Dilemma in Designing a Mathematics Curriculum: Descriptive Versus Prescriptive Approach

Ghan Shyam Joshi
Ghan Shyam Joshi, Lecturer of Pure Math and Statistics for Cambridge International Examination
GEMS School, Dhapakhel, Lalitpur, Nepal
ghanshyam.joshi@gihe.edu.np

Abstract
Developing Nepal's mathematics curriculum is a challenging task, requiring a crucial decision between prescriptive and descriptive curriculum approaches. This study examines prescriptive and descriptive curriculum approaches, their features, and their importance in developing school-level mathematics curriculum. Conversely, the Nepalese school mathematics curriculum predominantly exhibits a perspective and vertical structure. This study conducts a comprehensive comparative analysis of prescriptive and descriptive curriculum approaches, evaluating their objectives, limitations, and applicability. Based on the available literature, the study suggests that the collaborative curriculum model may be a suitable approach. This model involves the central government in curriculum benchmark design, with state governments defining specific educational goals and actively incorporating local input, ensuring a holistic approach to shaping the school math curriculum. The collaborative model shows promise in effectively addressing contemporary challenges in math teaching and learning issues in school mathematics, ensuring inclusivity and relevance for math learners, and paving the way for a brighter future. Additionally, this study highlights the importance of prioritizing learner identity, fostering ownership of learning, and addressing the unique needs of local communities, states, and the nation. This contributes to greater equity in society and globally.

Keywords: Brain drain issue, descriptive curriculum, ethno-mathematics, global access and equity, prescriptive curriculum

Introduction

The work of designing the mathematics curriculum is seen as a theoretical revision rather than a practical approach in the context of Nepal. The practical approach of designing the mathematics curriculum is still perceived as challenging work. As a former mathematics student and current mathematics learner and educator, I have experienced that Nepali mathematics curriculum from school level to university degree is designed in the prescriptive and vertical arrangement approach. The scenario of the mathematics curriculum was summative exam centred but not localized and contextualized. However, some of the top-ranking countries in PISA results like Korea, Singapore and Shanghai have adopted the descriptive approach of designing a curriculum (Lee, 2010).

According to Habermas (1972), there are three interests of the curriculum. One is the technical interest which focuses on the steps and format of teaching and learning mathematics used to transfer the knowledge from teachers to students. The second one is practical interest that focuses on intended learning outcome, experience-based practical skills for the job market and society. Similarly, third is an emancipatory interest which is the interest of liberal and self-responsible. It

means being the critic of self and others and liberating oneself from the limitations of narrowly conceived technical and practical interest of mathematics curricula for a broader vision and goal. In my experience, among the prescriptive and descriptive approaches, the prescriptive curriculum approach is guided by technical interest, whereas the descriptive curriculum approach is guided by practical interest. Emancipatory interests in curriculum development remain an underprioritized concept in Nepali education. For instance, technical interests often concentrate on the input and output processes, following an algorithmic approach, such as in calculus, algebra, and real analysis. On the other hand, emancipatory interest focuses on practical activities, meaning making process and ownership of learning.

Curriculum with technical interest talks about fixed structure or format of mathematical knowledge and classical teaching and learning in mathematics. The curriculum with practical interest focuses on construction, experience, and activity of the learners. Similarly, emancipatory interest focuses on authentic freedom of learners with a responsible way for self-reflection, values, and transformation. Moreover, emancipatory interest curriculum talks about self-questioning, self-reflection, social justice, self-identity, and inclusiveness for marginalized groups in learning mathematics.

Based on the national census (2021), there are 142 castes/ethnicitis groups and 124 languages spoken in our country Nepal. Among these languages, 19 languages are reported as mother tongue. Addressing this multicultural and multilingual issue has very good implication in providing education and literacy for all diversity groups, especially concerning provisions of curriculum, textbooks and teacher training in their mother tongues (UNESCO, 2015 as cited in Panthi & Belbase, 2017). In the context of mathematics different casts and ethnic groups have their own cultural mathematics (Ethno-mathematics) to contextualize the concept of pure mathematics. I assume that the promotion of Ethno-mathematics education is possible in descriptive mathematics curriculum approach. The Ethno-mathematics, discourse of mathematics, implementing the mathematical concepts, poverty, unemployment problem and global access may be the area for research and discussion.

A study conducted by Panthi & Belbase (2017) highlighted teaching-learning issues of mathematics in the context of Nepal. They have mentioned the issues related to social aspects are gender issues, language issues, social justice issues and issues related to the achievement gaps. Likewise, the teaching and learning issues are related to cultural diversity, language and ethnicity. Further, they say the issues related to political aspects are equity and access, economic status, pedagogical and professional organizations and unions. They also raise the issues related to technology. They highlighted the issues related to technology as the technological skills, use of technology in the workplaces and its affordance.

