Effect of Vygotsky's Concept of Zone of Proximal Development (ZPD) on the Achievement of Slow Learners

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Abstract

Achievement of majority of our students is always low in mathematics. Particularly, slow-learning students are observed to have low achievement in mathematics. Review of related literature also revealed that achievement of slow-learners is always low in mathematics. So, a study was conducted to analyze the effect of the Vygotsky's concept of Zone of Proximal Development (ZPD) for enhancing achievement of low-learners. The methodology employed was a true experimental design known as pretest-posttest control group design. A sample of 48 students was chosen and equated on the basis of their pretest scores into two groups and assigned experimental group (N=24) and control group (N=24). Each group was further sub-divided into low-achievers (N=12) and high-achievers (N=12) in the light of their pretest scores. The instrument used in the research was a self-developed achievement test in the subject of mathematics for 8th grade. The treatment span was six weeks, forty minutes a day. The same achievement was to be used as posttest. After treatment, the scores obtained were analyzed through mean, standard deviation, coefficient of variability and t-test. Results of the study revealed that low-achievers who were taught through Vygotskian methodology complemented by scaffolding showed better achievement in mathematics than the low-achievers of the control group taught through traditional method. Vygotskian model proved a better substitute of traditional mode of teaching mathematics for slow learners in elementary classes.

Key Words: Slow-learners, Zone of proximal Development, Scaffolding

Introduction

Achievement is an act of accomplishing or finishing. In other words, something accomplished successfully, especially by mean of exertion, skill and

practice of perseverance can be termed as achievement. Academic achievement is the extent to which a student, teacher or institution has achieved educational goals. It is the knowledge gained and the skills developed in any subject taught in school. It is usually measured on the basis of test scores. Academic achievement is important because it is equally linked to student' promotion in the next grade and chances of employment in the future. At the same time students who are academically successful are more likely to have higher level of self-esteem and self-confidence, and have lower level of depression and anxiety and vice versa (Marsh, Byrne, and Yeung, 1999; Alyes-Martins, Peixoto, Gouveia-Pereira, Amaral, and Pedro, 2002). The social and economic development of the country is directly linked with the academic performance of the students (Mushtaq and Khan, 2012). The academic performance plays an important role in producing best quality graduates who will become better leaders and better manpower for the country (Bakar, Yusop, Ali, & Bakar, 2023).

Several studies (Amirali & Halai, 2010; Rashid & Mukhtar, 2012, Bibi, 2009; GoP, 2009) and the researcher's twenty-two years' experience of teaching mathematics at elementary level reveal that achievement of our students in the subject is not up to the mark due to one reason or the other. Several efforts like revising curricula, arranging refresher courses, provision of various facilities were made by the government to improve the situation but problem still exists in one way or the other. One of the possible solutions of the problem is to use Vygotsky's concept of ZPD complemented with scaffolding in mathematics classroom.

Objectives of the study

The objectives of this study were:

i) To determine the existing level of achievement of slow-learners of 8th class mathematics students.
ii) To determine the effect of Vygotsky's concept of Zone of Proximal Development in enhancing achievement of slow-learners of 8th class mathematics students.

Hypotheses of the study

H_1: There is significant difference between the mean achievement scores of slow-learners of the elementary students taught mathematics through Vygotskian method and slow-learners taught mathematics through traditional method.

The above research hypothesis was tested through following null hypothesis.

H_0: There is no significant difference between the mean achievement scores of slow-learners of the elementary students taught mathematics through Vygotskian method and slow-learners taught mathematics through traditional method.

Review of Literature

Research shows that underachieving learners require specialized instruction and intervention to prevent further difficulties (Lu, Yang, Shi, & Wang, 2021; Chuang, 2021; Tayyaba, 2010; August and Shanahan, 2006). Vygotskian model complemented with scaffolding was used as a specialized method in current study due to its potential of improving achievement as revealed by review of related literature. According to the Vygotsky's theory of cognitive development, the academic achievement of the children can be best enhanced by providing them continuous support by a more knowledgeable person in a social setting (Vygotsky, 1993, 1994, 2004). This social interaction with more knowledgeable or capable others significantly influences their way of thinking (Lu et al., 2021; Chuang, 2021). A child develops his intellect through internalizing concepts based on his own interpretation of an activity, which occurs in social setting. The communication that occurs in this setting, with more knowledgeable others (teachers, parents and peers etc.) help the child construct and understand the concept (Chuang, 2021; Wu, & Wu, 2020; Bransford, Brown & Cocking, 2000). Thus social interaction plays a fundamental and indispensable role in the development of cognition and social activity is crucial to child's development as learner (Kersley, 2002). Through this interaction, less skilled members of the culture learn to use cultural tools to internalize the culture (Lu et al., 2021; Korikana, 2020; Santrock, 2005).

