules and theorems to more creative, imaginative and critical thinkers. These practices of mathematics education help to develop the positive attitudes toward mathematics learning and thus regard mathematics as emerging subject evolve through the human interaction within immediate environment and cultures. These theoretical or philosophical dispositions also reflect on their selected content strands.

Early grade mathematics curriculum in Nepal intents to develop the wide range of mathematical knowledge and skills. It consists nine different content strands: Geometry; Concept of number; Basic operations of mathematics; Time, currency, measurement and weight; Fractions; Decimals; Unitary method and interest, bills and

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budget;Statistics; Sets and Algebra (Curriculum Development Centre [CDC], 2063 BS.). Such overloaded mathematical curriculum hardly able to develop the positive disposition about mathematics. Due to the pressure on completing the desired contents in time, teachers are unable to use differentiated pedagogical approaches in mathematics classroom. Many of early grade children develop the negative attitudes and beliefs towards mathematics due to conventional pedagogical approaches (Belbase, 2013) and irrelevant curriculum that maintain more distance from their daily life activities. Most of the school activities are devoted to solve the routine problems with the help of certain mathematical facts, axioms and formulae. Its effects also reflected on implementation and outcomes (discuss in next section). I realized that early grade mathematics curriculum in Nepal based on the principles that all students can learn same mathematical contents in same times, pace and ways, which differs from other countries.

Korean, and Japanese early grade mathematics education also focus on more contents and mathematical knowledge before the latest revision of their respective early grade mathematics curricula. Korean early grade mathematics curriculum reduces approximately one third of its contents (MEST, 2011) hoping that the reduction will make ease students' load of routine problem solving and will able to provide more time to creative activities. In doing so, Korean early grade mathematics curriculum includes only three contents domain: Number and operation; letters and expressing; and patterns and function.

Japanese early grade mathematics curriculum practices somehow similar to Korean practices. It covers four content domains: number and calculation, quantities and measurement, geometry, and mathematical relation (Isoda, 2011). Japanese early grade mathematics education focuses on developing mathematical literacy and mathematical thinking. These three countries theoretically appreciate contemporary practices of mathematics but have not implemented fully in classrooms yet because of having their long history of traditional approaches.

In contrast to these countries, Singapore and Finland try to implement student's friendly teaching-learning activities in which most of the time focuses for fostering mathematical creativity, reasoning, communication and problem solving. In doing so, early grade mathematics curriculum in Singapore contains only three content strands: number and algebra, measurement and geometry and statistics along with three process strands: reasoning, communication and connection, application and thinking skills and heuristic. It indicates that Singapore early grade mathematics curriculum intends to focus on developing such types of skills and ability in which students will be able to solve non routine problems that will have encountered in daily life activities as well. Moreover, it also aims to explore the students' ability to see and make linkage among mathematical knowledge, concepts, ideas and other disciplines actually helps to grasp to true essence and importance of mathematical knowledge and skills in the real world.

In a similar fashion, Finland also intends to enhance the stated qualities. However, it has some more contents than Singapore. Selection of contents depends upon the hands of teachers. Teachers are free to choose the mathematical contents according to the needs, aspirations and prior knowledge of students. In general, national framework of Finnish early grade mathematics curriculum includes five content domains: number and calculation, algebra, geometry, measurement and data processing and statistics (Ministry of Education, 2004). In addition to, Finnish early grade mathematics curriculum intends to foster the mathematical thinking and furnish the skills for everyday problems so that students will be able to relate their mathematics knowledge, concepts and skills to real world scenarios (Sahlberg, 2007).From the above discourse, I came to conclude that intended curricula play a vital role because any minor revisions in curricula would contribute for enhancing the whole educational system. However, the implementation processes have much more impact on education system because the successes and failures of intended curriculum depend upon it.

