



RESEARCH PAPER

**Effectiveness of Teacher's Induction Program featured with
Preloaded Customized Tablets for the Improvement of Science
Teachers' Perception and Pedagogical Content Knowledge in KPK,
Pakistan**

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ABSTRACT

Science teacher's pedagogical content knowledge (PCK) is very much essential for the student's learning. This study aimed to explore the effect of induction program on newly inducted science teacher's perception, pedagogical content knowledge and practices. This study was descriptive and survey method was used for it. Thirty chemistry teachers were selected randomly from Peshawar. Out of these, fifteen newly appointed chemistry teachers were using customized tablets for teaching whereas the other fifteen chemistry teacher did not use customized tablets for chemistry teaching. Two different types of research tools were used to get an insight into teachers' perception and pedagogical content knowledge. A major difference was found regarding perceptions of teachers, pedagogical content knowledge. The teachers using customized tablets were found to have more pedagogical and content knowledge understanding as compared to others. It is recommended to provide customized tablets to science teachers as a regular feature of their training.

Introduction

The role of a teacher is changing significantly in educational institutes all around the world. Teachers have to teach in multicultural classrooms. The use of information communication technology (ICT) is emphasized for the improvement in the teaching-learning process and involvement of the community in school affairs. For this purpose, both pre-service and in-service training sessions are needed to make the teachers able to face the challenges in their careers. Professional

development is very important for teachers to develop and polish their knowledge base, skills, and expertise. The main objective of the professional development courses is to update the teachers with the advancements in their subject area and education as a whole. The term teachers' professional development (TPD) points to the development of professional knowledge and skills of teachers that are according to their needs. In professional development, there should be harmony in the knowledge base of the mentor and mentee. Through TPD, policymakers can convey a broad vision to the teacher community. It usually involves the 'modeling' process in which teachers are engaged as learners. The three broad categories of TDP include the standardized TPD, site-based TPD, and self-directed TPD. When TPD is ICT-based it needs intensive training in three domains; digital or ICT literacy, interactive teaching keeping learners in the center, integration of both these in classroom teaching (Hooker, 2017).

The standard or quality of education and teachers' training are directly proportional to each other (Khan, Fauzee, & Daud, 2016). In Pakistan, many teacher training programs are in practice. This study is related to a specially designed induction program for the newly recruited teachers in Khyber Pakhtunkhwa, Pakistan. This program is aimed at the development of teachers' pedagogical content knowledge and skills. A huge investment was made in this program as Rs 424 million was spent on it. Pre-loaded tablets were provided to the teachers having content regarding inclusive education and subject matter knowledge like English, mathematics, and science i.e. physics chemistry, and biology. The basic aim was to equip teachers with knowledge of their profession and make them effective teachers in the classroom so that the students may take benefit from their expertise in terms of improvement in their academic achievement.

Literature Review

Nature of science is an essential tool to promote pedagogical content knowledge through an immediate feedback process, which involves lesson planning, feedback questionnaire, audio, and video recordings (Choudhary, Noor and Javed, 2020) . It was also found that teachers having a clear understanding of the nature of science can provide immediate and proper feedback to students (Akerson, Pongsanon, Rogers, Carter & Galindo,2015). Nature of science explains the epistemological base of science, the impact of science in society, and the relationship between believes and values (Clough, 2006), and however, nature of science provides the abilities among teachers to communicate the understanding level of science education to students (Abd-El-Khalick, 2013).

For effective science teaching, teachers must have a clear understanding of the nature of science. The content and pedagogical skills of science teachers depend upon the clear comprehension of science teachers about the nature of science. Content knowledge concerning science and mathematics includes six classifications involves frequent content knowledge FCK, exceptional content knowledge ECK, level of learners and content LLC, teaching and content knowledge TCK, deep

content knowledge DCK, and curriculum knowledge CK, which is directly linked with the seven domains of the teaching-learning process consisted of pedagogical content knowledge PCK, methodical knowledge MK, educational programmed knowledge EPK, methodical content knowledge MCK, learners data knowledge LDK, context knowledge CK, and knowing about purpose along with ethics and values KPEV (Ball et al., 2008).

The knowledge and skills about the use of technology in the teaching of science and mathematics are considered as an essential tool to enhance the level of motivation of learners and at the same time promote the teachers' pedagogical content knowledge (Thomas & Palmer, 2014). Nilson (2008) has argued that one-third of the physics lessons can be converted through a blend of technology (audios & videos) to stimulate learners towards the learning process, therefore, pedagogical content knowledge may be enhanced through blended technology. It was found that reflective practice is effective during the learning of sciences as compared to the substantial horizon of science content because the reflection of perception is a larger ingredient of the science lesson through which perceive content knowledge about sciences can be improved and promoted (Zemal-Saul, Krajick & Blumenfeld, 2002).