The interaction with more knowledgeable other is a collaborative and constructive activity. The view that knowledge is collaborative and constructive in nature has been considerably emphasized by Piaget and later by Vygotsky (Zhang, 2022; Rogoff, 2001). Vygotsky views that a child does not learn in isolation; instead, learning is strongly influenced by social interaction (Basar, Mansor, Jamaludin, & Alias, 2021; Lu et al., 2021; Korikana, 2020; Vygotsky, 2004). To Vygotsky, we can understand and describe children's cognitive capabilities when we look at two aspects of their cognitive development. First, we can determine the extent to which children can perform a task independently without assistance from others; this is their level of actual development. Second, the extent to which they cannot perform the task independently but can do it with assistance of a more competent individual; this is their level of potential development. The gap between these two levels is termed by Vygotsky as Zone of Proximal Development (ZPD). Effective teaching is teaching within ZPD of a learner (Margolis, 2020; Azi, 2020).

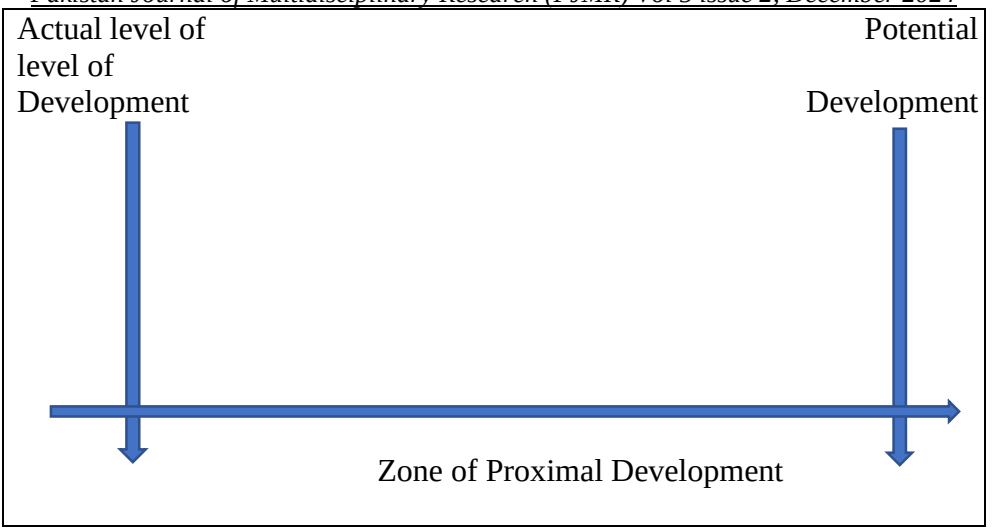

Fig: 1 Zone of Proximal Development

Vygotsky defines Zone of Proximal Development as "the distance between the actual level of development as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peer" (Zaretsky, 2021; Margolis, 2020; Azi, 2020; Vygotsky, 2004). Closely related to the concept of ZPD is the process of scaffolding (Santrock, 2001). The term 'scaffolding' grew out of the Vygotsky's work and was developed by U.S psychologist Jerome Bruner (Clark & Grave, 2005) which means the support and assistance provided by the teacher or the mentor in the learning process. Scaffolding is a metaphor that describes the way a teacher provides assistance to the students during learning process, in the same way the scaffolding serves as a temporary support until the building can stand on its own. It is a form of support for the development and learning of children and young people (Rasmussen, 2001)

Jacobs (2001) is of the view that the term 'scaffolding' can be used as an umbrella metaphor to describe the way that teachers or peers supply to the students with tools they need in order to learn (Yu, Yuan, & Wu, 2023; Zaretsky, 2021; Margolis, 2020; Azi, 2020). Nassaji and Swain (2000) say that scaffolding is the collaboration of both the learner and the expert within the learner's ZPD. A large number of educators and researchers have used this concept as a metaphor to describe and explain the role of adults and more knowledgeable others or peers in guiding children's learning and development (Cai, Mao, Wang, He, Chen, & Fan, 2022; Margolis, 2020; Azi, 2020; Krause, Bochner & Duchesne, 2003; Hammond, 2001; Daniels, 2001). Scaffolding has been applied to a number of learning areas. O'Toole & Plummer (2004), Siemon & Virgocna (2003) and Clarke (2004) studied the characteristics of scaffolding in mathematics lesson and proved it a better method. Chang, Sung, & Chen, (2001) proved scaffolding effective in supporting different learners with a variety of instructional tasks, including building concept maps.

