

## A Framework Of Pedagogical Content Knowledge On Arithmetic For Primary School Teachers

Lokanath Mishra

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### Article Info

#### Article History

Received:  
January 26, 2021

Accepted:  
April 11, 2021

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#### Keywords :

Pedagogical Content Knowledge, Primary School, Arithmetic, Frame Work

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### Abstract

*This paper will contribute in improvement of quality of arithmetic teaching at primary level. For Pedagogical Content Knowledge (PCK), the development of this framework, is an attempt to know and decrease the difficulty of teaching. This study was proposed for discovering the insights of teachers on teaching of arithmetic and developing a frame work on pedagogical content knowledge after taking in to consideration all previous studies. Considering the status of the schools for collection of data, 160 primary school teachers and eight teacher educators who are dealing with the pedagogy of mathematics were selected for the study. This study highlighted about the conceptions and misconceptions of students on arithmetic. Different models on PCK have been reviewed and a frame work was developed on the basis of different literature and the perceptions of stakeholders.*

#### DOI:

10.5281/zenodo.4679591

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### Introduction

Pedagogical content knowledge (PCK) is concerned with studying the ways of instruction, identifying the gap between transmission and grasping of knowledge, and learning the conception and misconceptions in the process of teaching and learning. PCK was categorized into three components. This incorporate substance information, information on student thinking and information on instructive methodologies. They characterized content information as information on the focal ideas, standards and connections in a curricular space, just as information on elective ways that can be spoken to in instructional circumstances. The pedagogical content knowledge worked as prodigious change that manifested different dimensions inside the process of teaching and mastering in actual lecture room scenario. It pointed out the missing paradigm that needs to be identified and corrected, in order to make teaching and learning environment free from chaos. PCK helps teachers to understand the loopholes in the subjects, how the students learn, why they fail to learn, and various other aspects related to process of teaching and learning. Having deep information of mathematical expertise is necessary however now not enough to train mathematics. Further, it's similarly no longer feasible to teach arithmetic while not having mathematical know-how. The teacher of Mathematics should be educated both from "mathematics knowledge" and "pedagogical content knowledge" (Turnuklu and Yesildere, S 2007). The knowledge of mathematics will help in teacher's expertise. For the growth of teacher's understanding PCK should be more focused. When a teacher transmits knowledge to students, the teacher must be able to know whether the students are learning correctly or not. If the students are learning wrong then he should be able to identify the gaps or misconception hindering students to learn correctly. Shulman. L (1986) called attention to the missing worldview, expressing that the accentuation is on how teacher deal with their study halls, arrange exercises, distribute time, structure assignments, credit commendation and fault, detail the degrees of their inquiries, plan exercises and check general comprehension. He further introduced that the missing questions are approximately the content material of the training taught, questions asked and the rationale supplied to the magnificence. How the teacher uses analogies, metaphors, examples, demonstration are other important factors which need attention. The teacher should not be confined to defining the concepts but should also be able to relate it to practical situation. Shulman. L (1987) "recommended one-of-a-kind styles of understanding which can be essential for instructors, consisting of content material understanding, general pedagogical information, curriculum understanding, PCK, understanding of newcomers and their characteristics, information of education contexts and know-how of schooling ends, their purposes and values". PCK embodies the understanding of teaching and learning in such a approach that, teacher will be able notice the changes required to make teaching or learning of particular topic simple and easy or difficult. It will help to understand the conceptions and pre-

conceptions held by the students which influence their learning. If those assumptions are misconceptions then the teacher should be able to identify them and clear them.

