Meta-Analysis on the Issues and Reform Dimensions of Primary Mathematics in Pakistan

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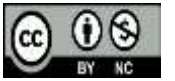

Abstract

This article aimed to explore the philosophy behind the mathematical content development and assess the problems in the implementation of mathematics curriculum**.** Mathematics curriculum is circumscribed by content, process and standard, and it cannot be achieved with optimum outcomes if the causal effects attributes are not determined. The relevant personals should be aware of the nature of this subject and the structural and functional requirements that are the most important for achieving the actual demand of this subject. In Pakistan, the stress is only on content mastery, documentations and illogical and inappropriate strategies through which the intended curriculum can hardly be achieved. Reforms must be done in both structure and function in order to achieve the curriculum objectives. This article is an attempt to highlight the structural, functional issues that are the basic hurdles in the attainment of the math curriculum objectives. The critical analyses of the available literature suggested some fundamental reforms towards the improvement of primary mathematics.

Keywords*: Content Knowledge, Pedagogical Knowledge, Standards*

1. Introduction

Mathematics curriculum is a written document and it represents overall program including learning experiences that an individual encounter in the school. Moreover, it is a way to achieve the intended objectives. All the intended objectives are declared and should be achieved through the standard processes that are mentioned in the curriculum documents (Rind & Mughal, 2020).The two main requirements in the mathematics objectives are mathematical knowledge and conceptual understanding and both are important for further construction of math content (Salim & Gilar, 2020). The first one is relatively easy and not the real demand of mathematics. However, the second one that is the conceptual

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understanding is the most important aspect among the main requirements in the curriculum program. In spite of this importance, conceptual understanding is hardly focused and achieved significantly throughout the educational institutes and through the process of education. The citation of different researches in this regards showed that conceptual understanding that always needs analytical and logical thinking are less in percentage than procedural mathematics (Ghazali & Zakaria, 2011).

Generally, to achieve something one must be positive in its attitude and disposition. On the same construct mathematics needs positive attitude in its teaching and learning process to achieve its natural objectives. The research also endorsed that attitude and achievement in mathematics are highly correlated (Chaudhary et al., 2019). So, positive attitude toward mathematics is one of the causal indicators (Ali & Jameel, 2016). Besides, reflecting this attitude into teaching strategies and mathematics, teachers' professional knowledge is often important (Russo et al., 2020).There could also be presented so many reasons; however, it is almost difficult to circumscribe around the diverse factors. Generally, the teaching of mathematics should be useful and it should be concrete and applicable in real life. Students always question about the usability and applicability of mathematics. Specifically, when students do not observe mathematics clearly in real and in concrete shape, they may lose their interest and belief about the reality of this real subject. In fact, mathematics is not abstract, but mostly the teachers cause this misperception. In other words, the way mathematics is currently being taught is a problem. In this new age, mathematics lost its originality and the way it was developed and the situation through which it was created, all is almost vanish. Moreover, the responsibilities of objectives are in the hand of non-professionals which is a source of a lot of problems. It has been reported that mathematics is not taught in compatible with its nature in Pakistan (Amirali & Halai, 2010) and that is why the dissatisfaction among students, teachers and experts have been documented frequently. To illustrate, students do better in the task that demands memorization of facts and procedure but they performed poor on those tasks that demand comprehension and problem solving skills (Kang & Saeed, 2018).

The importance of primary mathematics can never be ignored to achieve a well technological proficient society. The met-before knowledge of the primary mathematics is the basis for next grade mathematic and similarly for different technological fields (Mcgowen & Tall, 2010). Students' low understanding and proficiency in this level always stop them to learn next level mathematic with ease. At this level, children learn through three different representation and

manipulation ("Implication of Bruner's Learning Theory on Teaching," 2011). The process starts from perception and then act on the object to transform the concept into a sophisticated form. Further the concept store in the form of symbol that is the most flexible form of representation (Tall, 1995).Fluency in arithmetic helps to understand algebra and similarly axiomatic mind is the pre-requisite for advance mathematics. Still those necessary pre-requisites are not fully recognized and acknowledged by the teachers across the different tiers of education.