Similarly, Munawaroh, (2021) and Fatehi Rad, & Jalali, (2021 proved scaffolding a better method to enhance academic achievement. In a study, Khan (2010) observed that Vygotskian model of teaching complemented by scaffolding was more effective than traditional method for teaching mathematics.

Methodology

The methodology of the study was as under:

Research Design

The design of the study was a kind of true experimental design known as pretest-posttest control group design. The design was selected because according to **Gay** (2000), Gay, Mills, & Airasian (2012) and Fraenkel, Wallen, & Hyun (2012), it controls relatively a large number of threats to internal and external validity.

Population/Sample

A total of 13 elementary schools and their students of Khanpur circle (district Haripur) were the population of the study. Only male elementary school and their students were taken as the population because due to religious, cultural, regional and local barriers it was not possible for the researcher to select the female elementary schools and their students. Out of these schools one school and its students of 8^{th} class were selected as sample of the study. The sample consisted of 48 students. The sample was equated on their pretest score into 24 students each in experimental and control group. These two groups were assigned randomly to control group (N=24) and experimental group (N=24). Both groups were further subdivided into slow-learners (N=12) and high achievers (N=12) on the basis of their pretest scores. The focus of this study was the slow-learners of the control and experimental groups. The control group was taught through traditional method and the experimental group was taught through Vygotsky's method of ZPD complemented with scaffolding. Both groups were taught for six weeks under similar environmental conditions and facilities.

Instrument

The instrument used in the study was a self-developed achievement test. The instrument was developed from three units [Unit 5 (Arithmetic), Unit 7 (Algebra) and Unit 12 (Geometry)] of 8^{th} class mathematics. The instrument contained 40 multiple choice items and was developed in the light of table of specification according to knowledge, comprehension and application level of Bloom's cognitive domain of Taxonomy of educational objectives. This instrument was used as pretest as well as posttest and was administered before and after the termination of the experiment to both control and experimental groups.

Table 1 ***Table of specification according to Bloom's Level of Educational Objectives***

Area	Knowledge	Comprehension	Application	Total
Previous knowledge	2	4	4	10
Unit 5 (Square Root)	3	3	4	10
Unit 7 (Algebra)	3	3	4	10
Unit 9 (Geometry)	3	3	4	10
Total	11	13	16	40

Validity and Reliability

The instrument was validated by the experts in the field. Some items were rephrased in the light of their recommendations. The reliability of the instrument was determined using split-half reliability method. The reliability coefficient was 0.69.

Data Analysis

Data was analyzed using mean, standard deviation, coefficient of variability and t-test for independent sample.

Results

Table 2. ***Comparison of*** **Mean, Standard** ***Deviation and Coefficient of Variability of Slow-Learners of Control Group and Experimental Group before treatment***

Group	N	Mean	SD	Coefficient of Variability
Control		10.67	1.72	16.12
Experimental	12	10.33	1.72	16.65

Table 2 indicates that both comparison groups were similar to each other in their achievement before treatment in the subject of mathematics, both in terms of their mean achievement (M=10.67 for control group and M=10.33); and the spread of individual score (1.72 each) around their mean achievement. The experimental

group was found to be slightly more variable than the control group, as indicated by the coefficient of variability, which were 16.65 and 16.12 respectively.

Table 3: ***Significance of Difference between the Mean Achievement Scores of Slow-Learners of Control Group and Experimental Group before treatment***

Group	Total Scores	N	Mean	SD	*t*	df	*P*
Control	40	12	10.67	1.72	.47	22	.64
Experimental			10.33	1.72			

Table 3 shows a Comparison of control and experimental group before treatment. Levene's Test for Equality of variances gives value of significance equal to .88 which was greater than .05, so equal variance was assumed. *p* value for both control and experimental groups was .64 [N = 12, Mean = 10.67, SD = 1.72, for control group and N = 12, Mean = 10.33, SD = 1.72, for experimental group], *t* (22) = .47 at $p > .05$. As *p* value was greater than .05, there was no statistically significant difference between mean achievement scores of both groups before treatment.

Table 4: ***Comparison of Mean, Standard Deviation and Coefficient of Variability of Slow-***

Learners of Control Group and Experimental Group after treatment

Group	N	Mean	SD	Coefficient of Variability
Control		14.42	1.88	17.50
Experimental	12	24.08	3.20	13.31

Table 4 shows a comparison of mean, standard deviation and coefficient of variability of slow-learners of control and experimental group after treatment. The table indicates that mean score of slow-learners of experimental group is higher than the mean score of slow-learners of control group. There appears to be difference between the achievements of both the groups. The experimental group seems to have achieved more than the control group. The experimental group is apparently less variable in their individual scores than the control group.