The clarification of mathematics concepts is based on the teacher's pedagogical content knowledge; therefore, elementary teachers must be prepared for it. Effective mathematics and science teaching facilitate the problem-solving skills among learners to enhance the learning process (Morris, Hiebert & Spitzer, 2009) that is directly related to pedagogy. Methods to convey mathematical logic to learners in a useful manner is the main focus of pedagogical content knowledge (Beswick & Goos, 2012) through which misconception of learners about content can be addressed through intellectual tools (Aguire, Zavala & Kataanyoutanant, 2012). The following steps are useful to promote pedagogical content knowledge:

- a. An inclusive knowledge of subject matter as per cognitive abilities of learners
- b. Knowing about misconceptions and understanding level of learners in specific topic
- c. Information about horizontal and vertical approaches of curriculum regarding science subjects
- d. Comprehensive understanding of teaching strategies

It was found that the utilization of technological pedagogical content knowledge during the teaching-learning process of science education is not proper due to the lack of interest of science teachers (Kafyulilo et al., 2015). Pre-service teachers' training sessions should involve instructional design preparation, pedagogical content knowledge, and evaluation process with the use of technological tools (Kafyulilo et al., 2015) because it has great effectiveness.

The technological approach in the teaching of science education is an optimistic way to make teaching more effective (Agyei & Voogt, 2012; Mishra &

Koehler, 2006) because the use of technology promotes a collaborative design approach (Voogt et al., 2011) which helps teachers to enhance educational practices and skills. Tondeur et al. (2012) had suggested the following ingredients to promote pedagogical content knowledge through the use of technology:

- a. Inculcate theory approach into concrete practice
- b. Reflection of technology into the teaching-learning process
- c. Content knowledge is enhanced with the help of technology
- d. Collaborative methodology with all stakeholders in the education scenario
- e. Application of veritable technological modes
- f. Flexible learning approach

The product or outcome of the teaching science is directly associated with interest and academic achievement; therefore, the learner's motivation is linked with the instructor's interest. Technological tools create intrinsic and extrinsic motivation among learners (Javed, Buraira & Asghar, 2019) which supports a high level of academic achievement of the learners under the umbrella of teachers' pedagogical content knowledge (Keller, Neumann & Fischer, 2017) and also provides an enhancement in cognitive and affective domains. The blend of technological aid in synchronous and asynchronous modes affects the academic achievement level of the learners (Javed, Buraira & Asghar, 2019).

Pedagogical content knowledge is based on specific science content and the methods through which learner seeks knowledge and skills in self-directed and need-based learning (Nilsson, 2014; Runesson, 2006) in which instructor is a facilitator to inculcate specific content and a constructor of collective professional knowledge through a collaborative approach.

The quality of the teaching-learning process in science education is associated with knowledge and pedagogical skills (Vikström, 2014; Nilsson & Loughran, 2012; Heywood & Parker, 2010).

The blend of content, pedagogy, and technology is an effective tool towards the organization of content delivery for concept clarification in a systematic way and to understand the complex problems in classroom practices (Ball et al., 2005) which is helpful to enhance teachers' content knowledge and pedagogy (Schneider & Plasman, 2011).

Teacher's pedagogical content knowledge can also be enhanced through induction programs. Ingersoll & Strong (2011) examined different induction programs of teachers through a meta-analysis of 15 published articles during the past 25 years. The researchers found that, despite different variations in the components of the induction program, these had a consistently positive impact in the areas of teacher's retention, effective classroom management, positive classroom environment, developing lesson plans, promoting effective student questioning, designing classroom activities according to student's interests, maintaining positive

classroom environment (Ingersoll & Strong, 2012) and enhanced academic achievement of students (California County Superintendents Educational Services Association, 2016).

Induction Program of Khabar Pakhtoon Khawa

A new initiative was taken by the Elementary and Secondary Education Department (E&SED) of Khyber Pakhtunkhwa (KP) government in the form of an Induction Program (IP) targeting the training of newly hired teachers of English, Math, and Science. The new IP program was designed by the Directorate of Curriculum and Teacher Education (DCTE) and implemented by the Provincial Institute of Teacher Education (PITE) with the support of the Khyber-Pakhtunkhwa Elementary and Secondary Education Department (KP E&SED). The program was initiated for the primary, middle and secondary school Beginning Teachers (BTs) with support from the K-P Education Sector Programme Technical Assistance (KESP-TA). It was expected that BTs will improve their subject content knowledge and pedagogical skills in the subject of Maths, Science, and English. The duration of the training was more than six months. The training was provided with the help of purposefully made learning management systems loaded with the contents of the training for all three subjects. The contents of the training focused on improving the pedagogical content knowledge and teaching practices for the specified subjects. For this purpose, the teachers' induction program, provided 15,000 computer tablets pre-loaded with specifically designed LMS to all under-training teachers. The training material included training videos, descriptive materials, and self-assessment exercises. The subject-experts from high and higher secondary schools served as the resource persons for the face-to-face training sessions of BTs. These experts were first trained by the PITE to qualify to act as resource persons for the IP.