1.1 Objectives of the Study

The study was based on the following objectives:

1. To explore the philosophy behind the mathematical content development.
2. To assess the problems in the implementation of mathematics curriculum
3. To indicate the structural and functional issues in the attainment of curriculum objectives.

1.2 Significance of the Study

This meta-analysis is purely related to primary mathematics curriculum reforms and this would be helpful in devising the strategy for achieving the mathematics curriculum objectives. So, it would serve as a guideline for policy makers, and in order to achieve the objectives they should keep in their mind the structural and functional reforms to optimize the predetermined objectives. Mathematics teacher and mathematics curriculum evaluators may also get guideline in assessing curriculum and making lesson plans.

2. Research Methodology

2.1 Research Design

Meta-analysis- qualitative research design was used for this study. Out of 65 only 51 articles were critically reviewed related to mathematics education for reforms in structural and functional aspects of primary mathematics curriculum. Total 51 articles were critically analysed after scrutiny on the basis of objectives that are related to primary mathematics education. The articles were obtained from different online search engines and research sources including Science Direct, Semantic Scholar, Springer Open and Academia Premium. The following themes were generated on the basis of critical analysis of the articles;

2.2 Philosophy behind the Mathematical Content Development

Keeping the critical review of literature in mind the following questions were designed that may enable curriculum developers to rethink about Primary Mathematics Curriculum in order to address the issues and reform dimensions of primary mathematics.

1) Why to teach maths at the primary level?

2) Who will teach?
3) What to teach?
4) How to teach?

The first question is why to teach mathematics or why to include mathematics at primary school level. There are so many reasons to consider math content at primary level. In which five main reasons are mostly important: 1) because of its importance in daily life, 2) it is linked in other curriculum areas 3) for the intellectual development of the learners 4) to increase the enjoyment of learner in learning 5) human construction (Haylock, 2010).

The second question is about the teacher, to whom to assign the responsibility of teaching mathematics subject? Whether, the person who hasn't particular mathematics subject knowledge can teach this subject significantly? Generally, it is decided by the policy makers and Govt. officials. Although, mathematics students need a knowledgeable teacher who is willing to learn mathematics and their students' ways of learning must be equipped with pedagogical and technological combination of content disposition (Jarrah, 2020). In addition, the teachers who want to teach this subject must think beyond the pages (What Is the Role of a Mathematics Teacher?NCTMs, 2016). Pre-service professional teacher program in mathematics is essential in developing the foundation of proficiency of mathematics teachers (Tasdemir et al., 2019).

The third question is about the content that needs to be organised in accordance with the needs of society, students and the need of the day. The content should be prepared according to the logic on which basis one can survive in this dynamic society. There must be a consensus to organize the mathematics curriculum. The opinions, recommendations and discussion summaries of industrialists, society and intellectuals related to the subject should be taken into account by curriculum experts.

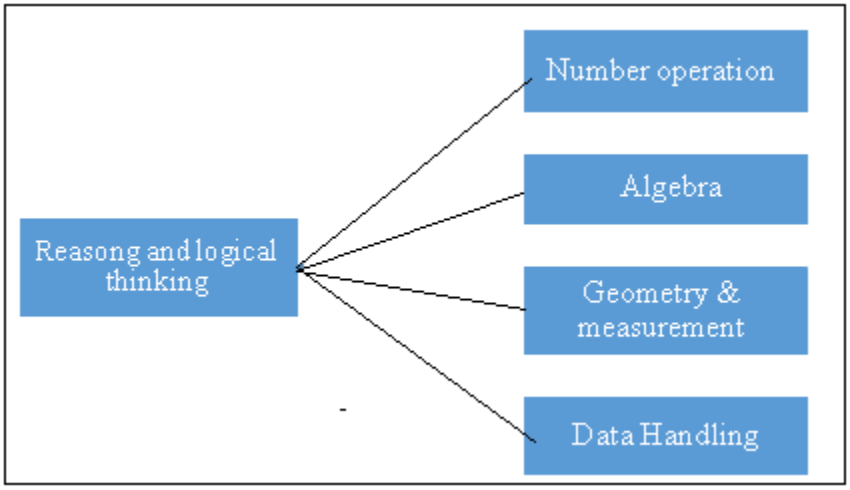
Now, the fourth aspect that is how to teach mathematics related to psychological aspects of this subject. That is how to teach mathematics in a way that effectively presents the content within the constraints of resources and time and achieves the main purpose of mathematics objectives. However, this is a process and need to be stage it with time. Relevant theories that are appropriate to this subject should be used by the teacher, and it is the teacher who can integrate the theory with the content to get meaningful ends. The theories are mostly general theories of learning, modification to the existing needs and situations are always there. Behaviourism, Cognitivism, Constructivism and Connectivism are all the theories that a teacher must know and the application is totally dependent on the teachers (Kashefi et al., 2017). How to teach, aspect

