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Exploring the Knowledge- Practice Gap in Preservice Secondary Mathematics Teaching

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Abstract

The article presents the findings of a study on Exploring the Knowledge-Practice Gap in preservice secondary mathematics teachers that was carried out with final year preservice university teachers who were aspiring secondary school mathematics teachers and involved in teaching practice exercises as well as teaching mathematics at different secondary schools. The semi-structured interview, document analysis and classroom presentation observation were used while collecting information through only six preservice teachers engaging in teaching practice in final year of B. Ed. The researcher summarized the study on four themes on interview, three themes in document analysis and five themes in classroom observation. The qualitative results suggested that preservice teachers increased the confidence to teach mathematics after graduation and that their teaching practice experiences were fun and valuable opportunities for them to learn, but here is very sensitive gap between knowledge and classroom practice and the speaking in interview and written on document are rarely gaped. And the preservice teacher suggested that There is gap between the math teaching that preservice teachers were trained to deliver in schools and the content of the training curriculum. Discussion included a summary, suggestions for how the course could be ordered and prospective areas of the curriculum that could improve the preservice teachers' competencies, decrease math anxiety and also decrease the gap between knowledge in content and pedagogy in classroom practice.

Keywords: Preservice teachers, teacher education, secondary school, preservice teacher education

Introduction

The role of mathematics is more important at present than ever before. It was eloped from the needs of people of organized societies & primitive tribes living on hunting. Now the nature of mathematics is considered in broad sense in discipline like business, economics, psychology, science & technology. Mathematics included as a basic subject in all levels of school in Nepal. It has been taken as a core subject since the beginning of systematic development of curriculum but also an abstract science of reasoning & thinking. So mathematics is making great contribution to the cognitive development of human race. Mathematics education is a discipline which studying always how people

learn & understand mathematical concept & how their learnings & understanding are influenced by teaching process.

Training and development describes the formal, ongoing efforts that are made within organizations to improve the performance and self-fulfillment of their employees through a variety of educational methods and programs. It is also considered as a tool for HRD. Training has immense potential in transfer and utilization of latest technical know-how, Leadership development, organization of people, formation of self-help-groups, mobilization of people as well as resources, empowerment of resource-poor rural mass, entrepreneurship development, etc., which are considered essential components of HRD. Teacher Education (TE) or teacher training refers to the policies, procedures, and provision designed to equip teachers with the knowledge, attitudes, behaviors, and skills they require to perform their tasks effectively in classroom, school, and wider community. Specific training for teachers was originated in France (1685) by St. John Baptist de la Salle. Teacher training spread rapidly in Europe as a result of the work of August Hermann Francke and Johann Pestalozzi. Formally the school education in Nepal was initiated with the establishment of "Durbar school" in 1910 BS and formally teacher training program in Nepal was started with the establishment of basic teacher training center (BTTC, 1947).

Educating the younger generations ready to succeed in the knowledge society is a global challenge. Now, many nations understand the fundamental importance of effective education and the need for highly qualified instructors. The United Nations 2030 Agenda for Sustainable Development, which approved one of its Sustainable Development Goals, both the availability of qualified teachers and the caliber of instruction have objectives. As a result, providing all children and youth with a high-quality education and investing in the preparation of qualified teachers are priorities for advancing. According to Hahl and Mikulec (2018), teacher educators must teach teachers how to actively learn throughout their careers. Learners must be able to learn permanently on their own in order to enjoy active learning. This competence requires the metacognitive abilities of planning, monitoring, and evaluation (Mutambuki et al., 2020). Curiosity, drive, persistence, and self-control are characteristics of lifelong learners (Solmaz and Aydin, 2016). Teachers need to consider themselves as lifelong learners in addition to having teaching competencies (Kallio et al., 2018). In short, expert teachers are required in teaching practice who, simultaneously, are excellent learners(Matsumoto-Royo et al., 2022).

Pre-service teacher education programs are a core element of education systems, providing a foundation of knowledge and skills that new teachers rely on in the classroom. As such, major interventions aimed at foundational literacy and numeracy (FLN) in primary schools in low- and middle-income countries (LMICs) must place more emphasis on pre-service teacher preparation to ensure the sustainability of the quality of the teaching workforce. (Sunzuma & Luneta, 2023) .