Moreover, there is not enough discussion, study and research for implementing the mathematics curriculum in the context of Nepal. Therefore, it is may be irrelevant that the descriptive approach is better curriculum approach than prescriptive approach. On the other hand, the prescriptive approach of mathematics curriculum helps us for global access, develop the economic models and for the complex application in the field of industry and science (Barton, 2008). It

helps even in getting the knowledge of what is mathematics. How is curriculum framework developed? And what curriculum contents are to be practiced? And helps in descriptive curriculum approach for the knowledge of contents and discipline? Moreover, remote area people also see, read and differentiate the NUC (near to Universal Conventional) mathematics practice all over the world and descriptive approach curriculum which they want to design. Therefore, from above-stated arguments, there is a dilemma situation in designing mathematics curriculum either to adopt the descriptive approach or prescriptive approach. In this paper, I compare the dilemma situation in designing mathematics curriculum that is descriptive versus prescriptive curriculum approaches with its intent and limitations for implementation.

Methods

This study is designed to explore the comprehensive comparative analysis of prescriptive and descriptive curriculum approaches, evaluating their objectives, limitations, and applicability in the context of designing mathematics curriculum in Nepal. Drawing on literature and my experiences as a teacher, teacher educator, and educational researcher, I aim to articulate this paper. In this process, I reviewed different curriculum theories, dissertations, research papers and journal articles.(e.g. Schubert, 2017; Schubert, 1986;Tyler, 1957;Bishop, 1997; CDC, 2016; Pateman et al.1990; Ellis, 2004;Barton, 2008;UNESCO, 2015) to mention but not limited) which are similar to my research issue. In this sense, this study is a desk-based study (Javaid et al., 2022) where the researcher concludes with their ideas with the help of pre-existing literature. In order to begin, the researcher reviewed previous research and developed an idea for this piece by incorporating knowledge from both the studies and his personal experiences. In the second phase, the researcher documented the concepts while the literature needed to support it.

Interpretations and Analysis

This study's portion provides the framework, which is based on previously published material and aids in the researcher's development of a clear concept and conclusion. In order to construct the subjects of this research work, I have read over twenty-five articles that examine curriculum and its applications in the creation of mathematical curricula. Upon reviewing their articles, I discovered that descriptive and prescriptive curriculum approaches are the most often used and beneficial methods for creating mathematics curricula at the school level. Additionally, I firmly believe that they have a beneficial effect on the process of developing mathematical curricula.

The other three primary curriculum methods—subject-centered, learner-centered, and problem-centered—were also discovered by the researchers; however, the characteristics of these approaches are shared by prescriptive and descriptive curriculum approaches. Rather than being descriptive curriculum methods, these three curriculum designs are more akin to prescriptive curriculum approaches. The notion of curriculum, prescriptive curriculum, descriptive curriculum, limitations in adopting prescriptive curriculum approach, and limitations in adopting descriptive curriculum approach are the themes I have established to support this study design. Under these themes, the researcher has gathered the literature on previous investigations, which serves as a guide for drawing conclusions. Therefore, firstly, I write the context of Nepal to situate how mathematics education is practiced

and how curriculum making is performed. Secondly, I explain the concept of curriculum, prescriptive and descriptive curriculum approaches. Thirdly, I explore the limitations of both curriculum approaches. Fourthly, I discuss the literature with my reflections. Finally, I explore the possible mathematics curriculum approaches to address the recent teaching and learning mathematics issues followed by my final reflection.

The Context of Nepal: Situating Mathematic Teaching

Nepal is a multi-ethnic, multi-cultural and multilingual country and addressing these multicultural and multilingual issues has very good implications in providing education and literacy for all diversity groups (UNESCO, 2015). My study concerns that the different casts and ethnic groups have their own cultural mathematics (Ethno-mathematics) to contextualize the concept of pure mathematics. According to Bishop (1979), Ethno-mathematics is a cultural mathematics of different ethnic groups and regions as their cultural property. For instance, to measure the land Kathha, Aana, Bigha are used in Nepal's Tarai region and Paisa, Aana, Ropani is used in Kathmandu valley and hilly area as measuring units. Similarly, square Haat/feet are used in Pokhara valley.