3. IMPLEMENTED MATHEMATICS CURRICULA

Implementation process is a crucial stage to produce desired outcomes of the intended curricula. Implementation of the intended curriculum depends upon many factors, namely human resources, pedagogical approaches, physical infrastructures, use of information and communication technology, socio-cultural background of students and society, socio-economic status, governmental and other agencies investment in education etc. Among these factors, I would like to discuss the implemented curriculum in terms of pedagogical approaches have been applied in classrooms.

The selected countries theoretically acknowledge the emerging pedagogical approaches; largely focus on humanizing methods in which teachers and students simultaneously engage in meaning and sense making process rather than acquiring only mathematical facts. But these emerging features of teaching-learning rarely can observe in classroom practices become a slogan of mathematical discourse in academia as if apolitical propaganda has been mostly seen in third world just before an election.

In Nepalese context mathematics classrooms largely focus on transmissions approaches in which teachers are dispenser of mathematical facts and

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knowledge and students are passive receivers of these mathematical facts and knowledge. Most of the classrooms practices follow the deductive approaches and compel students to remember and recite mathematical facts and formulae when necessary. Highlighting the feature of mathematics instruction in Nepali schools Luitel (2009) mentioned that reductionist linear method is one of the most frequently observed attributes. Most of the time, one way communication has been taken place in mathematics classroom. Teachers largely focus on completing undue routine problems preparing their pupils for upcoming so-called final examination. Moreover, Pant (2015) described that the classroom is more hierarchical in which power resides in teachers and students were muted followers. Similarly, Thapa (2016) argued that most of the time teachers accused their students as they do not intellectual enough for mathematics learning. These features of mathematics classroom indicate that teachers have not ready to take their sole responsibility for their teaching learning activities. The effects of these activities have been reflected on students outcomes in which decreasing trends have been observed in mathematics achievement since last decade (for detail see next section). Pedagogical approaches of mathematics classroom of Japanese schools are somehow similar in Nepalese practices, however in recently revised mathematics curriculum Japan incorporates more humanizing approaches than that of Nepal.

Japanese mathematics teachers generally start their classes by imposing the new and generally unfamiliar problems to the students and ask to solve it. After some time discussion, teacher provides the time for each student to present their problems. Teachers do not merely seek the correct solution. They acknowledge every solutions and encourage to engage mathematical real world problems. Finally, they review their solutions and focus on major conceptual structures that help to explore the true essence of mathematical concepts boost their relational understanding as well (Shimizu, 1999). Similarly, well discipline classroom environment, linear fashion of classroom presentations, emphases laid down on process rather than product and cooperative learning environment are some other features of mathematics classroom in Japan. In spite of having centralized curriculum, centrally prescribed syllabus and textbooks Japanese teacher's classroom activities tends to enhance scientific procedure, conceptual understanding and mathematical reasoning as well. In a similar vein, latest curriculum reform in Korea aims to transform teacher's role from knowledge dispenser to facilitators and co-constructor of knowledge.

Korean latest curriculum reform reduces approximately one third of its content areas for giving more attention towards mathematical creativity (MEST, 2011). To explore the mathematical creativity more emphasis has been given to problems solving, mathematical communication and reasoning. Most of the mathematics teachers use a problem posing strategy to provoke their mathematical creativity and reasoning power (Wong, Koyama, & Lee, 2014). Incorporating the story telling strategies in mathematics classroom is another salient feature of the Korean early grade mathematics teaching aiming to boost the communicative skills and imaginative and critical thinking (Pang, 2014). They believe that story telling practices in mathematics classroom help to contextualize mathematical activities and foster positive attitude towards mathematics and its learning. Story telling method is a very versatile emerging approach that creates or provides opportunities to explore interrelated factors in our society and nation at large and relate them with their socio-economic status, cultural disposition and political scenario and consequently develop their critical awareness and divergent thinking. It showed that Korean mathematics teaching-learning activities adopt the some of the humanizing approaches of learning in which not only cognitive aspect of learning is emphasized but also affective dimensions have highly recognized for developing positive disposition and character building. In mathematics teaching, respect the other voices, cultures, and valued cooperative learning environment regards as the good attributes of students that helps to foster the socially just and equitable society. In addition to critical self-reflective practices and affective aspects of teaching learning mathematics also highly valued in Singapore.