The study on "Effective Micro-Teaching Skills For Pre-Service Mathematics Teachers' Teaching Practices And Improve Self-Efficacy" is to examine the opinions of the pre-

service teachers about the micro-teaching course, taking information from 30 pre-service mathematics teachers who were enrolled mathematics teacher education program at the West Bengal state university and West Bengal University of Teachers Training, Education Planning and Administration (WBUTTEPA), West Bengal, India. In this paper, knowledge about students refers to teachers' knowledge that are difficult for students, common conceptions that are frequently experienced by students. This study focused on Professional skills, Problems Arising from Pre-service Teachers, and Class Activities regarding the mathematics subject. The findings suggested and an improvement in teaching skills based on micro-teaching. It was also found that prospective teachers satisfied several expectations of the approach during microteaching in mathematics subjects.(Chand, 2022).

According to the European Commission (2007 b), teacher education curriculum include the following four components: Strong subject knowledge, pedagogical expertise, the abilities and knowledge necessary to guide and encourage learners, and knowledge of the social and cultural aspects of schooling. The balance between these elements within the curriculum depends on a variety of issues and is related to the views the different stakeholders have. More and more teachers must be able to play multiple roles and contribute for development of children and young people as individuals. supervision of classroom learning activities. the transformation of the school as a whole into a "learning community." Relationships with the neighborhood and the world at massive (Swennen & Klink, 2008). The current Australian context the practicum, or professional experience in teacher education, continues to be a very challenging area to work in Australian universities. The recent National Inquiry into Teacher Education (2007) stated that, while there was no crisis in teacher education, there were still ongoing concerns about the quality of teacher preparation. The practicum was identified as a key persistent (Le Cornu & Ewing, 2008).

The Mathematics-Pedagogy Tasks (MPTs) were designed to help pre-service elementary teachers develop professionally, especially those who did not major in a subject related to mathematics. Pre-service elementary teachers can coordinate math learning, student cognition, and the order in which mathematics information is presented in the curriculum by using MPTs with appropriate theories. The learning of mathematics should be the starting point, as it enables them not only to understand the mathematics but also to build personal learning theories and to realize student cognition. The integration of mathematics and student cognition becomes the foundation for pre-service elementary teachers to comprehend curriculum arrangement and textbook design. (Stylianides & Hino, 2017).

The investigation into "Elementary Pre-service Teachers: Can They Experience Mathematics Teaching Anxiety without Having Mathematics Anxiety". This study looked into the likelihood that MA from past events causes MTA. Using a Framework for MA and MTA, written reflections from 53 elementary pre-service teachers were examined. The findings, one-third of the pre-service teachers had high prior mathematics anxiety but had never had MTA, indicating that there is not necessarily a connection between MA and MTA. Actually, some pre-service teachers might not have

mathematics anxiety (MA) because they are confident in their mathematical skills, but they might have mathematics teaching anxiety (MTA) because they are uneasy explaining math concepts to kids(Brown et al., n.d.).

The structure of pre-service teacher education differs widely across countries. High-income, high-performing countries participating in the Program for International Student Assessment (PISA) have pre-service teacher education lengths from three years (Flanders, Belgium) to as long as seven years (Germany). In LMICs, pre-service teacher training is often two to three years, India's two-year diploma in education. Pre-service training is sometimes shorter, however, while Sri Lankan institutions offer a one-year diploma in teacher education. Types of pre-service training to be available at present are: Universities may also offer bachelor's degrees in education, in addition to shorter pre-service programs offered by colleges or vocational training institutions. Bachelor's degrees are more commonly required for secondary teachers. Regardless of their length and structure, pre-service programs should be designed to connect theory and practice. While there is no standard curriculum for pre-service teacher training, new teachers need to understand the content of the subjects they teach, how to teach specific subjects to students, and how to teach well in general, including classroom management and student engagement (*Pre-Service Teacher Education in Nepal: A Qualitative Case Study, n.d.)*

The context of Nepal

Teacher education has always been a priority in Nepal. The Government of Nepal has made teacher education mandatory for all school teachers since 1971. To become a teacher, one must have three qualifications. One, minimum qualifications; two teaching licenses; and three the success in teacher employment examinations. Pre-service teacher education is provided by the universities, license and teacher entry exams are conducted by the Teacher Service Commissions. Teachers have an instrumental role in enhancing the overall development of students by nurturing their interests and sharpening their instincts. Mainly there are three phases in teacher education. The first one is the prior to their teaching career, which is called the pre-service teacher education. The second phase is very short, that induction training where the new teachers are oriented about school atmosphere, the classroom environment, nature of the students and other pedagogical aspects. The third one is the professional development opportunities provided to the working teachers is also called the in-service teacher education.