In a study conducted by Dutton (1954), teacher's lack of understanding, punishing students, using inadequate methods, difficulty in working arithmetic, and insecurity are the chief causes of dislike for arithmetic. The attitude and behavior of the teacher towards the subject or the content influences their teaching to great extent. Fear of making mistakes in front of students tends to confine them into monotony. Experimentation and error are the part of arithmetic, the teacher well equipped with PCK will learn from mistakes. In educational domain, arithmetic is always viewed as one of the elitist subjects. It is taken up as main course or studied by only those who have better insight and understanding of it. It is one of those subjects that students try to avoid and sometimes even by the teachers. It is difficult for those who are not good in numbers but not impossible to learn, the pre-conception or assumption about the subject makes it more difficult than it actually is. The pre-conceptions about the subject have to be removed first in the head, in order to make it easy and trouble free. Resek, D., & Rupley, W. H. (1980). expressed that extreme dread of arithmetic keeps numerous understudies from prevailing in essential mathematics course required for accomplishment in their orders. The dominance of number juggling calculations is a misjudged ability and may fill in as a proof of readiness to become idea situated toward rudimentary arithmetic. Fear of mathematic is not new; it is well known that the subject requires patience and skills to arrive at solution. Flexibility in the methods of instruction and vigorous practice is required for the teachers. Once the teacher is well equipped with the PCK of arithmetic along with the mastery in the subject, he/she will be able to point out the reasons for student's fear regarding the subject, have better understanding of student's conceptions and misconceptions. Arithmetic at elementary level needs more attention, as the child is at the basic level of learning. This period demands specific skills to deal with minors in the class. Arithmetic often tends to be taught in a hierarchical way (Dowker, 2005). At the initial stage, many teachers anticipate that they realize all of the mathematic needed and in absence of any specific pedagogic virtually try to uncritically reproduce the strategies they found out of their school days. Indeed, it's far the maximum vital phase wherein greater care is needed to nurture the potentials of the kid. This often finally ends up perpetuating issues throughout time and area. While inadequate teacher practice and aid acts undesirably on totally of school mathematics, at primary degree its important effect is the mathematics pedagogy hardly resonates with the results of teenagers' psychology. (Fennema and Franke, 1992) "If the teacher has a conceptual know-how of mathematics this impacts classroom practice in a wonderful way, consequently it is crucial to have arithmetic information for teachers". PCK focuses on methods and skills of teaching, way of demonstration, using simple examples that connect students, using analogies, identifying conception and misconceptions that hinder the process of teaching and learning. Teacher's PCK is highly associated with students gain and achievement (Olfos, R., Goldrine, T., & Estrella, S. 2014). This highlights that teacher's way of presenting the content greatly influences student's achievement. There are various factors contributing in making teaching difficult for teacher, whether it be workload, technology, outdated curriculum, or dealing with students from various physical, emotional and psychological background. The emphasis on professional development has encouraged teachers to reconceptualize their roles. The new role is doing more than what a mere machine without emotions can do. The teacher is a motivator and facilitator, who will encourage and help students to learn new knowledge. The attempt to use innovative materials in the process of teaching and learning is somewhat challenging for teachers but have major influence in their growth as teacher (Clarke, D. M. 1997). A very few studies (Carpenter et al., 1988; An S., Kulm G. and Wu Z.,2004; Blanton, Berenson, and Norwood ,2001; Baker & Chick, 2006; Carpenter, Fennema & Franke 1996; Danisman & Tanisli,2017; Hill 2010; Harr, Eichler and Renkl, 2014; Maniraho,2017, and Shuilleabhain,2016) have been found in the area where it was examined what exactly the teachers are doing in the arithmetic classroom. This examination tries to contribute in progress of nature of number juggling educating. The improvement of system for educational substance information is an endeavor to comprehend and decrease the intricacy of instructing. There are various factors influencing the teaching process but one of the most important is teacher, so the teacher must understand the art of knowing to teach mathematics. The researches on this area have not only given direction to the present study, but also highlighted the need to focus on pedagogical content knowledge in training course. Yeşildere İmre, Sibel & Akkoç, Hatice. (2012) suggested that primary school arithmetic teachers must be trained both from mathematical skills and PCK aspect. This shows mathematical knowledge alone is not enough for arithmetic teacher to deal with real classroom situation. The PCK helps teachers to be reflective in their methods of instruction that will ultimately assist them to enhance their teaching practice. The development of framework for PCK is an attempt to know and decrease the difficulty of teaching. There are various factors influencing the teaching process but one of the most important is teacher, so the teacher must understand the art of knowing to teach mathematics. In Mizoram there is dearth of mathematics and science teachers resulting in students' weakness in these two subjects. The teachers need to be adept in PCK in the arithmetic.

