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Effectiveness of Instructional Accommodations for Teaching Mathematics: An Experimental Study

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Abstract

This is particularly true of modern school environments, which are flexible enough to allow for adjustments to instructional methods. In order for students to make hypotheses, conduct investigations, gather and analyze data, and collaborate with their peers, meaningful and real-world related mathematical problems or activities should be actively used in mathematics instruction. In this method, the teacher primarily serves as a facilitator, directing the actions of the students. The purpose of the study is to evaluate how 5th grade pupils in FG schools learned mathematics as a result of instructional modifications. To determine if instructional adaptability had an impact on students' learning in mathematics in the fifth grade, an experimental research method was employed. Following the investigation, a pretest posttest control group design was used. The 22 fifth-grade pupils at FG Junior Public School No. 5 in Lahore Cantt were chosen as the study's sample. The technique of random sampling was used. For the aim of the research, students were divided into two groups: an experimental group and a traditional group. Results revealed that a significant improvement was found in the performance of the students of experimental group through instructional adaptations in teaching mathematics. Implication of the research was also discussed.

Keywords: Instructional adaptations, mathematics teaching, instructional improvement, instructional practice

Introduction

The idea of a flexible or innovative learning environment at school is also having an impact. The co-joining of classrooms to create learning communities, the increase in space to include outdoor and informal spaces, active surfaces, and new educational technologies, and a new generation of reconfigurable furniture are all examples of this (Dane 2016; Leiringer &Cardellino 2011). This is clear when the adaptability of contemporary school environments allows for adjustments to educational practices (Leiringer & Cardellino 2011). Flexible spaces are therefore likely to serve as a catalyst for pedagogical change in this way (Mulcahy et al. 2015).

Therefore, it is doubtful that teachers will adapt immediately or permanently in reaction to new educational circumstances. Teachers perceive a variety of action possibilities in flexible learning environments, including the potential for teacher collaboration, new structures and methods of coordinating time and space, malleable configuration of the learning environment, favourable influence on staff-student relationships, and a sense of connectedness and belonging (Lovejoy et al. 2014).

A teacher's reluctance to alter established routines or work cooperatively, their inability to adjust to changes in teacher visibility and access, and scheduling challenges related to flexible spaces are just a few examples of potential obstacles to adaptation (Lovejoy et al. 2014).

After the adoption of a global reform of mathematics curricula around the year 2000, student-centered instruction or inquiry-based instruction became widely promoted in many nations (Cai & Howson 2013). As part of this method of teaching mathematics, students are expected to actively participate in relevant and application-based mathematical problems or activities that allow them to formulate hypotheses, conduct investigations, gather data, and collaborate with their peers. In this method, the teacher primarily serves as a facilitator, directing the actions of the students. Additionally, it has been acknowledged that teaching mathematics is a multidimensional concept (Kelcey et al. 2019). Researchers have focused particularly on cognitive activation and

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offering student learning support while examining teachers' instructional practises (Depaepe & König 2018). The term "aspect of cognitive activation" in the context of mathematics instruction relates to how cognitively demanding teachers' chosen assignments and instructional tactics are for their students (Kunter et al. 2013). When students encounter challenges when working on cognitively tough tasks, the teacher should provide them with thoughtful support for their learning process (Depaepe and König 2018; Kunter et al. 2013).

The majority of mathematics instruction is "content- and exam-driven." The teacher dominates the lesson with little student participation. Additionally, students rarely get the chance to participate in group projects or activities; instead, they complete repetitive exercises alone and frequently in order to address issues swiftly in the future (Ni et al. 2014).

Our research aims to advance theory and practise in the area of enhancing mathematics instruction through instructional modifications. According to Kraft, Blazar, and Hogan (2018), well-designed coaching programmes have a considerable impact on both teaching and student learning. According to research, it is not an easy task to change instructional practise to make it more rigorous and intellectually challenging (Correnti & Martinez, 2012; Stein, Correnti, Moore, Russell, & Kelly, 2017).

A growing body of evidence points to instructional adaptability as a promising method for enhancing teaching and student learning (Yee Mikami et al, 2011; Biancarosa, Bryk, & Dexter, 2010; Blazar & Kraft, 2015; Bryk, Gomez, Grunow, & LeMahieu, 2015; Campbell & Malkus, 2011; Garet et al., 2011; Killion, 2012; Mangin & Dunsmore, 2015; Matsumura, Garnier, & Spybrook, 2013). For instance, Campbell and Malkus (2011) discovered that adjustments had a favourable impact on elementary students' mathematical achievement throughout the course of a three-year randomised control study.