Nepal has a history of eight decades of teacher education. Basic teacher education started as early as 1948. Formally the initiation of pre-service teacher education started in Nepal after the establishment of College of Education in 1956, five years before the establishment of Tribhuvan University (TU). This indicates that the government was anxious about quality education of children in schools. In the beginning the program concentrated on primary teacher training called normal teacher training. Secondary teacher training Since 1996 Tribhuvan University (TU) has been implemented three-year Bachelor programs with an annual examination system in Faculties of Education (FOE)but since 2072 BS to till now it is four years with an annual examination system and there is system of peer teaching, micro teaching and in the last of fourth year there

is 15 days school teaching program is called teaching practice. Teacher educator's program (M. Ed) is running in semester base. The purpose of teacher education was to make teachers competent both in content and pedagogy to help students learn better.

The School Sector Reform Plan (SSRP, 2009) is a long-term strategic plan to achieve the goals and objectives of Basic and Secondary education under the Government of Nepal (GON), Ministry of Education (MOE), is the continuation of the on-going programs such as Education for All (EFA), Secondary Education Support Programs (SESP), Community School Support Programs (CSSP) and Teacher Education Project (TEP), with the agenda for the school sector reform with an integrated system of 1-8 basic and 9-12 secondary education. The secondary levels, preservice teacher training is offered through university campuses (Faculty of Education) and Higher Secondary Schools (Education Stream) and the National Centre for Educational Development (NCED) was established to conduct training through Education Training Centers (ETCs) with objective to enhance teachers' qualifications and professional competencies. Completion of a professional teacher training course has been made mandatory prior to entering the teaching profession. In view of the needs and aspiration of quality education at all level of education, Nepal government has viewed education as an instrument for national development of self- sustainable, competitive, innovative and value oriented citizens for the socio-economic transformation of nation and societal change (SSDP, 2016), with the major organizational restructuring of the Ministry of Education Science and Technology(MOEST), the Centre for Education Human Resource Development (CEHRD) and MOEST's has been initiated. Out of ten objectives of SSDP the objectives related to secondary education and quality education are: Improving quality of secondary education with teacher's professional development by increasing provision of qualified and trained teachers and strengthened teacher management to supply adequate teachers to teach core subjects such as science, Mathematics and English are supposed more fruitful.

My Inspiration:

I was born and brought up in Pyuthan district. I was exposed to the teacher-centered teaching and learning environment in my school education. I even had such kinds of conventional educational system in my higher education. Memorization, recitation, pattern practice, drilling etc. were common phenomenal techniques in the learning process. My professional career begins from the teaching profession in 2000 AD in private school as a secondary mathematics teacher. As a mathematics teacher, I generally followed the conventional teaching learning activities without considering any pedagogical concept and skills provided by educational pedagogy. As my experience, pedagogical practices were more focused on teacher centered activities. Meaning that I was more guided by absolutist teaching learning activities. My profession attracts me on education faculty from science faculty and then got chance to know about pedagogy of teaching. Academically I experienced from my master's thesis on "Correlational study on teachers' knowledge and classroom practice of different methods" prescribed in secondary mathematics curriculum, almost teacher has the knowledge of method but not used in classroom activities, with very low degree of correlation coefficient 0.32 among

33 untrained teachers, so the researcher is again interested to study Exploring the Knowledge- Practice Gap in Preservice Secondary Mathematics Teaching in qualitative manner.

Objectives of the Study

The general objective of the study is to observe the pre-service teacher knowledge and its practice in classroom in secondary level mathematics.

The specific objective is:

a. To explore pre-service secondary level mathematics teacher knowledge and classroom practice in practice teaching classes.

Research Questions

Research questions are the guiding questions of the study. Generally, objectives are converted into the question form. Research question guide the researcher to reach the findings of the study but it is a valuable defense against the confusion and carrying the whole theme of research. It organizes, delimit, provide a framework and point to the data that will be needed (punch, 2005). The research will provide answer to the below question:

a. What is level pre-service mathematics teachers' knowledge and its practice in classroom?