includes the fact that teacher must have the inter-combination of Pedagogical Knowledge (PK) and Technological Knowledge (TK)(Khalil et al., 2019). Specific modified theories related to teaching of mathematics are: Van Hiele's theory of geometry learning, APOS theory, Piaget's stage theory and Bruner three modes of presentation etc.

Another, the curriculum for Mathematics is comprised of the four strands. The strands are intentionally kept broad to allow flexibility to the teachers to adapt their teaching styles in accordance with their students. These strands include Numbers and Operations, Algebra, Geometry and Measurement and Data Handling. All of these contents are underpinned by reasoning and logical thinking. All standards, benchmarks and students' learning outcomes are built around these strands (*SNC Mathematics 1-5.* , 2020).

Figure 1

Standards for Primary Mathematics



On the same construct the NCTM content standards are:

- Number and Operations
- Algebra
- Geometry
- Measurement
- Data analysis and Probability (National Council for Teachers of Mathematics, 2021.)

The objective of primary mathematics curriculum is clearly written and declared. But how to achieve and through whom those objectives may be attained

need to be reconsidered. Mathematics is the science of pattern and its learning create abstract mind with arithmetic fluency. It prompts creative thinking and gives human resource to the knowledgeable society (Lince, 2016). Primary mathematics focuses on content knowledge that are the bases for the next content and this content should be used to prompt different interlinked mathematical thinking skills (Daud, 2020). The way this subject is being taught, is not the demand of the subject. Mathematics proficiency, concept and procedural fluency are still below the standard. The main objectives of National curriculum of mathematics for grade 1-5 included to;

1. Instil Mathematical skills for everyday use.
2. Strengthen basic mathematical skills to set the foundation for higher-level mathematics.
3. Develop the ability to think in a logical manner to analyze diverse situations.
4. Develop a sense of appreciation and enjoy learning mathematics.
5. Develop a long lasting understanding of the concepts through Concrete, Pictorial and Abstract (CPA) approach.
6. Engage in investigations and enquiries to develop skills in mathematical reasoning, processing information, making connections to real life situations and making judgments.

In addition the content standard around four strands along with benchmark is clearly declared (SNC Grade 5 Math Book - Google Search, 2020). The nature of mathematics content and the nature of mathematics learning are two different aspects of mathematics curriculum. Pakistan's national curriculum actually focused on the content of mathematics and emphasized mental qualities: mathematical reasoning, problem solving and communication. However, the function is still awaited to achieve the target structure of its documented form (Mughal et al., 2021).Mathematics content is not fixed in nature and there are different points of view. The way the teacher transfer it makes it either absolute or fallibilist.

In order to improve the quality of mathematics teaching, teachers' concepts about mathematics are the most important. Teacher and curriculum experts must keep in his mind the duality of mathematical knowledge. That includes teachers' belief about math and mathematics teaching learning. Teachers' belief about knowledge, mathematics learning and the concept held about math play significant role in shaping students thinking (Amirali & Halai, 2010b). While teaching mathematics, one should keep the nature of mathematics and the two different philosophies regarding nature of content of mathematics.

Those are namely: Absolutism and Fallibilism, having different description about the knowledge of mathematics. According to absolutist, mathematics is an objective, absolute and incorrigible body of knowledge which rests on the firm foundation of deductive logic (Ernest, 2018). In addition, this subject is also rigid logical structure and it is independent of values, culture and universally valid. In contrary to absolutist, mathematics is a human construct according to fallible approach and it is the result of social and physical interaction. The focus is on habit of mind rather than content (Tuge, 2008).The role of teachers in both philosophies is important but not the same. Approaches are also categorized in terms of tradition verses interactive math curriculum. They are different because of their intended perspective. One focus on content and other demand is the habit of mind.