Research hypotheses

- ¹H₀ There is no significant difference between teachers' pedagogical content knowledge before and after the intervention through customized tablets
- ¹H_A There is a significant difference between teachers' pedagogical content knowledge before and after the intervention through customized tablets
- ²H₀ There is no significant change in the perceptions of teachers regarding the use of customized tablets for science teaching.
- ²H_A There is a significant change in the perception regarding the use of customized tablets for science teaching.

Material and Methods

The comparative research design was used in this study employing the survey method. A comparison was made between two groups of teachers getting in-service training. The control group was trained through traditional methods of training whereas the experimental group was trained with the help of pre-loaded customized tablets containing contents on pedagogy and subject of teaching. Secondary school teachers recruited through the National testing service in 2018 were part of the study. The professional development of chemistry teachers was focused on.

Chemistry teachers recruited through NTS from 2017-18, teaching grade 9th girls students at high and higher secondary school level comprised the population of this study. Thirty secondary school chemistry teachers recruited 2017-18 from tehsil Charsada of Peshawar were part of the study who gave consent to participate in the study.

Research Tool/Instrument

1. For the collection of PCK scores, a test about pedagogical content knowledge of teaches was prepared. There were two sections of the test i.e. content knowledge having 10 questions and pedagogical knowledge having 25 questions. The score range of the test was 0-35.
2. A self-developed 5-point Likert scale type survey questionnaire of 12 items was used to explore changes in teachers' perceptions before and after in-service training. Responses of the teachers were obtained, and scoring was done with the following key: 1 = definitely not, 2 = probably not, 3 = possibly not, 4 = probably, 5 = definitely.

Results and Discussion

Table 1
Comparison of PCK scores of control and experimental group before training

Group	Mean	N	Std. Deviation	t	df	Sig
Control	19.800	15	3.3423			
Experimental	20.133	15	3.888	-0.367	14	0.719

Table 1 shows the comparison of content knowledge and pedagogical knowledge of the control and experimental group before the experiment. It shows that there is no significant difference ($p=0.719$) between the control ($M=19.800$, $SD=3.3423$) and the experimental group ($M=20.133$, $SD=3.88$). It is clear from the data that both groups were equal before the experiment in terms of content and pedagogical knowledge.

Table 2
Comparison of PCK scores of control and experimental group after training

Group	Mean	N	Std. Deviation	t	Df	Sig
Control	19.933	15	3.3266			
				-10.174	14	0.000
Experimental	28.4667	15	3.020			

Table 2 shows the comparison of content knowledge and pedagogical knowledge of the control and experimental group after the experiment. It shows that there is a significant difference ($p=0.000$) between the control ($M=19.933$, $SD=3.332$) and the experimental group ($M=28.46$, $SD=3.02$). It is clear from the data that the content and pedagogical knowledge of the experimental group increased after the intervention of customized tablets.

Table 3
Comparison of PCK scores of control group before and after traditional type training

Test	Mean	N	Std. Deviation	T	df	Sig
Pretest	19.800	15	3.3423			
				0.7514	14	0.751
Posttest	19.933	15	3.3266			

Table 3 shows the comparison of content knowledge and pedagogical knowledge of the control group before and after the experimental procedure. It shows that there no significant difference ($p=0.751$) between the control group on the pretest ($M=19.80$ $SD=3.342$) and the posttest group ($M=19.933$, $SD=3.32$). It is clear from the data that the content and pedagogical knowledge of the control group remained the same before and after the experimental procedure as this group had no intervention of customized tablets.

Table 4
Comparison of PCK scores of experimental group before and after training with customized tablets

Test	Mean	N	Std. Deviation	T	df	Sig
Pretest	20.1333	15	3.888			
				-13.732	14	0.000
Posttest	28.4667	15	3.020			

Table 4 shows the comparison of content knowledge and pedagogical knowledge of the experimental group before and after the experimental procedure. It shows that there was a significant difference ($p=0.00$) between the experimental group on the pretest ($M=20.1333$, $SD=3.388$) and the posttest group ($M=28.466$, $SD=3.020$). It is clear from the data that the content and pedagogical knowledge of the experimental group increased significantly after the procedure as this group had received the intervention of customized tablets.

Table 5
Comparison of perception scores of control and experimental group before training

Group	Mean	N	Std. Deviation	T	df	Sig
Control	3.388	15	0.548			
				-1.132	28	0.267
Experimental	3.648	15	0.703			

Table 5 shows a comparison of the perception of the control and experimental group before teacher training programs. It shows that there was no significant difference ($p=0.267$) between the control ($M=3.388$, $SD=0.548$) and the experimental group ($M=3.648$, $SD=0.703$). It is clear from the data that both groups were having similar perceptions about the significance of training through customized tablets before the experiment.