Math proficiency in elementary school is a crucial factor in determining students' success in middle and high school, making it an important topic for strategy and instruction in FG schools (C/G) across the country. The degree to which understudies succeed in middle school maths classes can be determined by their participation in and performance in maths courses in grade five. By completing these math courses, one may predict how well-prepared children are for middle school math courses and whether they will be able to participate in and succeed in those classes without the assistance of remedial or formative math courses.

In Pakistan, FGEI (Federal Government Educational Institutions) (Cantt/Garrison) offer quality training and free education to the children of army soldiers and employees who live in Cantonment as well as to the civilian population of Cantt. It is the vision of the FGEI(C/G) Directorate.

The Federal Government Educational Institutions (FGEI) (C/G) Directorate's part searches for and manages the staff, budget, and organizational structure of 359 colleges and universities across the country that provide educational opportunities to the wards of military personnel as well as to regular citizens living in cantt territories. The research investigated how instructional modifications affected fifth-grade students' learning in mathematics at FG schools.

Research hypotheses

The following were the hypotheses of the study:

H1: There is a significant improvement in the learning of the students taught through instructional adaptations as compared to those taught through conventional classroom instructions

H2: There is a significant improvement in the learning of the "concept of average" of the students taught through instructional adaptations as compared to those taught through conventional classroom instructions

H3: There is a significant improvement in the learning of the "concept of percentage" of the students taught through instructional adaptations as compared to those taught through conventional classroom instructions

H4: There is a significant improvement in the learning of the "concept of fraction" of the students taught through instructional adaptations as compared to those taught through conventional classroom instructions

Significance of the Study

The research might be useful for pupils to enhance their capacity for learning and comprehend maths for future success. It might be useful for teachers to adjust their methods of instruction to the learning styles of their pupils. The study might improve scholarly research, policy development, and students' capacity to learn mathematics in the future. The study has the potential to provide policy makers and implementers with new perspectives on how to close the gap between practise and policy for the successful implementation of comprehensive learning in schools. To develop appropriate changes in the curriculum adaptation programmes for FGEI (Federal Government Educational Institutions) (Cantt/Garrison), guiding principles are presented for policymakers.

Methodology

To determine if curriculum change has an impact on fifth-grade students' learning of mathematics, an experimental research design was used. Following the investigation, a pretest posttest control group design was used. The 22 fifth-grade pupils at FG Junior Public School No. 5 in Lahore Cantt were chosen as the study's sample. The technique of random sampling was used. For the aim of the research, students were divided into two groups: an experimental group and a traditional group. Three chapters—average, percentage, and fraction—were chosen from the text book. Following the results of the pretest, the researcher chose two groups of students at random. The learner received instruction on these subjects for a month. After the lesson was over, both the traditional and experimental groups took a post-test. A test which was developed by the researcher on the basis of content of mathematics chapters for grade five was used to assess the current level of the learners. The developed test was refined after expert validation. Cronbach alpha was used to find out the reliability of the test. The instrument was administered to a sample of 22 students of grade 5. The cronbach alpha was 0.95. A treatment was planned and given to the selected sample, the experimental group. A set of instructions was developed based on instructional accommodations.

1. Visual media including subject specific images, graphs, charts videos, slides were used to see the usefulness of the instructional accommodations for teaching mathematics
2. Students were organized in the class so the visual images could be seen by all the members of the group.
3. Topics of each session were delivered with the help of images, graphs and charts.
4. Worksheets were used at the end of the session for the purpose of evaluation.
5. The students in the experimental group received a 45-minute class period for one month
6. There were five class periods per week
7. After each session, students were assessed on the basis of the performance of the activities.

Results

Table 1: Comparison of the performance of the experimental group and control group on pretest

Groups	N	M	SD	T	Sig
Experimental Group	11	10.36	11.45	.724	.654
Control Group	11	11.82	14.63		

To investigate the difference between the performance of learners in experimental group and control group on pretest the independent sample t test was used. Result reveals (t= .724, p= .654) that no difference was found between the performances of students in both of the groups.

