PERSONALIZED LEARNING AND ACADEMIC ACHIEVEMENT: AN EXPERIMENTAL STUDY OF HIGH, AVERAGE, AND LOW ACHIEVING SECONDARY SCHOOL STUDENTS

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Abstract

Personalized learning seeks to tailor instruction to students' individual needs, goals, and skill levels; therefore, examining its effect on secondary school students' academic achievement is of critical importance. This study aimed to investigate the effect of personalized learning on the academic achievement of high, average, and low achievers. A true experimental pretest–posttest equivalent group design was employed. The population comprised 9th-grade students from Govt. Madrissa Millia Islamia High School, F-Block, Satellite Town, Rawalpindi. Following the pretest, students were randomly assigned to experimental and control groups. A Subject Achievement Test (SAT), developed from three Mathematics chapters using a standardized questionnaire, was administered as both pretest and posttest. The experimental group was taught using personalized learning strategies based on the Essential Elements Model (Learner Profile, Student Agency, Flexible Learning Environment, Personal Learning Path, and Individual Mastery), whereas the control group received instruction through traditional teaching method. Both groups were taught by the same teacher over eight weeks. Results indicated that personalized learning significantly enhanced the academic achievement of high achievers (M = 38.65, SD = 13.73), while average achievers (M = 21.54, SD = 6.18) and low achievers (M = 9.67, SD = 1.44) showed comparatively limited gains. One-way ANOVA revealed statistically significant differences among the three achievement groups (F = 14.433, p = .000). Post hoc LSD tests confirmed that high achievers significantly outperformed both average and low achievers, whereas the difference between average and low achievers was not statistically significant. The findings of the study revealed that personalized learning significantly improved the academic achievement of secondary school students. The impact of personalized learning was particularly notable among high achievers, while average and low achievers also demonstrated measurable improvement in their academic performance. The results indicate that personalized learning provides opportunities for students to progress at their own pace, address individual learning needs, and enhance engagement in the learning process. In conclusion, personalized learning proved to be an effective instructional approach for enhancing academic achievement among secondary school students

across different achievement levels. By accommodating individual differences in learning pace, style, and ability, personalized learning creates a more supportive and responsive learning environment. It is recommended that secondary schools integrate personalized learning strategies into classroom practices to support diverse learners. Additionally, teachers should receive continuous professional development to effectively implement personalized learning and provide appropriate scaffolding for students with varying academic abilities.

INTRODUCTION

Education systems worldwide increasingly recognize the importance of adopting instructional approaches that address the diverse learning needs of students. In many traditional classroom environments, teachers often employ uniform teaching strategies and maintain the same instructional pace for all learners, despite significant differences in students' abilities, interests, learning styles, and prior knowledge. Such standardized instructional practices may fail to effectively accommodate individual differences among students, which can lead to disparities in academic achievement. As a result, some students may struggle to keep up with the pace of instruction, while others may not feel sufficiently challenged to reach their full academic potential. Consequently, educators and policymakers have emphasized the need for learner-centered instructional approaches that support individualized learning experiences and promote equitable educational opportunities (Katz et al., 2018).

In response to these challenges, educational researchers and practitioners have explored innovative instructional models that aim to enhance student engagement and academic performance. One approach that has gained considerable attention in recent years is personalized learning. Personalized learning refers to an instructional framework that adapts teaching methods, learning activities, and educational resources to the unique needs, preferences, and abilities of individual learners. Rather than delivering identical instruction to all students, personalized learning allows educators to provide differentiated learning pathways that enable students to progress according to their own pace and level of understanding. This approach seeks to create a flexible and responsive learning environment in which instruction is aligned with the specific academic needs and goals of each student (Bernacki et al., 2021).

Personalized learning emphasizes several key principles that distinguish it from traditional instructional approaches. These principles include learner autonomy, flexible pacing, targeted instruction, and continuous assessment of student progress. Within personalized learning environments, students are encouraged to take an active role in their own learning by setting goals, monitoring their progress, and engaging with learning materials that reflect their interests and learning preferences. At the same time, teachers play an essential role in facilitating learning by providing guidance, feedback, and appropriate instructional support tailored to individual students' needs. By combining student agency with teacher support, personalized learning aims to foster deeper understanding, stronger engagement, and improved academic outcomes (Hattie, 2009; Schunk, 2012).