This study looks at turned into supposed to discover the perceptions of teachers on teaching of arithmetic and developing a frame work on pedagogical content knowledge after taking in to consideration all previous studies. This study was undertaken with the following objectives:

- To analyze if primary school teachers in Mizoram are ready, assured and organized for the teaching of arithmetic.
- To identify the difficulty level in arithmetic faced by the teacher.
- To develop a framework on Pedagogical Content Knowledge for primary school Arithmetic teachers

### Methodology

Mizoram is one of the states having 8 districts in the North Eastern region of India and is the southernmost landlocked state. Through census 2011, the nation has third highest literacy rate in the country i.e. 92%. In directive to justify the aims of the study, data collection methods were used primary as well as secondary sources. All the primary schools' teachers of Mizoram 8703 with male 4059 and female 4644 were the target population of the study. Considering the status of the schools for collection of data, from all the primary schools in the eight districts, 20 primary schools were selected from each district. 160 primary school teachers (one from each school) were selected in order to know-how about the teachers "competence, confidence and the levels of support" they received. The study turned into expressed and defined a PCK structure, which in turn become used to manual and assist the specialized improvement. Further eight teacher educators who are dealing with the pedagogy of mathematics from eight District Institute of Education and Training (DIET) were included for the study. One best school from each district was selected for implementing the framework on experimental basis. The perceptions of teachers for implementation of PCK data were composed through Focus Group Discussion. In the first phase of the study a workshop was conducted for the development of questionnaire. After development of questionnaire the project director and the Junior Project fellows enter to the field with the help of Cluster Resource Center Coordinators (CRCCs). After collection of data and review of related literature a PCK frame work was developed in the workshop-2 conducted by the project director in which professors of education dealing with mathematics pedagogy from different universities of India, eight teacher educators from District Institute in Education and Training (DIETs) of Mizoram 10, primary school teachers participated. The frame work was then handed over to Director school Education, Mizoram for implementation in primary schools.

### Findings and Discussions

Teachers have to understand the difficulty count well so that it will educate it effectively, so it is critical they own mathematics know-how. While teaching, teacher may come across many problems. For most of the teachers teaching arithmetic is not a complex job, but there is a chunk of teachers' population who faced complexity in teaching arithmetic in the actual classroom.

**Table 1 -Problems in Teaching Arithmetic**

Sl. No	Statements	Yes	%	No	%
1.	Teaching is too complex	122	76%	38	24%
2.	Syllabus of primary school arithmetic is too heavy	94	58%	66	42%
3.	Facing problems in teaching arithmetic	73	45%	87	55%
4.	Feeling in competent in teaching arithmetic in primary schools	88	56%	72	44%
5.	Teaching Mathematics correctly	92	57%	68	43%
6.	Language of arithmetic confuses teachers	23	14%	137	86%
7.	Received hard spot training on arithmetic	98	60%	62	40%
8.	Consulted other teachers while you face problems in teaching arithmetic	72	44%	88	56%
9.	Aware about the misconception of teaching arithmetic	54	33%	106	67%
10.	Capable to understand student's misconception	27	16%	133	84%

Complexity in teaching arithmetic arises due to various reasons like lack of conceptual understanding of teacher, lack of interest, heavy syllabus, and others. Curriculum revision from time to time is required to resolve the difficulties tackled by the teachers and their learners in teaching and getting to know processes of arithmetic. Need of PCK in the preparation of teachers as inadequacy to link the content in actual classroom was dispiriting for both teacher and students.

Some teachers (56%) did not feel competent in teaching arithmetic which results in creating chaos in the classroom environment. Forty-four percentage teachers feel to consult with other teachers for teaching arithmetic. Most teachers are not aware of the misconceptions occurring while teaching mathematics, with 106 (67%) teachers expressing their lack of awareness. Most important demanding situations in teaching are in understanding the misconceptions, doubts and confusion of students. 133(84%) teachers admitted to being aware of student's problem with understanding mathematical concepts. Teachers often wonder why their students underperform despite their best efforts.