Discussing the scenario of ethno-mathematics in Nepal, I observe the existence of specialized mathematical practices among various groups. For example, farmers use mathematics in planting, harvesting, weather forecasting, and crop production, demonstrating a type of mathematics unique to their line of work. Similarly, even without receiving a formal education in mathematics, carpenters, kaligadh workers, porters, and shopkeepers exhibit mathematical proficiency. These experts have a high degree of proficiency in mathematical computation, estimate, and prediction. These cases all represent ethno-mathematics, in which mathematical practices are important cultural legacies that are passed down through the generations.

On the study of Klein (2015), it is found that mostly the urban people like the global education and English. Similar to the claim of Klein, mathematics teaching and learning practice of urban area in Nepal are related to e-pad and e-learning because the people of these areas mainly go abroad for business and study purposes. So, they have adopted themselves and enjoy in global English culture and technology. It indicates that people of an urban area preferred the prescriptive curriculum approach to educating their children, which is a problem in the growth of mathematics in local ways. There are several teaching and learning issues in mathematics in the context of Nepal and these issues are mainly related to culture, language and ethnicity, political aspects of equity and access, economic status, pedagogical, professional organizations and unions and technology (Panthi & Belbashe, 2017).

Nepalese society considered mathematics as a foreign subject and meaningless body of pure and objective knowledge rather than subjective knowledge because of more collection of mathematical symbols (Luitel, 2009).I reflect that there is a colonization view in mathematics teaching and learning which has psychologically affected the society. Therefore, colonization in mathematics teaching and learning has been promoted the prescriptive curriculum. In addition, the teaching and learning activities of mathematics education in Nepal is based on memorizing and following the certain mathematical facts, rules, formulae

and theorems (Panta, 2017). Moreover, teachers and students follow algorithms or linear approach without making conceptual understanding that is just achieving better grades in final examinations. However, the pass out result of students in the School Leaving Certificate (SLC now SEE) is very poor (Mathema & Bista, 2006). Based on my teaching and learning experience of mathematics, I argue that I adopt other countries curriculum-designing approaches. Indian mathematics trend of growth has dominated our mathematics curriculum, textbooks and teaching materials, teaching and learning methods, and teachers' training. Supporting my claim, Luitel (2009) mentioned that our mathematics is decontextualized mathematics because textbooks and other learning materials mostly depend on Eurocentric thoughts and are not relevant in our cultural context. My understanding from personal experience is that there is a generalized fear in our society about mathematics learning. A large portion of the public in Nepalese society feels and says that mathematics is a difficult subject that should only be studied by intelligent students. Moreover, society people have a propensity to be classified as either mathematically proficient or not. Following the completion of Grade X in the Secondary Education Examination (SEE) and Grade 12 tests administered by the National Examinations Board (NEB), these societal perceptions became very familiar.

Students frequently experience a psychological aversion to learning mathematics as a result of this pervasive fear of the subject and, consequently, of mathematics topics. They have challenges and might not be motivated to interact with the content, even when they are enrolled in math classes. Based on the literature discussed above and my personal experiences, it becomes evident that the school mathematics curriculum of Nepal is influenced by a prescriptive curriculum approach. Examining and understanding the curriculum is a crucial aspect of identifying the shortcomings in the growth of mathematics education in the country.

The Concept of Curriculum

Curriculum has multiple meanings, but it is essential to shape the education system of a country and produce capable human resources. According to Schubert (1986; 2017), curriculum as content or subject matter, as a program of planned activities, as an intended learning outcome, as experience, as cultural reproduction, as an agenda for social reconstruction, as discrete tasks and concept and as "Currere". Therefore, the curriculum can be defined as prescriptive, descriptive, or both. So, it is better to know about the prescriptive and descriptive curriculum approaches.

Prescriptive Curriculum

According to Ellis (2004), a prescriptive curriculum is a form of a curriculum which provides us with what probable to happen and do not more often take the form of a plan and an intended program. It does not include expert opinion, teachers and students voice about what needs to take place in the course of study. It is similar to the medical prescription that patients have suggested by pharmacists and doctors. This curriculum adopts top-down planning in which developers propose and the teachers follow it in classrooms. This curriculum approach is similar to overcoats that are made generally for all people, supposing that this fits commonly to all.

In my lived experiences as a Nepali mathematics teacher, the school mathematics curriculum totally adopts prescriptive

approach, as I are unaware with the process of curriculum making and development. I experience that it is very difficult to get the draft of the mathematics curriculum in Nepal. For instance, the chapter Time and Work was removed from the curriculum of class IX and X by the Nepal Curriculum Development Center (CDC, 2016 and Dahal, 2014), without discussion with stakeholders and research. This chapter was related to time and work, which is a very useful chapter in the field of mathematics. This intension of CDC supports that prescriptive mathematics model do not allow space for ownership and critical thinking to teachers. It is simply linear approach of teaching and learning where I find the process of input and output such as I use formula, find the answer and count as mathematics learning. It is more statistic and a product rather than new construction. Therefore, mathematics curriculum of Nepal is mostly guided by the prescriptive approach. In line with this, Tyler (1957) mentioned the curriculum is all the learning experiences that are planned and directed by the school to attain its educational goals. However, this curriculum is not helpful for capability development of learners; thus, I require descriptive curriculum.