Another important aspect of mathematics learning is to know its nature. In order to learn a subject, first of all it is very important to understand its nature. Every book and content needs some specific tree pattern and pre-requisite knowledge. In the same way, the content of mathematics has its own attributes regarding its underline structure that needs some sort of mathematical thinking for deep understanding (Tall et al., 2014). In this diversity, learning arithmetic differs from algebra, and similarly, learning statistics needs something other than calculus. Mathematics curriculum at primary level must be designed for all diverse society with their needs. Which concretization is the essence and the learning process should be declared with meta-analysis. As, mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigor as it is need and a gate way to understand other disciplines (Teaching Math in the 21st Century, 2016).

The three different nature of mathematics must be kept in mind while teaching and learning mathematics (Tall, 2002). Embodied (practical), symbolic (theoretical) and formal mathematics (axiomatic mathematics) (Tall, 2004). In primary mathematics children use their sensory perception plus action and then spirally develop a sophisticated form of mathematical thinking with the help of language plus symbolism (Tall et al., 2014). In primary stage, most of the activity should be presented on practical bases and the main issue how the student compresses the picture into simple symbol in form of cognitive unit. In the recent or any math curriculums, mathematics content is never the origin of problem but rather the way this subject is being taught is a problem. This subject involves and needs the skills: logic, critical thinking, reasoning and tenacity that must be used and loved by the individual who wants to learn this subject. Mostly this subject is

not taught in this way. It is mostly taught in an algorithmic way, through a series of steps in a fixed way (Teaching Math in the 21st Century, 2016).

2.3 Problems in the Implementation of Mathematics Curriculum

In research process, the difficult task is the recognition of the problem with all of its dimensions. Mathematics learning always is a result of engagement in the activity and this aspect is always deficient in the lower grades. Pedagogical relationship between teacher and students is important for real engagement in math learning (Gronow, 2015). Lack of graduate teachers in math and how this subject is being taught at primary level are the main issues of the low product in the subject. In addition, this subject is dominated by procedural or instrumental methods and the focus is not on the demand of this subject. For this, teachers need to be aware of the negative effect of the purely instrumental approach (Gronow et al., 2020). In the research of Maugesten (2019) the importance of teacher attitude and students engagement was also reported intensively along with so many general characteristics of good teachers characteristics.

Last but not least, the lack of technology or less use of technology in Pakistan is still in practice. There are so many technological facilities through which a mathematics standard and understanding can be achieved, but it is still out of practice. In addition, the assessment of mathematics curriculum is in real almost fog. The test and examination scores are just numerical quantities that describe only one dimensional aspect that is rote learning and content that is extensively memorised (Waqar & Bokhari, 2019).

One of the basic problems in Pakistan regarding the problem of primary mathematics is the lack of specific content of primary teacher for this job. Mughal et al. (2021) clearly indicated that the majority of primary school teachers faced difficulties in delivering the content along with concept in most of the basic mathematics. Further teachers also faced difficulties in using hands and minds-on-activities. Here the questions must be raised that what primary mathematics teachers need to know to be successful in the classroom? It is a quite simple that at least teachers must have a sophisticate and deep understanding of mathematics content knowledge that must be higher than primary level (Standards for Preparing Teachers of Mathematics, 2017).

Mathematics teaching is a professional job and mathematics teachers robustly deep understanding of relevant advance mathematical knowledge (Patterson, 2021).Substantial mathematical knowledge for primary mathematics teachers must include procedure and concept and the way the knowledge is organized. In addition, teachers must be aware of the cognitive demand of the content along with reasoning, its application and different representation of

content. The teacher role in delivering the content must be relational and link the mathematics with different areas of mathematics (Cotton, 2016).