Table 2: Comparison of the performance of students in experimental and control group on pretest and posttest on the performance of the concept of Average

	Groups	N	M	SD	T	Sig
Pretest	Experimental Group	11	10.36	2.37	1.43	1.58
	Control Group	11	10.82	3.28		
Posttest	Experimental Group	11	21.64	2.76	12.50	.000
	Control Group	11	15.06	2.04		

In order to see the difference between the performance of learners in experimental group and control group on the concept of average independent sample t test was used. The analysis shows (t= 1.43, p= .158) that there was no difference between the performance on average items of the experimental group and control group in the pretest. The analysis also reveals (t= 12.50, p= .000) that the performance in the concept of average of the experimental group (Mean= 21.64) was better than control group (Mean= 15.06) on the posttest.

Table 3: Comparison of the performance of Learners in experimental and control group on pretest and posttest in concept of percentage

	Groups	N	M	SD	T	Sig
Pretest	Experimental Group	11	11.27	2.72	.849	2.56
	Control Group	11	10.18	3.281		
Posttest	Experimental Group	11	20.87	2.56	4.92	.003
	Control Group	11	13.37	3.82		

In order to see the difference between the performance of learners in experimental group and control group in the concept of percentage the independent sample t test was used. The analysis shows that (t= .849, p= 2.56) there was no difference between the performance on chapter percentage items of the experimental group and control group in the pretest. The analysis also reveals that the performance in the concept of percentage of the experimental group (Mean= 20.87) was better than control group (Mean= 13.37) on the posttest.

Table 4: Comparison of the performance of learners in experimental and control group on pretest and posttest in the concept of fraction

	Groups	N	M	SD	T	Sig
Pretest	Experimental Group	11	9.64	5.08	-9.10	.289
	Control Group	11	9.87	3.34		
Posttest	Experimental Group	11	25.97	2.56	.186	.018
	Control Group	11	11.27	3.90		

In order to see the difference between the performance of learners in experimental group and control group in the concept of fraction the independent sample t test was used. The analysis shows that (t= -9.10, p= .289) there was no difference between the performance on chapter fraction items of the experimental group and control group in the pretest. The analysis also reveals that the performance in the concept of fraction of the experimental group (Mean= 25.97) was better than control group (Mean= 11.27) on the posttest.

Discussion and Conclusion

The use of mathematical adaptation in the units "average, percentage, and fraction" was incorporated into this experimental research study that was distributed to fifth-grade students.

The findings of this t-test indicate that there has been a slight improvement in the pupils' performance as measured by their scores in the traditional group of fifth graders. The performance of the students in the chapter "average" and "percentage" makes it abundantly clear that adopting the new approach (experimental) has made learning simple for the experimental group of fifth-graders, but kids who were taught by the traditional way were unable to perform well on their assessments. From pre-test to post-test, it was seen that the experimental group performed better.

Students' post-test scores improved after receiving instructional adaptation. After receiving instructional adaptation for the "fraction" chapter, students did better on the experimental post-test. It is undeniable that the traditional group's progress level was unsatisfactory and subpar, compared to the experimental group's improvement level, which is exceptional.

The results of the independent sample t-test indicate that there is no difference in the students' achievement in terms of scores in experimental group and traditional group in pre-test 5th grade students.

Similar findings have been incorporated in the previous studies by Yee Mikami et al., 2011; Bryk, et al., 2015; Killion, 2012; Mangin and Dunsmore, 2015; Matsumura, et al., 2013, that instructional adaptation is a promising intervention to support teaching improvement and student learning and adaptations positively influenced elementary student mathematics achievement. Similar to this, it has been suggested that small group instruction in mathematics is a good technique to help pupils build their higher-order thinking and problem-solving capabilities (Kutnick et al., 2017; Webb et al., 2014). Additionally, teachers preferred using smart books over required textbooks. Smart mathematics textbooks typically have characteristics like being action-based, emphasizing problem-solving, connecting mathematical representations to one another, and elaborating on mathematical topics (Lew, 2016).

Finally, some additional research is necessary in light of the findings. There aren't many comprehensive studies comparing the use and advancement of digital textbooks in mathematics to traditional textbooks, despite the tremendous expansion of the field. Teachers may also require professional development regarding the required textbooks and their use in light of the curricular reforms. We believe that teachers may require professional development in especially related to how to conduct group work activities provided in the textbooks and how to adjust the tasks in mathematics textbooks.

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