Table 6
Comparison of perception scores of control and experimental group after training

Group	Mean	N	Std. Deviation	T	df	Sig
Control	3.398	15	0.482			
				-8.229	28	0.000
Experimental	4.591	15	0.287			

Table 6 shows a comparison of the perception of the control and experimental group after teacher training programs. It shows that there was a significant difference ($p=0.000$) between the control ($M=3.398$, $SD=0.482$) and the experimental group ($M=4.591$, $SD=0.287$). It is clear from the data that both groups were having significantly different perceptions about teacher training programs carried through customized tablets after the exposure to the Induction programs.

Table 7
Comparison of perception scores of control and experimental group before and after teachers' training

	Test	Mean	N	Std. Deviation	t	df	Sig
Pair 1	control group perception scores before training	3.3880	15	.54874			
					-.324	14	0.751
Pair 2	control group perception scores after training	3.3987	15	.48236			
	experimental group perception scores before training	3.6487	15	.70333			
					-5.768	14	0.000
	experimental group	4.5913	15	.28715			

 perception scores
 after training

Table 7 shows the comparison of perception scores of the control group before and after the teacher training program carried out without using customized tablets. It shows that there was no significant difference ($p=0.751$) between the control group before teacher training ($M=3.388$, $SD=0.548$) and before teacher training ($M=3.398$, $SD=0.482$). It is clear from the data that the perception of teachers of the control group remained the same before and after training as this group had no intervention of customized tablets.

Table 7 further makes the comparison of the perception of the experimental group before and after the teacher training program (IP). It shows that there was a significant difference ($p=0.000$) between the experimental group before training ($M=3.648$, $SD=0.703$) and after training with customized tablets ($M=4.591$, $SD=0.287$). It is clear from the data that the perception of the teachers of the experimental group changed significantly after receiving training through customized tablets

Discussion

In this study, the effect of the induction program was explored on the newly inducted science teachers of Khayber Pakhtoon Khawa. The purpose of the training program was to increase teacher's pedagogical content knowledge with the help of technology in the subjects of English, Math, and Science. For this reason, 15,000 pre-loaded tablets were provided to teachers. The program was framed by the curriculum and teacher education directorate with the support of KP Education sector program technical assistance (AESP-TA). The tablets contained videos and descriptive self-assessment exercises.

The findings of the study showed that the pedagogical and content knowledge of those chemistry teachers improved who used customized tablets. This finding is in line with Nilson (2008) as he found that one-third of the physics lessons can be converted through a blend of technology (audios & videos) to stimulate learners towards the learning process, therefore, pedagogical content knowledge may be enhanced through blended technology. Besides this, the perception of science teachers also improved with the use of customized tablets. The teachers realized that "scientific knowledge is important for science teaching and learning." There is a significant change in the perception of science teachers that "science teaching needs a personal approach according to the teaching-learning environment".

The use of customized tablets helped to make science teachers realize that if their content knowledge is sound then student's understanding and higher-order thinking can be made better. Morris, Hiebert & Spitzer, (2009) also emphasized that Effective mathematics (science) teaching facilitates the problem-solving skills among learners to enhance the learning process. These abilities are enhanced if teachers use

technology not only for teaching and learning but also for lecture preparation. Schneider & Plasman, (2011) signified that the blend of content, pedagogy, and technology for the concept clarification in a systematic way and to understand the complex problems in classroom practices is an effective tool towards the organization of content delivery (Ball et al., 2005) which is helpful to enhance teachers' content knowledge and pedagogy. Moreover, science teachers also agreed that good pedagogical knowledge helps in better content delivery. Science teachers agreed that with the use of customized tablets, their pedagogical content knowledge is improved. This finding is in line with (Thomas & Palmer, 2014). Moreover, the induction program also helped teachers to deal with real-life problems. Hangul (2017) also found that induction programs are very much helpful for teacher's retention, classroom management, lesson plan, and better students' academic achievement.

Conclusions

Induction programs are very much helpful to enhance teacher's pedagogical content knowledge. Such programs can be more significant when combined with technology, as today's learners also want to be taught through technology, therefore, if teachers will have a clear understanding of content and its appropriate pedagogy and the digital mode of delivery, it will have a positive impact on student's learning. the preloaded tablets helped teachers to refresh their knowledge and learn new content in a specific area.

Recommendations

The provision of training must be done to the in-service teachers too. Moreover, the tablets must be provided permanently. The teachers must also be provided internet packages for better connectivity and smooth execution of the teaching and learning process. The provision of tablets must be ensured for the teachers of all levels and all subjects.

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