The second problem is the lack of pedagogical content knowledge that is essential in delivering content. It includes about students' thinking about mathematics and best teaching practices that reflect on deep understanding (Patterson, 2021). As in teaching mathematics, specific skills attainment is the key objective. It is not just to deliver the procedural knowledge that always create problem for students when they confront with non-routine problem. For this, problem based learning (PBL) which is a constructivist approach and a best instructional model to explore the deep concept mapping of a particular content can be a solution. In PBL, students always focus on thinking skills rather than instruments that help in activating students' adaptive and strategic competency (Darwani et al., 2020). Good teachers always have multiple and bunch of strategic tools in his/her toolbox. The selection of tools depends on the concept and situation. Choices must be made by the teachers according to concept and they must be aware of all choices (Cotton, 2016).

Third is the lack of technological pedagogical and content knowledge of primary teacher. Today, technology is a handheld device and everyone uses it for various purposes, but it is still mostly out of classes in Pakistan. Technological tools, physical models and different representations tools are there that explore and visualize concept and process of concept (Standards for Preparing Teachers of Mathematics, 2017). In teaching mathematics, there are so many best softwares that concertize most of the mathematics concepts in an effective way. GeoGebra, Mathematica, MathBoard and GAP etc. are in the lists of teaching maths via technology. This concept is also known as TPACK (Technological Pedagogical Content Knowledge), which is the inter-combination of three disciplines, technology, content and pedagogy. The main role of the teacher is to present the content with technology integration, using an appropriate strategy to achieve educational goals. In this whole process, teachers' belief about this emerging discipline is necessary (Karakus, 2018).

Out of the above three main deficiencies in the primary teachers, the two basic approaches are Cognitivism and Constructivism approaches of mathematics learning. How learning occurs? Piaget described it on the bases of age and stages. Effective learning depends on previous stage and the thinking behaviour of the stage that the learners achieve (Khalil & Haq, 2019a; Ojose, 2008). The four stages are important and the mental processes are declared for each one. The four stages are namely: sensory-motor, pre-operational, concrete and formal stages. Teachers' roles are important and the activities are responsible for developing the

relevant thinking stage in certain age. Prior concept is also necessary for the new one. While, constructivist believe in active participation of learner and student have to construct their own knowledge that is discovery (Kashefi et al., 2017b; Zuliana et al., 2019).

2.4 Structural and Functional Issues in the Attainment of Curriculum Objectives

The main problem of lower mathematics achievement levels and failure in comprehension level in Pakistani primary education system is due to structural and functional problems in the education system. Always low achievement occurs not accidently but there are the elements in the process of teaching leaning that are not handled optimally with proper proportion (Tampubolon, 2018). In the domain of teaching mathematics there should be some necessary content knowledge and their integration with pedagogy and technology that will optimize the attainment of mathematics curriculum objectives. Induction in the elementary education only needs 14 year education, it means there is no specific post and criteria for primary mathematics teaching. Citation of relevant document indicated two main aspects that must be considered for the reforms: (Andrade & Valtcheva, 2009; Rakoczy et al., 2019; Koponen et al., 2016 & 2019). To improve the primary mathematics education, reforms should be ensured in the structure under the following points. And without these reforms and amendments the existing mathematics curriculum objectives may never be achieved with significant output. Here, some obstacles that include:

2.4.1 Structural Problems

a) Primary mathematics teacher appointment criteria,
b) No specific content for professional mathematics teacher,
c) Lack of process declaration in achieving the curriculum objectives,
d) There is no structure to assess the mathematics delivery process,
e) Lack of association between curriculum team and primary mathematics teachers.

2.4.2 Functional Problems

a) Lack of teachers' professional mathematical knowledge,
b) Poor teacher pedagogical technological content knowledge for relevant concept,
c) Insufficient knowledge of how to use this professional knowledge,
d) Process of achieving the content objectives,
e) Inequality among the teachers regarding content declaration,
f) Instrumental approach,
g) Book oriented assessment tendency