Table 5: ***Significance of Difference between the Mean Achievement Scores of Slow-Learners of Control Group and Experimental Group after treatment***

Group	Total Scores	N	Mean	SD	*t*	df	*p*	Eta^2
Control			14.42	1.88				
Experimental	40	12	24.08	3.20	- 9.01	22	.00	.78

Table 5 shows a Comparison of control and experimental group after treatment. Levene's Test for Equality of variances gives significance value equal to .16 which was greater than .05, so equal variance was assumed and the scores were widely spread around the mean. *p* value for both control and experimental groups was .00 [N = 12, Mean = 14.42 and SD = 1.88 for control group and N = 12, Mean = 24.08, SD = 3.20 for experimental group. *t* value for both control and experimental groups was t (22) = - 9.01 at $p < .05$. As *p* value was less than .05, so both groups were statistically significantly different from each other after the treatment. The magnitude of the effect (Eta^2) was .78. This was a very large effect which shows better achievement of the students of experimental group.

Conclusion and Discussion

On the basis of the above results it was concluded that the equal ability slow-learners who were taught mathematics through Vygotsky's method of teaching based on ZPD complemented by scaffolding did better than those who were taught by traditional talk and chalk method. Therefore, Zone of Proximal Development complemented by scaffolded teaching was a better substitute to enhance the achievement of the slow learners. Zone of Proximal Development (ZPD) is basically an individualized method of teaching with no time limit but the researcher used it in time bound period system in Pakistani school. The researcher himself is pioneer to use the said concept in the classroom in Pakistan (Khan, 2010). Earlier, Akbar (2002), in her Ph. D study, analyzed the Zone of Proximal Development (ZPD) in graduate teacher training programs of the Allama Iqbal Open University, but it was not a classroom experiment.

As teaching within zone of proximal development complemented with scaffolding is an individualized form of teaching, while the researcher used it in the whole class in period system, so one limitation of the present study was in the management of time. The researcher has to teach the new topic and to supervise the scaffolding session within 40 minutes. To deal with this problem the researcher prepared charts on each topic, which contained rules and solved examples. These charts remained hung in the class throughout the scaffolding session. So, they not only saved the researcher's time but also helped the researcher to explain the topic within 10 minutes. Also, they were a continuous source of guidance during the scaffolding session and the researcher was able to scaffold students' learning of topic in 20 to 30 minutes. Another limitation pertains to the determination of ZPD of each student. Due to time constraints and also being beyond the scope of the study it was not possible for the researcher to do so. However, in the class the researcher used oral questioning technique and previous achievement record of each student, in mathematics, to test the level of previous achievement.

The use of ZPD and scaffolding in the classroom was new approach for the students so naturally they had better orientation towards this change leading to better results. Almost every learning activity was within ZPD of the students, i.e. the

activities were within their potential level of development so they learnt new concepts in better way. This factor contributed to high achievement of slow-learners of the experimental group. Further, the process kept them active during every scaffolding session. This factor contributed to better achievement of slow-learners of the experimental group.

ZPD complemented with scaffolding is one to one teaching technique. In this technique, a more knowledgeable other (teacher, peer, or adult) interacts with less knowledgeable person and enables him/her to master the concept under discussion. The effects of this type of interaction with more knowledgeable others (teacher, peer, or adult) or one to-one tutoring (scaffolding) have been studied by several researchers. The results of current study are at par with all previous results. Dill and Boykin (2000) found that interaction and scaffolding of peers was more influential than individual tutoring. Such interactions with teachers, peers or adults in a cooperative setting proved to be more helpful in children learning (Cannella, 1993; Haynes and Gebreyesus, 1992). Similarly, Wentzel (1991) concluded that positive peer interaction is associated with higher levels of motivation and engagement in school. Results of Coolahan, Fantuzzo, Mendez and McDremott (2000) also show that social interaction with peer results in positive engagement in the classroom. A number of other studies also conclude that interaction with more knowledgeable others have enhanced the educational outcomes up to a reasonable extent (Lu et al., 2021; Chuang, 2021; Wu, & Wu, 2020; Korikana, 2020; Zhang, 2022; Basar et al., 2021). Because, the children who are scaffolded by peers, demonstrate positive learning behavior as well as more engagement and achievement in the classroom, so education ministry and all other education managers may encourage teachers of elementary, secondary and higher levels of education to use Vygotsky's ideas of cognitive development for promoting student learning.

Recommendations

On the basis of findings and conclusions of the study, following recommendations were made;

i) Existing curriculum of 8th class mathematics may be reviewed and this methodology may be incorporated in the curriculum. The traditional method of teaching may be gradually switched over to this new methodology.
ii) Working teachers in the field may be trained to use this new methodology.
iii) Curriculum of the teacher training institutions may be reviewed and this methodology may be incorporated in that curriculum.

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