Some examples of prescriptive mathematics curricula: Curriculum related to traditional rote memorization learning, standardized tests (Summative Evaluation), and teacher centered instructions. This approach mainly emphasizes rote memorization of mathematical formulae, facts, and procedures. It often follows a prescribed sequence of topics, such as arithmetic, algebra, geometry, and calculus. The prescriptive mathematics curriculum teaches specific formulas and algorithms without much emphasis on the application or understanding of mathematics in real-life contexts.

Prescriptive mathematics curriculum in Nepal is aligned with standardized tests, with an emphasis on teacher-centered instruction beliefs in transmitting mathematical knowledge to students, and students are expected to learn by following the teacher's instruction. This curriculum approach talks about less student engagement and more direct instruction.

Descriptive Curriculum

The descriptive curriculum is beyond the prescriptive terms, and the curriculum not merely on how things ought to be but how things are required in real classrooms, culture and society (Ellis, 2004). Ellis further pointed that this is the curriculum approach focus on the learner's experience and claimed that it provides glimpses of the curriculum in action. According to Brown (2006), students have different experiences relating to the improvement of skills and strategies in thinking critically and creatively, solving problems, working collaboratively, communicating Ill, writing more effectively, reading more analytically and conducting research to solve problems by themselves. This statement is also supported by Silva (2009) as cited in Ellis (2004), who stated that an emphasis on what students can do with knowledge rather than what units of knowledge is the important thing of 21st-century skills. This means curriculum is an experience of the learners through active interactions and collaboration. It is the construction of the learners rather than the prescribed thing.

As per my understanding, descriptive mathematics curriculum gives the space of ownership to learners, which is open for learning and not in scores oriented. There are options to choose and include local

culture and values. For instance, A-level, the O-level course of Cambridge University and Module based teaching and learning of the Kathmandu University are some examples of the descriptive curriculum.

Some examples of descriptive mathematics curriculum: Curriculum related to problem solving, real life applications, inquiry based learning, and students centered flexible learning paths and assessment for learning and understanding. The descriptive mathematics curriculum places emphasis on problem-solving skills and critical thinking. This curriculum encourages students to explore mathematical concepts through open-ended problems, allowing them to discover mathematical principles on their own.

Moreover, the descriptive curriculum approach gives space for real-life applications such as integration in agriculture, economics, and local industries. Learners can see and feel the practical applications of mathematics in real life.

Additionally, this curriculum approach focuses on inquiry-based learning by promoting student inquiry and exploration. In this curriculum approach, learners are encouraged to ask questions, investigate mathematical phenomena, and collaborate with peers and group work to deepen their mathematics understanding. Therefore, it's a more student-centered approach.

Descriptive curricula may allow for flexibility in the order and depth of topics covered, enabling students to pursue areas of interest or address specific educational needs. This approach can cater to diverse learning styles and paces.

Instead of focusing on standardized tests, this focus is on assessment for learning rather than assessment for grades and marks. The evaluation criteria may vary, including projects, presentations, model-making, and portfolios, to evaluate students' understanding and application of mathematical concepts.

Limitations in Adopting Prescriptive Curriculum Approach

Prescriptive curriculum approach is focused on near to universal conventional (NUC) mathematics, which is the academic mathematics practice in pure format and includes most common mathematics of the world (Barton, 2008). Besides its good aspects, this curriculum approach has some limitations in the context of teaching and learning mathematics in Nepal that I discuss as follows.

Ownership in Mathematics

Mathematical knowledge is not something that is acquired by listening to teachers or reading textbooks. Mathematics learning is constructed through active participation making mental connections with previously gained knowledge. I experience that people understand mathematics as a fixed body of knowledge, however it is the construction of people as it is a social practice rather than the discovered thing. Students create and build new concepts but not a just owned by teachers, textbook writers, mysterious mathematicians etc. For instance, students earn the perimeter of a circle in different ways, but due to our curriculum and marking scheme students are forced to follow the formula and certain steps. Therefore, the prescribed curriculum approach of mathematics limits such constructive rights of the learners in learning mathematics.