Singapore is the top performing countries in Trends in International Mathematics and Science Study [TIMSS] (2015) and Program for International Students Assessment [PISA] (2015).Without successful implementation of intended curriculum such grand success cannot be achieved. One of the major causes of such grand success enjoy by Singapore mathematics education program might be its integrative approaches (inductive and deductive) of curriculum reform in which most of the teachers voices are valued even though they deploy centralized curriculum reform policies. It encourages mathematics teachers to take their responsibility in mathematics classroom.

Rather than prioritize mathematical facts, knowledge and scientific procedures to solve the routine mathematical problems for obtaining good marks in final examination, Singapore school teachers focuses on developing conceptual and relational understanding for acquiring the skills and ability to solve the non routine problems that have encountered in daily lives. Collaborative, interactional and reflective ways of teaching learning activities are the key features of classroom practices (Wilms, 2011). Teachers always tend to incorporate differentiated pedagogical approaches in their classroom so that students deeply engage in mathematical activities.

Teachers lead inquiry based learning activities is another salient feature of mathematics classroom in which teachers create lively learning environment in which much of the students get a chance to share their experiences and felling and valued others' voices and approaches. Moreover, Singapore school teachers paid due attention for developing the positive disposition about mathematics. They tried to base their teaching on prior students' mathematical experiences. It signify that Singapore mathematics education program gradually become more humanistic and tries to balance the cognitive and affective aspects of learners. Such humanizing approaches also found in Finnish mathematics education practices in early grade.

The teaching-learning activities in the Finnish comprehensive schools have some distinct features than that of comparing countries. Teaching is highly valued and prestigious profession in Finland. Most of the top performing school graduates choose teaching as their future career. Teachers are autonomous for not only selecting pedagogical approaches but also for reforming the syllabus and choosing appropriate textbooks. According to Hendrickson (2011) classroom teaching-learning activities focus on developing the mathematical understanding, creative thinking and relate mathematics with other subjects or real life problems. Finish mathematics teachers largely endorse the five pillars of mathematics teaching: conceptual understanding, procedural fluency, strategic competency, adaptive reason and productive disposition(Andrews, 2013). To enhance and ensure such quality of mathematics, teachers enjoy with pedagogical independent. It indicates that inquiry based pedagogical approaches is one of the most important feature of mathematics teaching in Finnish comprehensive school education. Moreover, research is an integral part of mathematics teaching-learning activities. Most of the teachers engage in action research for improving their teaching-learning strategy. They try to bring the research findings in their classroom teaching-learning activities that help to adopt the contextualized teaching strategies that promote students participation in learning. As a result of adopting more contemporary and emerging approaches of curriculum reform and teaching-learning activities in school level mathematics the Finnish students' outperform in an international comparative study that can be able to draw an attention of international societies and researchers.

4. ATTAINED MATHEMATICS CURRICULA

The attained mathematics curricula have been described based on performance and attributes of the students. Student's performance and their socio-cultural attributes depend upon the intended and implemented curriculum. Keeping this view in mind, I would like to compare the attained curricula of respective countries based on national and international standardized achievement tests.

Education Review Office (ERO) conducted the national achievement tests to determine the educational status of school level children in Nepal. We observed a decreasing trend of third and fifth grade students in mathematics from 2012 to 2015. Third grade students have an average achievement score of 60 (out of 100) in 2012 and 44.6 in 2015. Similarly, fifth grade students achieved an average score of 53 in 2012 and 48.3 in 2015. Moreover, the achievement scores of both groups have significantly (Approximately 20 points) less in higher level cognitive domains than that of lower level cognitive domains. In similar vein, students got nearly 20 points less in subjective type items as compare to objective type items (ERO, 2012; 2016). This showed that our primary level student's achievement is very poor. It means our students can do some tasks as robotic manner but cannot perform well when it required the higher order cognitive thinking, reasoning and critical analysis. Such trends also explored in other selected countries as well.