3. Conclusion

The meta-analysis of the articles indicated that mathematics is not practiced in its true sense rather taken it as drill without practical implementation of the mathematical concepts. This calls for professional training of mathematic teachers. The standard of education cannot be achieved unless the causal reforms are made. There is still the problem of translating mathematical content and bridges are needed to bridge the gap between math teachers and math educators. The necessary and pre-requisite logical and relevant to the field of mathematics education are still out of consideration and not even acknowledged by the higher authorities. The causal attributes regarding structures and function need to be considered for intensive implementation. The three main domains for professional mathematics teachers must be included in teachers training programs specifically to content constraint. In order to elevate the standard of mathematics education in Pakistan it is primarily important to improve the recruitment procedures and eligibility criteria for the appointment of mathematics teachers at primary education level in Pakistan. Lastly, providing continuous professional development opportunities on merit basis and making training mandatory for promotion may aid to elevate the pedagogical practices of mathematic teachers at primary education level in Pakistan.

4. Recommendations

Based on the meta-analysis, following recommendations are outlined;

1. University education departments may start elementary mathematics education program.
2. Short courses, diplomas and certificate may be launched for primary mathematics education. With these diplomas and certificates, a program in mathematics education should be initiated according to international standards.
3. A mathematics educator specialist may be employed in all schools to deal with the mathematics curriculum process.
4. The content delivery along with mathematical thinking should be conserved and equal across the whole primary schools.
5. Hire subject specialist, each for every subject in the primary schools who can coordinate with National Curriculum Council (NCC) in order to update and guide for the true implementation of curriculum. Subject specialists in the schools may support the classroom teachers in lesson planning and evaluation.

References

Ali, H. H., & Jameel, H. T. (2016). Causes of Poor Performance in Mathematics from Teachers, Parents and Student's Perspective. *American Academic Scientific Research Journal for Engineering, Technology, and Sciences*, *15*(1), 122–136.

Amirali, M., & Halai, A. (2010). Teachers' knowledge about the nature of mathematics: A survey of secondary school teachers in Karachi, Pakistan. *Bulletin of Education and Research*, *32*(2), 45–61. https://ecommons.aku.edu/pakistan_ied_pdck/91

Andrade, H & Valtcheva, A (2009) Promoting Learning and Achievement Through Self-Assessment, *Theory Into Practice, 48*(1), 12-19, https://doi.org/10.1080/00405840802577544

Chaudhary, A., Malik, M., & Rafiq, N. (2019). Attitude of Students towards Learning Mathematics at Elementary Level. *Journal of Elementary Education*, *29*(1),109–120. http://pu.edu.pk/images/journal/JEE/PDF/8_v29_1_19.pdf

Cotton, T. (2016). *Understanding and Teaching Primary Mathematics*. Routledge.

Darwani, Zubainur, C. M., & Saminan. (2020). Adaptive reasoning and strategic competence through problem based learning model in middle school. *Journal of Physics: Conference Series,* 1460, 012019. https://doi.org/10.1088/1742-6596/1460/1/012019

Daud, Z. (2020). A Comparative Analysis of Fractions in Chinese and Pakistani Primary School Mathematics Textbooks. *9*(1), 24.

Ernest, P. (2018). *The Philosophy of Mathematics Education Today*. Springer.

Ghazali, N., & Zakaria, E. (2011). Students' procedural and conceptual understanding of mathematics. *Australian Journal of Basic and Applied Sciences*, 5, 684–691.

Haylock, D. (2010). *Mathematics Explained for Primary Teachers*. SAGE Publications...

Implication of Bruner's learning theory on teaching. (2011, August 17). *My English Pages*. https://www.myenglishpages.com/blog/implication-of-bruners-learning-theory-on-teaching/

Jarrah, A. M. (2020). The Challenges Faced by Pre-Service Mathematics Teachers during their Teaching Practice in the UAE: Implications for Teacher Education Programs. *International Journal of Learning, Teaching and Educational Research*, *19*(7), 7. https://www.ijlter.org/index.php/ijlter/article/view/2370

Kang, M., & Saeed, A. (2018). *Teaching of mathematics: A comparative analysis of Secondary School Certificate (Grade-X) and General Certificate of Education (O-level) courses of studies in Karachi*. https://doi.org/10.13140/RG.2.2.10009.31840

Karakus, F. (2018). An Examination of Pre-Service Teachers' Technological Pedagogical Content Knowledge and Beliefs Using Computer Technology in Mathematics Instruction. *IUMPST: The Journal. Vol 3 (Technology)*, *3*. https://files.eric.ed.gov/fulltext/EJ1199683.pdf