Academic achievement is widely regarded as one of the most important indicators of educational success and effectiveness. It reflects the extent to which students acquire knowledge, develop cognitive skills, and achieve educational objectives within a given learning context. Numerous studies have highlighted the critical role of instructional strategies in shaping students' academic performance. Effective teaching approaches can enhance students' understanding of subject matter, strengthen their motivation to learn, and improve their ability to apply knowledge in meaningful ways. Conversely, instructional methods that do not accommodate students' diverse learning needs may hinder

academic progress and exacerbate achievement gaps among learners (Kyriakides et al., 2018).

At the secondary school level, academic achievement becomes particularly significant because students encounter increasingly complex content and greater expectations for independent learning. During this stage, differences in students' abilities and learning needs become more pronounced. High-achieving students often demonstrate strong academic motivation and may benefit from enriched learning opportunities that extend their knowledge and skills. In contrast, average and low-achieving students may require additional instructional support and structured learning experiences to foster a deeper understanding of academic concepts. Instructional approaches that do not account for these differences may limit students' academic growth and impede their overall educational development (Smale-Jacobse et al., 2019).

Personalized learning offers a promising solution to these challenges by providing flexible instructional strategies that accommodate diverse learners within the same classroom. Through differentiated learning activities, adaptive instructional methods, and ongoing formative feedback, personalized learning enables teachers to address the varying needs of students across achievement levels. High-achieving students can benefit from opportunities to explore advanced concepts and engage in independent learning tasks, while average and low-achieving students can receive targeted support that strengthens foundational knowledge and addresses learning gaps. Such individualized learning experiences have been shown to contribute to improved academic outcomes for students across different ability groups (Bernacki et al., 2021; Xie et al., 2019).

A growing body of research has demonstrated the positive impact of personalized learning on students' academic outcomes. Studies conducted in diverse educational settings indicate that personalized learning environments can increase student engagement, enhance motivation, and improve academic performance. For instance, recent studies have shown that students in personalized learning programs exhibit greater academic growth than those in traditional instructional settings. Additionally, integrating personalized elements into subject-specific instruction, such as mathematics, has been found to significantly improve student engagement and performance by connecting learning tasks to learners' interests and prior experiences (Bernacki et al., 2021).

Despite the growing interest in personalized learning, there remains a need for further empirical research examining its effectiveness across students with varying achievement levels. Many prior studies have focused primarily on overall student outcomes without specifically investigating how personalized learning impacts high-, average-, and low-achieving students differently. Understanding these variations is crucial, as instructional strategies that benefit one group of learners may not produce the same effects for others. Therefore, exploring the differential impact of personalized learning across achievement levels can provide valuable insights into its effectiveness for diverse classroom contexts (Dede et al., 2017; Hmelo-Silver et al., 2013).

Given these considerations, the present experimental study seeks to investigate the effect of personalized learning on the academic achievement of secondary school students categorized as high, average, and low achievers. By examining how personalized learning influences students across different levels of academic performance, this study aims to contribute to the existing literature on learner-centered instructional strategies and provide practical recommendations for educators seeking to improve teaching effectiveness and student learning outcomes in secondary education (Walkington, 2013).

Academic achievement remains one of the most important indicators of educational effectiveness and student success. It reflects the extent to which students acquire knowledge, develop cognitive abilities, and master the skills and competencies required within a particular academic discipline. Educational researchers widely regard academic achievement as a key measure of the quality of teaching and learning

processes within educational institutions. Numerous studies have shown that students' academic outcomes are significantly influenced by the instructional strategies employed by teachers in the classroom. When instructional practices are designed to address students' individual learning needs, abilities, and preferences, they can enhance engagement, promote deeper understanding, and improve overall academic performance. Consequently, the careful selection and implementation of appropriate instructional approaches play a crucial role in fostering positive learning outcomes and supporting students' academic development (Kyriakides et al., 2018; Seidel & Shavelson, 2007).