Social Interaction and Quality Mathematics of Learning

Pateman and Johnson (1990) emphasis that constructivism establishes learning environment. The construction of knowledge nurtures interest that protects

and cares in growing and understanding through co-operation and high quality of the social interaction among learners. Pateman and Johnson further agreed that children are good in constructing their own mathematics through their actions. This creation by learners comes through and their reflections and their social settings. For this, three aspects of curriculum are needed to be considered such as content, methodology and assessment (Pateman & Johnson, 1990). This means descriptive mathematics curriculum helps in regular classroom engagement and rich social interaction for learning mathematics. Moreover, the descriptive curriculum of mathematics helps quality learning mathematics, but the prescriptive approach may decrease such learning quality. For instance, while learning addition and subtraction of binary and quandary numbers in grade-VIII, students do addition and subtraction, but they do not get time to discuss in the context of its application in the computer program.

Quality of Mathematics Teaching and Learning

According to Lattimore (1998), constructivism is an appropriate principle for improving mathematics discourse that understanding comes in social form for learner's identity and justice. In addition, construction and interaction help learners in understanding mathematics through actions as taken to be shared. Nonetheless, prescriptive curriculum approach does not include teachers and learners' voice. For example, I need to follow fixed algorithmic approaches while solving some problems of algebra and calculus. Therefore, this curriculum approach may obstacle for learners' identity and justice and that affect quality of mathematics teaching and learning. For instance, if students score high marks, then they are considered genuine, and if not, they are counted as less intelligent students in learning mathematics. I argue that statistic evaluation within the three hours is not a final evaluation for mathematics learners.

Brain Drain Issue

Rural communities understand the formal education as mechanism of education to train their children to leave the community and never return in their places that are known as Brain Drain issues of formal education (Carr & Kefelas, 2009; Corbett, 2007 as cited in Klein, 2015). As per my experience, brain drain is one of the burning issues in Nepal in the context of mathematics teaching and learning. Brain drain happens because of prescribed curriculum approach and globally colonized view in the mathematics curriculum. In this scenario, my understanding and experience say that adopted curriculum framework of the mathematics obviously serves for those group and area whose approach we have adopted. In the context of designing mathematics curriculum, I understand that other countries approach may irrelevant to our context. Therefore, such prescriptive approaches curriculum serves for those people for whom they have designed the curriculum. These curriculum triggers the issue of brain drain. For example, if any students want to read mathematics in master level, then the student should leave his/her places because in the most area there are no specialized universities in mathematics. There are no other job guarantees rather than mathematics teaching and providing tuition classes. Therefore, prescriptive mathematics curriculum of mathematics is an issue of brain drain in the context of Nepal.

Language Colonization: English First in Teaching Mathematics

English is not the first language of instruction in mathematics as in teaching in many countries (Pateman & Lim, 2012), but also most of the countries are focusing English as a first language of instruction. In the context of Nepal, English is not the mother tongue of any ethnicity but this language gets priority for teaching and learning. If I know English fluently, I get more respect and job easily; otherwise I face rejection in the field of teaching mathematics and in another employment opportunity. Even most schools prefer English talking and main agenda of school meeting is focused on English communication amongst teachers-students and students-students. English is important due to its high demand and needs in the workplaces, global business, learning, entertainment, media centers and even in invention and technology. Therefore, English first has been prioritized in learning mathematics too in the context of teaching and learning mathematics in Nepalese schools, for which prescriptive curriculum approach plays a vital role. For instance, there are two types of schools in the context of Nepal, private and government. When parents are able to send their children to private schools and find their children are good in English, they feel proud but in mathematics, most of the students are failing due to the English language requirements. Therefore, the English language is quite necessary to understand mathematics in Nepali Classrooms. Similarly, there are other limitations that may arise from the implementing of prescriptive mathematics curriculum approach. Based on my lived experience, such limitations are degradation of culture and Ethno-mathematics, invalid personal interpretation, justice and identity of marginalized groups in learning outsiders' mathematics.

Limitations in Adopting Descriptive Curriculum Approach

Social Political Turn (SPT) and Discourse of Mathematics

According to Gutierrez (2013) while conducting research and highlights the dynamic nature of identity I need multiple kinds of literature outside the field of mathematics education. He further mentioned that mathematics education is in the phase of its infancy till because Ethno-mathematics was created in the 1980s, critical and social justice mathematics has been flourished in the last 2 decades. Similarly, critical race theory, LatCrit theory, and science and technology studies only gained momentum in the mid-1990s that are related to the discourse of the mathematics for justice education. On the similar way, post-structuralism and postmodernism have been embraced in mathematics education only in the present phase (Gutierrez, 2013). Gutierrez claim that there are decolonization practices in research and not concerned mathematics education in research from the point of equity stance for marginalized learners but research manipulates various literature in the technical sense rather than focusing an emancipatory framework.