There were various areas of arithmetic in which individual teacher found it confusing while teaching content to the students. Those areas include place value, addition and subtraction, multiplication and division, fraction, expansion, percentage calculation, ratio and proportion, decimals, measurement, time and work and tables. It was found that, few teachers (42%) were not sure whether they were teaching correctly or not. This dilemma of teachers indicated lack of self confidence in delivering knowledge in the classroom. The language in arithmetic not only exemplified the theoretical portion in different areas of arithmetic but also the abstract codes, vocabulary, syntax, etc.

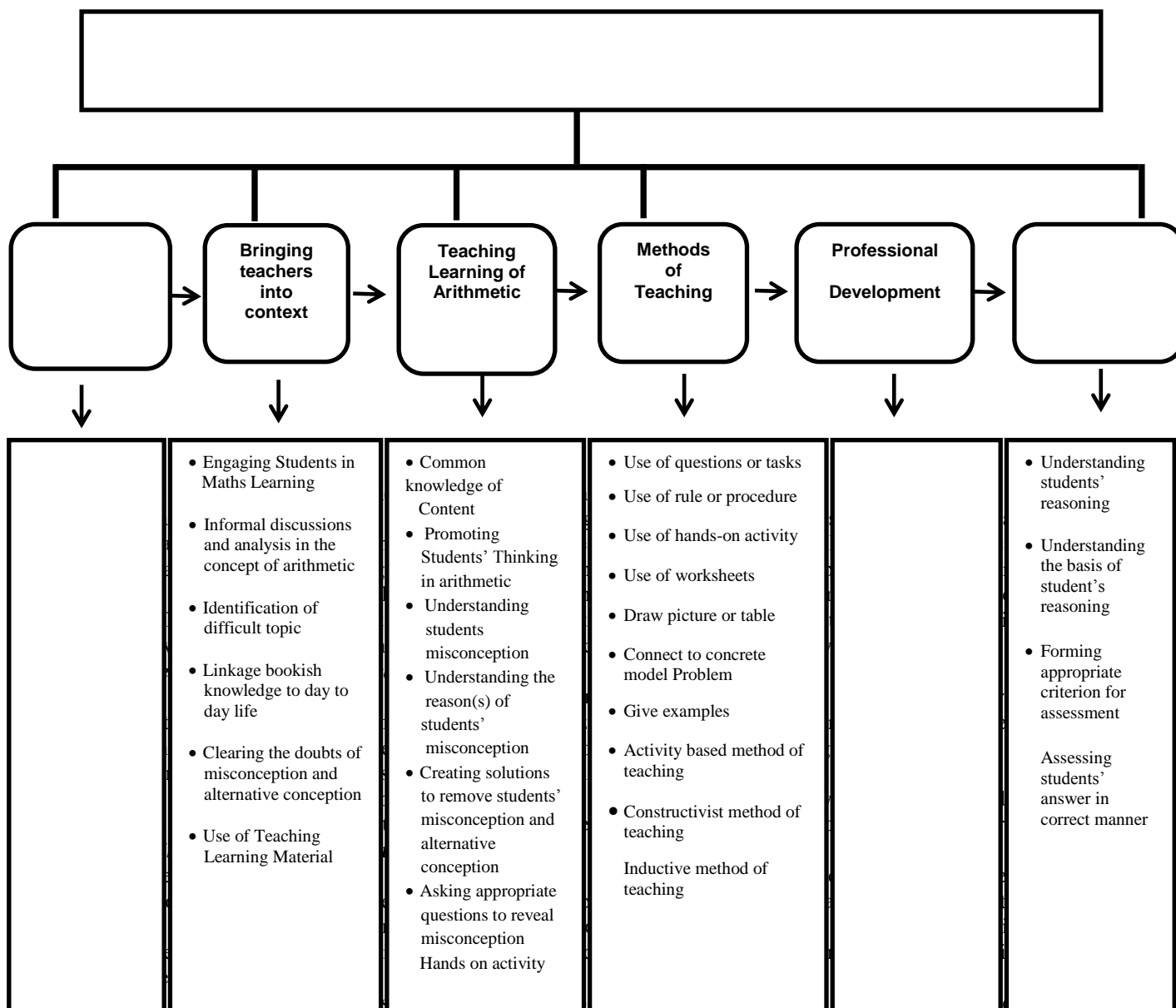
The significant proportion of teachers (76%) responded that they had not received any hard-core training in arithmetic. The training program is essential to nurture potential, to develop understanding and in order to respond to different chaotic situations prevailing in the class. In arithmetic misconception is not something new, this misconception occurs from inadequate knowledge, faulty understanding, inability to link the previous knowledge to new one or trying shortcut to solve mathematical problems etc. Teachers should be made aware about the misconceptions before teaching in the class to avoid delivering faulty knowledge to the students.