The continuity of teacher training programme in Nepal from basic teacher training center (BTTC, 1947) to School Education Sector Plan (SESP. 2022) in all educational policies the teacher training in different forms and nature conducting by different government and private organization indicating the need of teacher training. Most of the educational policies suggesting update the teacher competences framework and coordinate with universities for the development and implementation of teacher preparation and pre-service training programmes, this indicates the need of pre-service teacher training. According to the European Commission (2007 b), The Mathematics-Pedagogy Tasks (MPTs), The United Nations 2030 Agenda for Sustainable Development, and World Economic Forum, 2020, the teacher training is essential component of quality education, so Teaching Needs of Preservice Teachers' is a rational topic for study.

Delimitations

This report discusses secondary level pre-service teacher education i.e. B. Ed programs. After the establishment of TU all the programs of College of Education were brought under the University. Later Kathmandu University started teacher education programs for Primary teachers (2002) and Early Childhood teachers (2009). Purwanchal University started its preservice secondary teacher education through distance mode in 2005. At present Sudurpaschim University, Mid-Western University also running Bachelor degree in Education. However, the massive teacher education program still is run by TU, so this study is limited in the study of preservice teacher education conducted by TU only and that is mainly limited in the preservice teachers of Butwal Multiple Campus Butwal in B.Ed. fourth year.

Methods

A qualitative method was used in the course of information collection, in which 6 preservice mathematics teachers studying bachelor degree in Mathematics education in Butwal multiple campus Butwal under internal supervision of researcher-self were interviewed and documents (lesson plan and the teaching materials made by them) were analyzed about their pedagogical knowledge, content knowledge, role of teachers, classroom presentation, classroom management and knowledge about different teaching methods and classroom strategies. The information was collected by using interview, document analysis to collect information about knowledge and observation for the classroom presentation of the knowledge.

Findings: The literature summarized on the way to research to prepare foundation of research, I found it is very significant area to study because there are many more research work in preservice teacher development program and the developed country has grand investment in preservice teacher development program and they improved their education and they developed by investing in quality education through different type of teacher training program. But our investment, lacking in engaging preservice teacher in peer teaching, microteaching and school teaching, lack of motivation in teaching field, lack of guidance in subject selection our quality education is in slow race. In our contest the new generation is not interested in teaching, so they need only the certificate but not skill for their job, so they are not attracted by micro teaching, peer teaching and school teaching.

Discussion

Pre-service programs provide for growth in content knowledge and pedagogical content knowledge. Content knowledge and pedagogical content knowledge is translated into practice through the filter of one's philosophy of mathematics and its learning (Swafford, 1995). Thus, apart from knowledge and abilities, prospective teachers are expected to develop positive attitudes and beliefs related to the task. Teacher education should facilitate trainee teachers to transform and enhance their beliefs in relation to classroom actions, so the study to explore the gap of knowledge- practice of secondary mathematics teacher of preservice teachers' focuses on the five (4) themes generated from the analysis of information obtained from interview protocol. The five (4) themes generated from semi structure interview protocol are: content knowledge, pedagogical knowledge, classroom presentation and strategies, and confidence. The three themes were viewed in document analysis classroom presentation by formal observation protocol and the document prepared by teachers were analyzed.

The information gathered from interview:

Themes	Preservice Mathematics Teachers	Results
Content Knowledge	PMT1, PMT2, PMT3, PMT5, PMT6	Good
	PMT4	Average
Pedagogical Knowledge	PMT1, PMT2, PMT4, PMT5	good

	PMT3, PMT6	poor
Presentation Strategies	PMT1, PMT2, PMT4, PMT5	good
	PMT3, PMT6	average
Confidence	PMT1, PMT2, PMT3, PMT4, PMT5	good
	PMT6	average

The above information table-1, shows the information about Preservice Mathematics Teachers gathered from interview about defined four themes. Teaching practice provides preservice mathematics teachers with teaching opportunities in which they put into practice what they have learned in college. All six PMT that responded to interview questions of this study, which shows five teachers has good content knowledge, four teachers have good pedagogical, four teachers have good presentation strategies, and five teachers are confidence in their job. Likewise, only one teacher is average in content knowledge, two teachers are average in pedagogical knowledge and presentation strategies and only one teacher is average in subject matter confidence. The PMT 1, 2 and 5 are proving good in interview.