Kashefi, H., Ismail, Z.B., Mirzaei, F., Tak, C.C., Wan Obeng, S.N., & Ching, T.Y. (2017). Teaching and Learning Theories Applied in Mathematics Classroom among Primary School Teachers. 7th World Engineering Education Forum (WEEF), 607-612. https://doi.org/10.1109/WEEF.2017.8467070

Khalil, M., & Haq, K. (2019a). Concept Process with Mathematical Thinking Tools under the Domain of Piaget's Theory of Cognitive Development. *3 Journal of Contemporary Teacher Education,3*, 1-12. https://jcte.aiou.edu.pk/wp-content/uploads/2020/02/1KhalilHaq-4.pdf

Khalil, M., Khalil, U., & ul Haq, Z. (2019b). Geogebra as a Scaffolding Tool for Exploring Analytic Geometry Structure and Developing Mathematical Thinking of Diverse Achievers. International *Electronic Journal of Mathematics Education*, *14*(2). https://doi.org/10.29333/iejme/5746

Koponen, M., Asikainen, M. A., Viholainen, A., Hirvonen, P. E. (2019). Using network analysis methods to investigate how future teachers conceptualize the links between the domains of teacher knowledge. *Teaching and Teacher Education*, *79*, 137–152. https://doi.org/10.1016/j.tate.2018.12.010

Koponen, M., Asikainen, M. A., Viholainen, A., & Hirvonen, P. E (2016) Teachers and their Educators- Views on Contents and their Development Needs in Mathematics Teacher Education. *The Mathematics Enthusiast*, *13*(1) https://doi.org/10.54870/1551-3440.1370

Kurt, S. (2018, May 12). *TPACK: Technological Pedagogical Content Knowledge Framework. Educational Technology*. https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/

Lince, R. (2016). Creative Thinking Ability to Increase Student Mathematical of Junior High School by Applying Models Numbered Heads Together. *Journal of Education and Practice*, 7.

National Council of Teachers of Mathematics. (2021). *Nctm.org*. https://www.nctm.org/Standards-and-Positions/Principles-and-Standards/Principles

Maugesten, M. (2019). Good mathematics teaching at lower primary school level. In U. T. Jankvist, M. van den Heuvel-Panhuizen, & M. Veldhuis (Eds.), *Eleventh Congress of the European Society for Research in Mathematics Education* (Vol. TWG19, Issue 18). Freudenthal Group. https://hal.archives-ouvertes.fr/hal-02430103

Mcgowen, M., & Tall, D. (2010). Metaphor or Met-Before? The effects of previouos experience on practice and theory of learning mathematics. *The Journal of Mathematical Behavior*, 29, 169–179. https://doi.org/10.1016/j.jmathb.2010.08.002

Mughal, S. H., Asad, M.M. & Adams, D. (2021), Goals of the national mathematics curriculum of Pakistan: educators' perceptions and challenges toward achievement", *International Journal of Educational*

Management, *35*(1), 159-172. https://doi.org/10.1108/IJEM-04-2020-0203

Ojose, B. (2008). Applying Piaget's Theory of Cognitive Development to Mathematics Instruction. *The Mathematics Educator*, *18*(1), 26–30. https://files.eric.ed.gov/fulltext/EJ841568.pdf

Gronow, M. T. (2015, January). *A place for mathematical structure in the classroom* [Series of papers]. The Brother John Taylor Fellowship, Sydney BJTF_2015_Mark_Gronow_Mathematical_Structure.pdf (csnsw.catholic.edu.au)

Patterson, B. (2021). Real Analysis Mathematical Knowledge for Teaching: An Investigation. *IUMPST: The Journal*, *1*(Content Knowledge). https://files.eric.ed.gov/fulltext/EJ1290170.pdf

Rakoczy, K., Pinger,P.,Hochweber, J., Klieme, E., Schütze, B., & Besser,M (2019). Formative assessment in mathematics: Mediated by feedback's perceived usefulness and students' self-efficacy. *Learning and Instruction.* doi.org/10.1016/j.learninstruc.2018.01.004.