Singapore, Korea, and Japan fourth grade students gradually increase their achievement scores in TIMSS 2011 and TIMSS 2015. However, students from Finland decrease their scores by 10 points. Singapore stood the first position by securing 618 points in TIMSS 2015 followed by Korea, and Japan with 608, and 593 points respectively. In this latest version Finland obtained only 535 points. These average points are all above the central points but have not attained in advanced benchmark 625.Only 50, 45, 32 and 8 percent of students reached advanced international level from Singapore, Korea, Japan and Finland respectively. Similarly, Korea, Finland and Japan achieved 11, 5 and 2 points more than their average achievement score in higher level cognitive domain whereas Singapore got 15 points less than that of their average point. In general, decreasing trends of achievement scores of students in higher cognitive domains are also observed in these countries (Mullis; Martin; Foy; & Hooper, 2015).

Moreover, these top performing countries did not able to enhance confidence and positive disposition about mathematics and its learning. More conflicting fact is that those countries who gave more emphases on humanizing pedagogy and acknowledged students voices in their classroom teaching did not reveal the positive attitude and confidence in learning as comparing to other countries who secure lower or intermediate benchmarks in international tests. The percentage of students who do not feel confident in mathematics is at least twice that of the students who feel very confident in Singapore (19%), Japan (15%) and Korea (13 %). Among the selected countries, Finland is only one country in

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which the percentage of students feeling very confident (28%) in mathematics is approximately 8% more than that of students who did not feel confident in mathematics learning. All of these countries fall below the international average of the students who fell very confident (32%) and above the international average of the students who did not feel confident (23%) in mathematics except Finland (20%) (Mullis; Martin; Foy; & Hooper, 2015).Likewise, the percentage of students who did not like learning mathematics is higher than that of the students very much like learning mathematics except Singapore. These percentages of students are higher than that of international average (30%). Unlikely, the percentages of students who very much like learning mathematics (vary from 19% Korea to 39% Singapore) below the international average (46 %) (Mullis; Martin; Foy; & Hooper, 2015).

Furthermore, from the perspective of engaged learning, there were some positive indicators. Percentage of fourth grade students from Finland and Singapore deeply engaged in learning were 58, and 55 just below the international average of 68% whereas only 28 % and 26% students from Korea and Japan deeply engaged in mathematics learning. Likewise, the percentages of the students from all countries rarely engaged in learning (Vary from Finland 5 % to Japan 20%) above the international average of 5 percent (Mullis; Martin; Foy; & Hooper, 2015). It reveals that Finland and Singapore have somehow successful to promote the engage learning situations believe to nurture mathematics learning culture within and outside the schools.

5. DISCUSSION AND IMPLICATION

From the above discourses of early grade mathematics curricula, all countries expect Nepal shift their attentions from acquiring more mathematical facts and rules to nurture creative, critical, imaginative thinking, and reasoning and communication skills of their pupils. It requires more engage, collaborative, constructive, and contextualize learning approaches. For doing so, Singapore, Korea, Finland, and Japan reduces their content strands within three to five different benchmarks whereas Nepal has nine different content domains. Apart from these countries, Australia also includes only three content strands namely number and algebra, measurement and geometry, and statistics and probability having focuses on understanding, fluency, problem-solving and reasoning (Stephens, 2014). Similarly USA also comprises five content strands such as, number and operation, data and probability, geometry, measurement, and algebraic thinking along with three process strands: problem solving, reasoning and communication (National Academic of Science, Engineering and Medicine, 2015). Moreover, TIMSS 2015 includes only three contents domains: number, geometric shape and measure and data and display (Mullis; Martin; Foy; & Hooper, 2015) to assess fourth grade student's performances. It indicates that internationally early grade mathematics curricula practices reduce content strands and centralize their focus to cultivate creative reasoning, logical and communication skills. In contrast to these practices, Nepalese early grade mathematics curriculum embraces so many discrete contents and does not explicitly state the process strands. In my opinion, it needs to be urgently addressed. Here, I do not want to claim that reducing the content domains is a panacea that automatically ensure and enhance the qualities of mathematics education in early grade. However, my argument is that providing in depth knowledge and skill within the frame of integrated approaches is far better than giving formal superficial knowledge and skills covering wider range of discrete contents.