This study highlighted that few numbers of teachers were (38%) aware about arithmetical misconception. According to the findings, some teachers expressed (21%) their inability to understand student's misconception in arithmetic. The factors like limited knowledge of teachers, lack of awareness about misconception, negligence etc., were contributing in making it more complex for the teachers to understand the student's misconception.

The study highlighted different areas of arithmetic, where the students were having misconception. Areas like, percentage calculation, ratio and proportion, geometrical figures, expansion, fraction, decimals, measurement and place value were some important areas in which the teachers find majority of students' misconception. Though in areas like addition and subtraction, multiplication and division and time and work less number of students were having misconception but these were equally important and could not be ignored. Even a slightest doubt in student's mind can create big confusion in future; therefore, it is important on the part of teacher to clear student's doubt in effective way.

It further revealed different areas, in which the students were having alternative conception. Majority of teachers in the study expressed that they tried to clear student's misconception/ alternative conception while teaching arithmetic in the class. Chances of arithmetic errors depend both on teacher and student, teachers were required to have conceptual understanding about the content he/she was dealing in the class in order to avoid ambiguity. In keeping with the findings of the study, teachers were more comfortable with activity-based approach in teaching arithmetic to the students. It involved students as active participants rather than passive learners and focused on learning by doing.

This investigation has made a noteworthy commitment to this goal by distinguishing PCK, through crafted by prestigious researcher and teacher and instructors, as the best for the educating mathematics. Wide depictions of normal information on knowledge, particular information on knowledge, information on substance and students, and information on substance and instructing that make up PCK were gotten from the works of mathematics education. A structure for looking at pedagogical content knowledge for encouraging arithmetic has been planned based on the above findings as said by the educators, two noteworthy stands of research from Shulman (1986) and resulting related works by various famous researcher. The improvement of a PCK framework for essential instructors that is dependent upon ceaseless assessment end up being a significant instrument for the expert turn of events. As per the explanations of PCK parts checked on researchers have concentrated on different aspects of teacher knowledge. In any event, while asserting their model was based upon Grossman's (1990) and Tamir's (1988) work, Magnusson et al. (1999) just generally embraced their PCK component from a general perspective. The sub-parts in their model speaking to the implication of every segment are very not the same as Grossman's (1990) and Tamir's (1988)



models in the light of information and proceed to present new and increasingly significant inquiries. Rich instances of what presenting can produce in study halls can rise up out of this work. This area additionally accentuates the relationship

**Stage-3: Teaching and Learning of Arithmetic**

In light of the data analyst recognized some regular theme on which educators will create common information on content, advancing understudies' intuition in math, understanding students' misguided judgment, understanding the reason(s) of students' misinterpretation, making answers for evacuate understudies' confusion and elective origination, posing fitting inquiries to uncover misguided judgment and create hands on action.

The structure featured the uniqueness of PCK through concentrating on building up a theme explicit PCK for grade teachers. By concentrating on theme explicit models, elementary school science educators can create explicit systems that mean the compelling utilization of praiseworthy models of number juggling instructing inside subjects. The model at that point further permits the mix of details and complexities of the hypothesis and practice of showing number juggling utilizing PCK.