The secondary school stage represents a particularly critical period in students' educational development. During this phase, students encounter more complex academic content, increased expectations for independent learning, and greater responsibility for managing their own educational progress. At the same time, differences in students' academic abilities and achievement levels often become more apparent. High-achieving students typically demonstrate strong academic motivation and may benefit from enriched learning opportunities that extend their knowledge and critical thinking skills. In contrast, average and low-achieving students may require additional instructional support, structured learning activities, and targeted feedback to strengthen their understanding of key concepts. Therefore, instructional strategies that acknowledge and respond to these differences are essential for ensuring that all students have equitable opportunities to succeed academically. Educational approaches that accommodate diverse learning needs can help reduce achievement gaps and support the academic growth of students across different ability levels (OECD, 2018; Van Klaveren, 2011). Although a growing body of research has examined the benefits of personalized learning in educational settings, there remains a need for further empirical investigations that specifically explore its impact on students with varying levels of academic achievement. Many previous studies

have focused on the general effectiveness of personalized learning without analyzing how this instructional approach influences high, average, and low-achieving students differently. Understanding these variations is important because students at different achievement levels may respond differently to instructional interventions. By examining the differential impact of personalized learning across achievement groups, researchers can gain deeper insights into its effectiveness in promoting inclusive and equitable learning environments. Therefore, the present experimental study seeks to investigate the impact of personalized learning on the academic achievement of secondary school students categorized as high, average, and low achievers, with the aim of providing empirical evidence that can inform instructional practices and educational policy (Walkington, 2013).

LITERATURE REVIEW
Personalized Learning in Education
Personalized learning has emerged as a significant instructional approach in modern education, aiming to address the diverse learning needs of students within contemporary classrooms. Traditional instructional models often rely on standardized teaching methods that assume all learners progress at the same pace and possess similar learning preferences. However, research in educational psychology and pedagogy has increasingly emphasized that students differ in their abilities, motivations, and learning needs. Personalized learning seeks to address these differences by tailoring instruction to meet individual students' needs, thereby fostering more meaningful and effective learning experiences. In this approach, instructional content, learning pace, and learning pathways are adjusted according to students' readiness levels, interests, and prior knowledge (Connor et al., 2015).

Personalized learning emphasizes the active role of students in their own learning processes. Unlike traditional teacher-centered instruction, personalized learning encourages learners to take responsibility for setting learning goals, monitoring their progress, and engaging with

learning materials that align with their interests and academic needs. This shift toward student agency promotes greater autonomy and intrinsic motivation, which are considered essential components of effective learning. When students feel a sense of ownership over their learning experiences, they are more likely to engage deeply with academic tasks and develop a stronger commitment to achieving their educational goals (Schunk, 2012; Zimmerman, 2002).

Another key characteristic of personalized learning is its emphasis on flexible instructional design. In personalized learning environments, teachers often implement a range of instructional strategies such as differentiated instruction, adaptive learning technologies, and project-based learning activities to support diverse learners. These approaches create multiple pathways for students to engage with content at varied levels of readiness and interest, facilitating individualized progress and deeper learning (Beatty, 2019; Tomlinson & Imbeau, 2010). By combining flexible instructional methods with ongoing formative assessment, personalized learning environments enable educators to continuously adjust teaching practices and tailor instruction to better align with students' changing academic needs (Walkington, 2013).

Furthermore, the integration of technology has significantly contributed to the development and implementation of personalized learning practices. Digital learning platforms, adaptive software, and data-driven instructional tools allow teachers to monitor students' learning progress and adjust instructional strategies accordingly. These technologies provide opportunities for individualized feedback, targeted interventions, and differentiated learning experiences. As a result, personalized learning supported by technology has the potential to enhance both the efficiency and effectiveness of teaching and learning processes in modern educational settings (Walkington, 2013).