The information gathered from document analysis:

Themes	Preservice Mathematics Teachers	Results
Content Knowledge	PMT1, PMT2, PMT4, PMT5, PMT6	Good
	PMT3	poor
Pedagogical Knowledge	PMT1, PMT2, PMT4, PMT6	good
	PMT3, PMT5	average
Presentation Strategies	PMT1, PMT2, PMT4, PMT5	good
	PMT3, PMT6	average

The above information table-2, shows the information about Preservice Mathematics Teachers gathered from document analysis, which are prepared by six PMT these are their lesson plan and teaching materials about defined three themes. Teaching practice provides preservice mathematics teachers with teaching opportunities in which they put into practice what they have learned in college. All six preservice mathematics teachers document analyzed properly, which shows five teachers has good content knowledge, four teachers have good pedagogical, and four teachers have good presentation strategies. Likewise, only one teacher is average in content knowledge, two teachers are average in pedagogical knowledge and presentation strategies and only one teacher is average in subject matter confidence. The PMT 1, 2 and 4 are proving good in document analysis.

The information gathered from class observation:

Themes	Preservice Mathematics Teachers	Results

Content Knowledge	PMT1, PMT5	Good
	PMT2, PMT3, PMT4, PMT6	average
Pedagogical Knowledge	PMT1, PMT4	good
	PMT2, PMT3, PMT5, PMT6	average
Presentation Strategies	PMT1, PMT2, PMT4	good
	PMT3, PMT5, PMT6	average
Confidence	PMT1, PMT2, PMT4	good
	PMT3, PMT5, PMT6	average
Mathematical Anxiety	PMT1, PMT3	yes
	PMT2, PMT4, PMT5, PMT6	no

The above information table-3, shows the information about defined five themes from Preservice Mathematics Teachers gathered by class observation. Which are collected by the researcher himself, who was internal supervisor in teaching practice. Teaching practice provides preservice mathematics teachers with teaching opportunities in which they put into practice what they have learned in college. All six preservice mathematics teachers' classes were observed properly, which shows only two teachers has good content knowledge, two teachers have good pedagogical knowledge, three teachers have good presentation strategies, only three teachers are confidence in content matter and two teachers have anxiety in mathematics and job. Likewise, four teachers are average in content and pedagogical knowledge and three teachers are average in presentation strategies and confidence but two teachers are facing anxiety in mathematics. Only the PMT1, is proving good in each themes related to class observation.

Conclusion

The present study was designed to explore the knowledge-practice gape of preservice mathematics teacher in secondary level. One of the more significant finding emerge from this study is that, the theatrical knowledge is very easy than the practical knowledge, most of the teachers are perfect to answer the content knowledge, pedagogical knowledge and they are more excellent to present their knowledge in written form that is in lesson plan and materials they made, but the classroom presentation of that same materials which they presented in very good manner in lesson plan and replied in interview are not presented. They replied teaching practice exercise were organized in a such a way that, the experience was so interested, and memorable event that provide them with a lot of learning opportunities and boost their confidence of teaching mathematics. But the result of classroom presentation not indicating this, the preservice teachers facing problems of lack of confidence and mathematical anxiety.

The triangulation of the information obtained from the three different sources: interview, document analysis and classroom observation in four different themes, the PMT having content knowledge average, pedagogical knowledge average, average in

presentation strategies and average confidence level has no mathematical anxiety that is one odd situation find in research. The researcher also identifies the opposite condition some teachers having good content knowledge, pedagogical knowledge, good presentation of documents but having mathematical anxiety and but the classes presentation is good. The PMT having good content knowledge and pedagogical knowledge, good in document preparation has no strategies for good classroom presentation and the same PMT having average in content knowledge, average in pedagogical knowledge, average in presentation strategies and average in confidence but no anxiety in mathematics. The PMT having average in pedagogical knowledge is also have good presentation of content in classroom. The PMT having good in each and every themes of all three sources has mathematical anxiety it is next odd situation in the study, so the researcher come to the following conclusions:

1. We are unable to realize learner(teachers), the teaching is skill based job.
2. We are unable to engage preservice teachers in micro teaching and peer teaching.
3. National policy is failure to motivate learners in teaching profession, so they need only document but not quality and skill.
4. No guidance in subject selection, they facing lack of confidence, anxiety in their major subject.
5. Practically we are weak because pedagogical knowledge is weak than content knowledge and classroom practice is weak than in pedagogical knowledge.
6. The education system is not motivating them in teaching profession, they are reading education but looking opportunity in other sector.
7. A good teacher in all themes from all sources is facing mathematical anxiety, it means they are not, willing for teaching profession because the education system cannot attract the good people in teaching profession they are reading only for documents.
8. Only 16% preservice teacher are looking smart for teaching.

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