Being intended curriculum more practical, contextualized, flexible and emerging is not sufficient for enhancing the quality of mathematics education. Implementation process has vital role for producing the desired outcomes. During the implementation process, teachers and their adopted teaching strategies play crucial roles. Most of the countries intended curriculum clearly mentioned the pedagogical strategies; mainly focuses on constructive and collaborative approaches but the classroom activities cannot be mirrored such practices. Finland, Singapore, and Korea early grade mathematics classroom practices seem to be more emerging, constructive, students friendly however Japan and Nepal largely focus on behaviorist transmissions approaches of teaching learning activities. Furthermore, most of the classroom practices of the selected countries intend to foster the students' positive attitude and confidence in mathematics to boost student's performance. However, they did not paid a due attention about the disposition of teachers towards mathematics. Teachers attitudes or beliefs towards mathematics reflect on their teaching and impact on students achievement as well (Blomeke, 2014).That is, for the betterment of early grade mathematics education teacher perceived problems, their causes and solutions of intended and implemented curriculum need to be addressed.

In this connection, I realize that the selected countries have not able to attain the desired mathematical outcomes as they documented in their intended curricula. Most of the curricula of the selected countries (Korea, Singapore, & Finland) mostly focus on developing the higher order thinking but the results did not support the claims. Most of the students did not well perform in the items that required reasoning, creative and imaginative thinking. Moreover, students from top performing countries did not show the positive attitude toward mathematics and had less confident then those countries having just above or below the lower international benchmarks.

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For examples, approximately 4 or 5 times more percentage of fourth grade students from Turkey, Oman, and Kazakhstan showed positive attitudes than that of the students from Singapore, Korea, Japan, and Finland. Similarly, 1.5 times more percentage of students from Serbia, Cyprus, Norway, Bulgaria, and Jordan revealed very confident in learning mathematics than that of the students from the top performing countries (Mullis; Martin; Foy; & Hooper, 2015).These results leave us wondering which countries perform best in international comparative test.

Which components of the learning, such as developing positive disposition, foster confidence and creative thinking or numerical achievement in externally recognized competitive test are valued? In my opinion, the most importance function of mathematics education is to nurture humanitarian values and critical thinking that helps to create socially just society and nation at large (Gutstein, 2006).Most of the national and international comparative achievement tests declared the top performing countries or students without incorporating above stated components that seem to be unjust practices. If we follow these trends without critique there would be the possibility that those countries currently able to address the humanitarian aspects of mathematics might turn their practices towards imparting mathematical facts, knowledge and concept for the name of obtaining the highest rank in such tests. It might hinder the educational systems and personal lives of students as well. That is, to make mathematics teaching-learning activities more constructive, creative and critical, we need to change our deep rooted believe that mathematics is an instrumental and mechanistic subject(Ernest, 1994) and goals of mathematics have to be achieved so-called highest marks in externally imposed standard tests. For doing so, we need to change technically oriented curricula reform process.

CONCLUSION

From the above discourse, I came to conclude that the curricula development or reform processes have been largely dominated by the perennial thinking. However, some countries (Singapore, Finland, and Korea) try to escape from the mesh of instrumental or perennial thinking by incorporating the practically oriented curriculum reform processes. Nepalese early grade mathematics curriculum is overcrowded as compare to other countries' curricula. Principles of curricula development or reforms have somehow linear relation with implementation processes. Early grade mathematics achievement of Nepali students has decreased since a decade whereas other countries gradually increase their achievement level in early grade mathematics. However, these countries have not been able to enhance the positive disposition, higher order thinking and confident in learning mathematics as documented in intended curricula. It indicates that there is a huge gap between intended, implemented, and attained curricula in these nations.

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