In addition, other key obstacles that cause a sooner sociopolitical turn in mathematics are equity in mathematics education which is a hot topic but less focused on research. Lubienski and Bowen (2000) found only 5% addressed issues related to race, ethnicity, or social class accommodate in the context of mathematics education (Gutierrez, 2013). In this regard, without enough research in the discourse, Ethno-mathematics and its challenges, directly adopting the descriptive approach of

designing mathematics curriculum in Nepal will generate negative issues in the teaching and learning mathematics.

Global Access and University Admission

According to Husen (1967)), all students regardless of social and cultural background, gender, religious beliefs, ethnicity, geographical location, and family financial circumstances, should have the same opportunity to learn (OTL) mathematics for its equitable and accessible learning. Here, OTL is the degree of intersection between content taught and content assessed. Learning mathematics mean not only the knowledge got by learner but also his/her access and fitness in the global market. While talking about the justice in learning mathematics I should not forget the importance of access because without addressing the point of access in learning mathematics justice becomes incomplete. Yes, contextualized mathematics is one thing for learner's justice but if the learner is unable to exchange his/her knowledge in other workplaces and context and cannot achieve the common goals of learning mathematics, and then there is a problem of justice in learning.

As per as my experience, there is a big role of access in learning mathematics in the context of Nepal. For example, if any students can read in Kathmandu and got the degree from there, then these human resources gain more knowledge and are competent. In the context of Nepal, there are some factors that play the role for equity and access in learning mathematics which include classroom conditions, curriculum decisions, teachers and society's beliefs about mathematics, teacher preparation in mathematics, teaching the knowledge of effective teaching strategies and availability of materials and resources. In this regard, Husen (1967), claimed that equity and access approach is that without the opportunity to take courses beyond basic arithmetic and elementary level mathematics, students face it difficult to continue on to mathematics and science courses at the higher level of study that is necessary for success at the college or

Despite English is not the first language of instruction in mathematics in many countries (Pateman & Lim, 2012), this language is used because of global access and requirements of universities of the modern society for fittest and survivable need. Mostly, the higher-level mathematics and university mathematics is designed in prescriptive approaches by focusing abstract core Knowledge. For instance, if a student has not read optional mathematics in grade-IX and X, he/she cannot perform Ill in Inter of science and if cannot read science. If they cannot read science in XI and XII, then they cannot open the door for technical education (e.g., MBBS, Engineering etc.) and think that I cannot do anything in my life and parents also use to behave accordingly in Nepal.

Constructivism in Mathematics Teaching and Learning

According to Sierpinska (2005) as cited in Gutiérrez (2013), constructivism is a reality of the individual's construction, so in reality of the physical world, thought and ideas may not be interrelated, and individual knowledge cannot be measured. It is constructed not under some measurable variable and defining the variable also there is the debate in this world. Further he stated that the importance of not focusing too strictly on mathematics so that social relations and advocacy disappear, I must also be cautious of not focusing on discourse to the point where mathematics disappears. It is easy to philosophize about what mathematics is or can

be. However, I care about how mathematical practices connect with the identities, futures, and lived consequences for individuals in society. Therefore, there is a limitation on adopting the descriptive approach in designing mathematics curriculum because it may limit the knowledge and instead of everything for all it may be nothing for all in learning. For instance student has solved particular problems differently. Suppose it is the case of 1+1=2, and students started 1+1=10 by binary concept only then what I say? Personal interpretation is only right, or conversion way of mathematics is right? Actually, 1+1=2 in Hindu Arabic Number System and 1+1 =10 in the Binary Number System. Therefore, sometimes there can be debate on construction. Besides there are other limitations such as social and culture can be different and that creates difficulties in communication and practice. Descriptive curriculum approach may limit the knowledge of mathematics, may create a problem of employment, and may remain as a backward practice from the view of Global market and access.

Despite mathematics is applicable in all sectors, it may nothing to all due to individual interpretation and construction in learning, may create the vast gap in learning mathematics. For instance, e-pot and e-learning in urban areas and farmers, porters, carpenters mathematics in a rural area. Additionally, there can be the limitation for the position on top competitions like PISA, IMO etc., creates the gap between an urban and remote area in learning and may limit in the application of forwarding development. Ethno-mathematics is fixed but global practice is an ongoing process in the context of mathematics knowledge.