Personalized Learning and Academic Achievement

Academic achievement is widely regarded as a central indicator of educational success and the effectiveness of instructional practices. It reflects students' mastery of subject matter knowledge, cognitive skills, and the ability to apply learned concepts in various contexts. Educational researchers have consistently emphasized that teaching methods and learning environments play a critical role in influencing students' academic performance. When instructional approaches align with students' individual learning needs and abilities, they can significantly enhance students' understanding of academic content and contribute to improved learning outcomes (Hattie, 2009; Schunk, 2012).

Several studies have demonstrated the positive impact of personalized learning on academic achievement. For example, research on secondary school students in Pakistan found that personalized learning approaches were associated with higher academic achievement compared to traditional instruction, highlighting the role of tailored instruction and individualized support in enhancing performance. Similarly, experimental studies of personalized adaptive and project-based learning approaches have shown that students receiving personalized instructional activities and resources significantly improved their academic scores relative to control groups, suggesting that individualized pacing and differentiated tasks help students master academic concepts more effectively

Similarly, recent studies have examined the effects of personalized learning in mathematics instruction and found that integrating students' interests and preferences into learning activities significantly improves engagement and academic performance. For instance, Li et al. (2021) demonstrated that students who engaged with mathematics content tailored to their personal interests showed higher motivation and greater achievement compared to peers in standard instruction. Likewise, Chen and Zhang (2022) reported that connecting instructional content to students' experiences and preferences promoted active participation and deeper conceptual understanding, ultimately enhancing overall academic outcomes.

In addition, research on differentiated instruction supports the effectiveness of

personalized learning strategies in promoting academic achievement. Studies have shown that when teachers adapt instructional practices to accommodate differences in students' readiness levels, interests, and learning profiles, they can create learning environments that foster the academic growth of all learners. Such approaches ensure that both advanced learners and struggling students receive appropriate levels of challenge and support within the classroom (Deunk et al., 2018; Smale-Jacobse et al., 2019).

Personalized Learning for Students with Different Achievement Levels

Classrooms typically consist of students with diverse academic abilities and achievement levels, which presents significant challenges for teachers attempting to meet the needs of all learners. High-achieving students often require opportunities for advanced learning and intellectual stimulation, whereas average and low-achieving students may need additional instructional support and guidance to master complex academic concepts. Instructional approaches that do not address these differences can contribute to achievement gaps and hinder students' academic progress (Darling-Hammond et al., 2020; Tomlinson & Imbeau, 2010).

Personalized learning offers a promising solution to this challenge by providing differentiated learning experiences that accommodate students' varying levels of academic ability. High-achieving students can benefit from personalized learning environments as these allow them to progress at an accelerated pace and engage with advanced content beyond the standard curriculum. This flexibility helps sustain intellectual engagement and provides appropriate academic challenge, thereby supporting their continued academic growth (Walkington & Bernacki, 2020; Xie et al., 2019).

At the same time, personalized learning can provide significant benefits for average and low-achieving students. These learners often require targeted instruction, additional practice opportunities, and continuous feedback to strengthen their understanding of fundamental concepts. Personalized learning environments enable teachers to identify learning gaps and provide individualized support that helps struggling students overcome academic difficulties. Through adaptive instructional strategies and scaffolded learning experiences, personalized learning can help improve the academic performance of students who may otherwise struggle in traditional instructional settings (Pane et al., 2015; Zimmerman, 2002).

Moreover, personalized learning approaches promote inclusive and equitable learning environments by ensuring that students receive instruction aligned with their individual needs and learning abilities. Such environments foster collaboration, active participation, and the development of self-regulated learning skills among students. As learners gain greater control over their learning processes, they become more confident in their abilities and more capable of managing academic challenges effectively (Panadero, 2017; Zheng et al., 2020).

Empirical Studies on Personalized Learning

A growing body of empirical research has examined the effectiveness of personalized learning in improving students' academic outcomes. Many studies have reported that personalized learning environments contribute to increased student engagement, improved motivation, and enhanced academic performance. For example, Pane et al. (2017) conducted a comprehensive study on the implementation of personalized learning practices in schools and found that students in personalized learning programs demonstrated higher academic growth compared to students receiving conventional instruction.