The PCK framework assisted teachers to be intelligent of their instructional rehearsal in manners that can recover the instructing of number juggling ideas. Intelligent intuition, with or without associates, urges teachers to improve their number-crunching guidance and to acknowledge the demand of instructing with lowliness. The data accumulated inside the system was seen as effectively versatile for the choices on the structure of the system just as the later examination of the entire advancement of PCK. This structure unites learning results, guidance and evaluation and can possibly impact the manner in which teachers or students learn arithmetic positively. The system requires arrangement ahead of time, and achievement is probably going to be

accomplished simply after rehashed and steady application so as to improve the adequacy of the model. The taxonomies by Veal and Ma Kinster (1999), Loughran et al. (2003) “pedagogical content knowledge representations (Co Re), and Pedagogical and Professional-experience Repertoires” (Pa P-e Rs).

#### ***Stage-4: Methods and approaches of teaching***

The child-centered context is surroundings wherein the development of PCK changed into performed the usage of the kid- centered technique. Throughout the growth of PCK the scholar helps as a organizer, circulating many of the corporations to provide assist and steering. Instructors are using pastime methods of coaching using of arms-on interest. In this degree teachers should provide more emphasis on usage of questionnaires, draw photograph or tables, connecting to actual model, constructivist method of coaching and inductive technique of teaching. Instructors are caused see that there are regularly specific ways to solve a trouble so he can adopt distinct assumptions and use special techniques of evaluation

#### ***Stage -5: Professional development***

In data analysis teachers must attain different professional development program to build confidence and a willingness and disposition toward teaching as well as learning. They also want to attain seminars/ Conference, training programs, peer consultation and internet browsing for the development of mathematical knowledge.

#### ***Stage 6: Assessment of PCK (metacognition)***

As a teacher one needs to choose what to educate, extricate the large thoughts, make drives outcomes and afterward create a plan on the best way toward encourage this exercise. Valid appraisal is applied and is a technique for getting data about students' understanding in a setting reflecting practical circumstances, and that provokes students to utilize what they have realized in class in a real setting.

Pedagogical content understanding framework presents a fantastically complete version for forthcoming studies of PCK in educator trends. The pedagogical content information framework in this study permits researchers and instructor education applications to as it should be discover and cope with differences among information bases of numerous instructional disciplines. It additionally enables researchers analyzing information improvement in instructors and trainer schooling programs to classify and characterize unique traits of arithmetic coaching. In addition, the outline identified the virtual position that scholar and teacher supply to the one-of-a-kind additive of PCK. The framework served to arrange and integrate scholar efforts targeted on PCK.

Numerous situations arose in which PCK regarded to increase at some point of the professional development. The maximum commonplace category of expertise to broaden became the one related to students' problems, this is, know-how of content material and beginners. Often, the teachers did not realize of or expected the regions wherein inexperienced persons could have issue. When such conditions arose, the lecturers found out and projected the problems that beginners can also have and, as a result, the academics' expertise of content material and rookies advanced, in relation to the relevant factor of mathematics.

#### **Conclusion**

This research study concentrated on utilizing a model/system for the improvement of PCK. It in any case, didn't explain if educational substance information develops over the span of expert turn of events. On the off chance that the facts confirm that it develops, what might be the situations or occasions causing the development of this information? There is requirement for additional study in these two regions. Because of the less time for study the investigation couldn't survey and assess the effect of the advancement of academic substance information utilizing an educational substance information structure to grade teachers to their student's exhibition in the study hall. A portion of the teachers' present information can be ascribed to showing experience or from information that created preceding their expert turn of events. Review of literature proposes that even experienced teachers don't have adequate information for teaching, which could imply that they keep on depending on their basic substance information. Legitimately or in a roundabout way, educator training project will profit by further PCK inquire about? The result of this study can be helpful for teacher, researcher, including in-service and pre-service teachers, scholar involved in curricular development as well as scholar in field of education. The resources and data utilized in this research study made it conceivable to set up exceptionally sorted out helps and think about the numerous methods for refining each phase of the pedagogical content knowledge framework.

**Funding** – This research funded by National Council of Educational Research and Training (NCERT), New Delhi

**Conflicts of interest/Competing interests** – There is no Conflicts of Interest in developing this paper and conducting this research

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**Author Information**

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**Prof. Lokanath Mishra**  
Director, Faculty Development Center  
Mizoram University, Aizawl

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