Discussion

The result of the literature review and my lived experience show that there are debate and confusion in designing mathematics curriculum in the context of Nepal to address the teaching and learning issues of mathematics. It is found that there is not enough discussion and research in the field of the discourse of mathematics and less research in Ethno-mathematics. It is also found that behind colonization in teaching-learning mathematics, there are other issues such as poverty, lack of research and development. There is a politics in designing and following NUC mathematics in school level. There are interesting questions such as: Whose Cultural mathematics is in school practice and curriculum? I explored that there is a dilemma to design school mathematics curriculum in the context of Nepal whether to adopt the prescriptive or descriptive approach. Even both approaches have advantages and limitation. The limitations of the prescriptive approach are brain drain issue in rural areas, language colonization, ownership problem in learning, social interactions and quality of mathematics teaching-learning, degradation of culture and Ethno-mathematics. Moreover, limits the interpretation of mathematics knowledge, justice, and identity of marginalized groups in learning. These limitations raise the questions such as whose mathematics and whose curriculum?

On the other hand, there are also the limitations of adopting the descriptive approach in designing school mathematics curriculum. Such as social and cultural difference and difficulties to communicate such practice (Barton, 2008). The descriptive approach limits the knowledge of mathematics (Husen, 1967). Similarly, it creates the problem of employment and may be backward

practice from the view of the Global market, access, and wide use of technology. In spite of mathematics for all, it may be nothing to all due to individual interpretation and construction in mathematics knowledge (Ellerton & Ken, 1992). There is a vast gap in learning mathematics for instance e-pot and e-learning in urban area and farmers, porters, carpenters' mathematics in a rural area (Ellerton & Ken, 1992). Further, the descriptive approach may limit from the knowledge exchanging process like in PISA, IMO etc., may create the gap between an urban and remote area in learning and could risk in the field of application for forwarding development. Thu sit is confusing that, which curriculum approach may address the several recent issues of teaching and learning of mathematics in the context of Nepal. I found that there is a great dilemma condition in designing a mathematics curriculum.

Conclusion

In this research paper, I have delved into the intricate dilemma of designing a mathematics curriculum in the context of Nepal, specifically focusing on the prescriptive and descriptive curriculum approaches. This analysis has illuminated the intent and limitations of these approaches from the perspectives of design, implementation, and practicality in the realm of school mathematics.

Throughout my exploration, it became evident that stakeholders in the field of mathematics education, including philosophers, researchers, curriculum experts, and educators, are sharply divided between the two curriculum approaches. Each approach possesses distinct intentions and invites criticism in the context of designing a mathematics curriculum for Nepal.

The descriptive curriculum approach, I discovered, offers a pathway to address critical aspects such as fostering ownership of mathematical learning, constructing mathematical knowledge, promoting social and cultural interpretations of teaching and learning, and mitigating concerns related to brain drain and the lingering specter of colonialism in mathematics education.

Conversely, the prescriptive curriculum approach emerges as a viable solution to tackle issues pertaining to employment opportunities, global accessibility, admissions into higher education institutions, and the development of advanced mathematical models for complex applications, including inventions and industrial processes.

Despite the merits of these approaches, I observed a conspicuous paucity of research concerning the descriptive curriculum approach, both on a global scale and within the context of Nepal. This scarcity underscores the complexity of wholly adopting the descriptive curriculum without substantial research and development, particularly in the unique educational landscape of Nepal.

Furthermore, my analysis illuminated that the multifaceted challenges in teaching and learning mathematics in Nepal cannot be adequately addressed by embracing a single curriculum approach. As a remedy to this conundrum, I propose a comprehensive curriculum model that synthesizes elements from both the descriptive and prescriptive approaches.

To implement this balanced curriculum model effectively, I recommend a collaborative approach. The Central Government should oversee the creation of a curriculum benchmark, while state governments should set specific goals tailored to their regional needs. At the local level,

stakeholders must have a voice in shaping the curriculum, ensuring that it aligns with the unique requirements of the community.

Such a combined curriculum model, informed by the strengths of both approaches and involving all levels of government, is poised to tackle the pressing challenges faced in mathematics education in Nepal. It not only has the potential to promote justice and identity among learners but also addresses the diverse needs of local communities, states, and the nation, contributing to the betterment of society and the world at large. This collaborative and inclusive approach holds the promise of a brighter future for mathematics education in Nepal, where the ownership of learners and the advancement of society go hand in hand.

REFERENCES

Barton, B,(2008). *Cultural and social aspects of mathematics education*: Responding to Bishop's Challenge. In: Clarkson P., Presmeng N.(eds.). Critical issues in mathematics education. Boston: Springer Publication.