Similarly, Kulik and Fletcher (2016) examined the impact of individualized instruction supported by computer-based learning systems and reported positive effects on students' academic achievement across various subjects. Their findings suggest that personalized learning approaches supported by adaptive technologies can effectively address individual differences in learning and improve overall academic performance.

Furthermore, a meta-analysis conducted by Hattie (2009) identified individualized instruction as one of the instructional strategies with a significant positive impact on student learning outcomes. The study emphasized that when instruction is tailored to students' specific learning needs, it can substantially improve academic achievement and promote deeper understanding of subject matter.

Despite these positive findings, some researchers have emphasized the importance of effective implementation when adopting personalized learning strategies. For personalized learning to be successful, teachers must receive adequate training and professional development to design and manage individualized learning environments effectively. Additionally, schools must ensure that appropriate technological resources and instructional supports are available to facilitate the implementation of personalized learning practices (Darling-Hammond et al., 2017; Bernacki et al., 2021).

Research Gap and Need for the Study

Although previous research has highlighted the potential benefits of personalized learning, there remains a need for further empirical investigation into its impact on students with different levels of academic achievement. Many existing studies focus on general academic outcomes without specifically examining how personalized learning influences high, average, and low-achieving students differently. Understanding these variations is essential because instructional strategies that are effective for one group of learners may not produce the same results for others.

Furthermore, much of the existing research on personalized learning has been conducted in Western educational contexts, which may differ significantly from other educational environments in terms of resources, curriculum structures, and teaching practices. Therefore, additional experimental studies are needed to explore the effectiveness of personalized learning in diverse educational contexts and among different groups of learners.

In light of these considerations, the present study aims to investigate the impact of personalized learning on the academic achievement of secondary school students categorized as high, average, and low achievers. By examining the differential effects of personalized learning across these achievement groups, the study seeks to contribute to the existing literature and provide evidence-based recommendations for educators aiming to enhance teaching effectiveness and improve student learning outcomes (Holmes et al., 2019; Bernacki et al., 2021).

METHODOLOGY
Design of the Study

This study employed a quantitative approach and an experimental research design to examine the effect of personalized learning on the academic achievement of secondary school students. Specifically, a true experimental design was employed, as it allows for the most rigorous evaluation of cause-and-effect relationships between the intervention (personalized learning) and the outcome (academic achievement).

The true experimental design was selected because it enables controlled manipulation of the independent variable (personalized learning) while minimizing potential biases through random assignment of participants. Students were randomly allocated to either the experimental or control group based on their pre-test scores, ensuring equivalence between groups and enhancing the internal validity of the study. This approach allows for a precise comparison between students who received the personalized learning intervention and those who experienced traditional instruction.

The intervention was administered to the Experimental group, whereas the Control group did not receive it, allowing the researcher to determine the effect of personalized learning on students' academic achievement. By employing this design, the study ensures that observed differences in academic achievement can be attributed to the intervention rather than extraneous variables (Creswell, 2009).

A systematic specification of the research design is presented as follows.

R = O_1 T_1 O_2 R = O_3 T_2 O_4

At this stage

R = Random assignment of the subject to a group

T_1 stands for treatment with personalized learning

O_1 and O_3 Stands for Pre-test.

O_2 and O_4 stand for Post-test

T_2 stands for treatment with traditional learning.

This design provides a robust framework to evaluate the effectiveness of personalized learning in enhancing the academic outcomes of high, average, and low-achieving secondary school students.

Population of the Study

For this study, the population included all Government Boys' Secondary Schools in the Rawalpindi district. According to the most recent school census, the district included 483 such schools, collectively enrolling a total of 46,189 students. Among these, the Government Madrassa Millia Islamia High School, located in F-Block, Satellite Town, Rawalpindi, represented one of the key institutions within the district and served as a focal point for understanding the broader student population. The large and diverse student body across these schools provided a representative framework for examining the research variables within the context of government secondary education in the Rawalpindi district (School Census, 2024, https://education.punjab.gov.pk).