Rind, A., & Mughal, D. (2020). *An Analysis of Pakistan's National Curriculum of Mathematics at Secondary leve*l. https://doi.org/10.33122/ejeset.v1i1.4

Russo, J., Bobis, J., Sullivan, P., Downton, A., Livy, S., McCormick, M., & Hughes, S. (2020). Exploring the relationship between teacher enjoyment of mathematics, their attitudes towards student struggle and instructional time amongst early years primary teachers. *Teaching and Teacher Education*, 88, 102983. https://doi.org/10.1016/j.tate.2019.102983

Salim, N. D., & Gilar, J. M. (2020). Conceptual Understanding And Procedural Knowledge: A Case Study on Learning Mathematics of Fractional Material in Elementary School. *Journal of Physics: Conference Series*, 1477, 042037. https://doi.org/10.1088/1742-6596/1477/4/042037

SNC grade 5 math book—*Google Search*. (2020). http://www.mofept.gov.pk/SiteImage/Misc/files/SNC%20Mathematics%201-5.pdf.

SNC Mathematics (2020). http://www.mofept.gov.pk/SiteImage/Misc/files/SNC%20Mathematics%201-5.pdf

Standards for Preparing Teachers of Mathematics | AMTE. (2017). https://amte.net/content/standards-preparing-teachers-mathematics..

Tall, D., de Lima, R. N., & Healy, L. (2014). Evolving a three-world framework for solving algebraic equations in the light of what a student has met before. *The Journal of Mathematical Behavior*, *34*, 1–13. https://doi.org/10.1016/j.jmathb.2013.12.003

Tall, D. (2011). *Introducing Three Worlds of Mathematics*. https://www.researchgate.net/publication/246523544_Introducing_Three_Worlds_of_Mathematics/link/53eb48f60cf2fb1b9b6b09c3/download.

Tall, D. (2004). T*hinking through three worlds of mathematics.* Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education, 4.

Tall, D. (1995). *Integrating History, Technology and Education in Mathematics*. 10, 49-53

Tampubolon, T. (2018). The Application of Bruner's Learning Theory on Teaching Geometric at Smp Negeri 2 Sipahutar in Academic Year 2017/2018. *International Journal of Advanced Engineering, Management and Science*, *4*(5), 351–356. https://doi.org/10.22161/ijaems.4.5.1

Tasdemir, M. Z., Asghar, M. Z., & Tahir, A. (2019). Factors of Pre-service Teacher Education Affecting the Elementary School Teachers' Preparedness in Punjab. *Journal of Elementary Education, 29*(2),15-36. http://pu.edu.pk/images/journal/JEE/PDF/2_v29_2_19.pdf

Teaching Math in the 21st Century: Changing the Focus from Calculations to Critical Thinking. (2016, March 14). *Learning Bird. https://learningbird.com/teaching-math-in-the-21st-century-changing-the-focus-from-calculations-to-critical-thinking/The role of mathematics*

in the overall curriculum | International Mathematical Union (IMU). (n.d.).https://www.mathunion.org/icmi/role-mathematics-overall-curriculum

Tuge, C. (2008). Mathematics Curriculum, the Philosophy of Mathematics and its Implications on Ethiopian Schools Mathematics Curriculum. *Ethiopian Journal of Education and Sciences, 4*(1), Article 1. https://doi.org/10.4314/ejesc.v4i1.42996

Waqar, Y., & Bokhari, T. B. (2019). *Redesigning the Design: A Review of Education Technology Interventions in Pakistan* [Working Paper]. Commonwealth of Learning (COL). http://oasis.col.org/handle/11599/3273

National Council of Teachers of Mathematics. (n.d.).What is the Role of a Mathematics Teacher? - https://www.nctm.org/News-and-Calendar/News/NCTM-News-Releases/What-is-the-Role-of-a-Mathematics-Teacher_/

Zuliana, E., Retnowati, E., & Widjajanti, D. B. (2019). How should elementary school students construct their knowledge in mathematics based on Bruner's theory? *Journal of Physics: Conference Series*, 1318, 012019. https://doi.org/10.1088/1742-6596/1318/1/012019

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