Bishop, A. J. (1997). *The relationship between mathematics education and culture. In Opening address Delivered of Iranian Mathematics Education Conference*. Kermannshah, Iran. Retrieved from https:// www.researchgate.net/ publication/255590052

Brown, H. T. (2006).*Beyond constructivism: navigations in the knowledge era, On the Horizon.* 3(14). https://doi org/10.1108/10748120610690681.

CDC (2016). *Hamro Ganit Pathyapustak, Kashya- 9 &10.* Bhaktapur: Author. Curriculum Development Center (CDC). (2016*). National curriculum framework for school education in Nepal.* Sanothimi, Bhaktapur, Nepal: CDC.

Central Bureau of Statistics. (2021). Caste/ Ethnicity. Nepal Census.https:// censusnepal.cbs.gov.np/results/ downloads/caste-ethnicity

Dahal, H.P. (2016). *Speedy mathematics for grade-IX and X. Kathmandu:* United Nepal Publication.

Ellerton, N. F. & Ken, M. A. (1992). *Some pluses and minuses of radical constructivism in Mathematics education. Mathematics Education Research Journal.* Edith Cowan University and Deakin University.

Ellis, A. K. (2004). *Exemplars of curriculum theory*. Larchmont, NY: Eye on Education.

Gutierrez, R. (2013).*The Sociopolitical Turn in Mathematics Education*. University of Illinois.

Habermas. J. (1972). *Theory of communicative action*. Madrid: Trotta.

Husen, T. (1967). *International study of achievement in mathematics* (Vol. 2). New York, NY: Wiley.

Javaid, M., Haleem, A., Singh, R. P., & Suman, R. (2022). Artificial intelligence applications for industry 4.0: A literature-based study. Journal of Industrial Integration and Management, 7(1), 83-111. https://doi. org/10.1142/S2424862221300040

Klein, R. (2015). *Connecting Place and Community to Mathematics Instruction in Rural Schools. In: Gellet U, Gimenez Rodriguez J., Hahn C., Kafoussi S. (eds.) Educational Paths to Mathematics. Advances in Mathematics Education. Springer, Cham.*

Lattimore, R. (1998). The Implementation of Radical Constructivism within the Urban Mathematics Classroom, Trotter Review: Vol. 11: Iss. 1, Article 16. Available at: https://scholarworks.umb.edu/trotter_review/vol11/iss1/16

Luitel, B. C. (2009). Culture, worldview and transformative philosophy of mathematics education in Nepal: A cultural-philosophical inquiry. (Doctoral dissertation) Curtin University of Technology, Perth, W Australia

Mathema, K.B. & Bista, M.B. (2006). *Study on Student Performance in SLC (Main Report).* Kathmandu, Nepal: Ministry of Education and Sport and Education Sector Advisory Team, Kathmandu.

Panthi, R. K., & Belbase, S. (2017). *Teaching and learning issues in mathematics in the context of Nepal. European Journal of Educational and Social Sciences*, 2 (1), 1 – 27.

Pant, B. P. (2017). *Pondering on my beliefs and practices on mathematics, pedagogy, curriculum and assessment* [Unpublished M.Phil. Dissertation]. Kathmandu University, School of Education, Hattiban, Lalitpur, Nepal.

Pateman N.A. & Lim C.S. (2012). The politics of equity and access in teaching and learning mathematics. In: Clements M., Bishop A., Keitel C., Kilpatrick J., Leung F. (Eds.), *Third international handbook of mathematics education (pp. 243-263)*. New York, NY: Springer International Handbooks of Education, Springer.

Pateman, N. A., & Johnson, D. C. (1990). *Curriculum and constructivism in early childhood mathematics: Sources of tension and possible resolutions*. In L.P. Steffe & T. Wood (Eds.), *Transforming children'smathematics education: International perspectives* (pp. 346-356). Hillsdale, NJ: Lawrence Erlbaum.

Lee, Peng Yee. (2010). Designing a mathematics curriculum. Journal on Mathematics Education. https://www.researchgate.net/publication/311095136_Designing_a_mathematics_curriculum/citation/download

Schubert, W.H. (1986). *Curriculum: Perspective, Paradigm and possibility*. New York: Macmillan. University of Technology, Perth, Australia.

Tyler, R. W. (1957). *The curriculum then and now. In proceedings of the 1956 invitational conference on testing problems.* Princeton, NJ: Educational Testing Service.

UNESCO Kathmandu Office. (2015). *Education for all: National review report 2001 – 2015*. Kathmandu, Nepal: UNESCO.

Schubert, W. H. (2017). Growing Curriculum Studies: Contributions of João M. Paraskeva. *Journal of the American Association for the Advancement of Curriculum Studies (JAAACS)*, ***12***(1).