Sample of the Study

A sample is a smaller segment of a larger group chosen for observation and analysis, and examining it enables researchers to draw conclusions about the whole population it represents. Furthermore, any changes registered from the sample can also be assumed to apply to the entire population (Creswell, 1998). For this study, a random sampling method using matched pairs was applied to a total of 60, 9th graders students at the Government Madrassa Millia Islamia High School, F-Block Satellite Town, Rawalpindi. The students were divided into two equal groups, an experimental group and a control group, based on their pre-test scores. Both groups consisted of 30 students each, with one serving as the Control group and the other as the Experimental group.

Procedure / Treatment

Formal permission was obtained from the administration of the selected institution, Government Madrassa Millia Islamia High School, F-Block Satellite Town, Rawalpindi, to conduct the study with 9th-grade students. The study focused on the subject of Mathematics due to its foundational importance and relevance to the research objectives. For the intervention, three chapters from the 9th-grade Mathematics curriculum were selected, ensuring a broad representation of mathematical concepts that aligned with the goals of personalized learning.

The pre-test was developed in alignment with the Rawalpindi Board examination framework to assess students' prior knowledge in mathematics. The test instrument comprised three distinct sections: MCQs, short-answer questions, and long-answer questions. This structure was designed to evaluate students' initial conceptual understanding and problem-solving abilities in mathematics. T Both the Experimental and Control groups were given the same pre-test to measure their baseline academic achievement and to establish comparability prior to the intervention. The experimental group received instruction using a personalized learning, where lessons were tailored to each student's learning pace, abilities, and needs. Eight lesson plans were developed specifically for this purpose, covering the selected content over an eight-week period. In contrast, the control group received traditional instruction, following a standard teaching method for the same three chapters, without any adjustments made to accommodate individual learning differences.

Research Instrument

The research instruments employed in this study comprised a pre-test, post-test, and retention test. These assessments were developed in accordance with the curriculum and content prescribed in the Grade 9 Mathematics textbook, with specific emphasis on the three selected chapters to ensure content relevance and alignment with instructional objectives. The pre-test served to establish a baseline measure of students' prior knowledge and academic achievement in Mathematics. The post-test, administered at the conclusion of the intervention, was designed to assess the immediate impact of the personalized learning approach on student performance. Finally, the retention test was administered after a specified period to evaluate the long-term retention of the learned material, ensuring a comprehensive evaluation of both short-term and long-term learning outcomes. The test items covered key concepts and problem-solving methods that reflect a deep understanding of mathematical problems. The questions were classified into three levels of difficulty: easy, medium, and difficult, to assess various cognitive skills. Mathematics was the core subject for this study.

Pre & Post-Test

With a focus on the cognitive domain, the pre-test and post-test were created in accordance with Bloom's updated taxonomy (Näsström, 2009). The final version was created after the first draft was altered based on pre-testing and expert input. Tests items focused on significant concepts from the three selected chapters of the 9th-grade Mathematics curriculum. The teaching schedule for these topics was followed closely to ensure alignment with the content taught during the study. The selected topics provided a comprehensive assessment of students' understanding in the subject of Mathematics.

Validity of the Instrument

The instrument was verified. The instrument's validity was examined with the assistance of subject specialists. The research tool was prepared and altered with the advice and opinions of specialists. Content validity was established during the test construction phase, ensuring that the test items aligned with the curriculum and key concepts from the selected chapters of the 9th-grade Mathematics textbook.

Reliability of the Instrument

The consistency between true and observed scores is known as reliability. A pilot study was conducted with 20 low-achieving 9th-grade students from a different group within the same locality, selected for their similar characteristics. The study took place at Government Boys Secondary School Locoshaid, Rawalpindi. These students were randomly selected using the same instruments as in the main study, but they did not belong to the sampled institution. Cronbach's Alpha was used to evaluate the reliability of the instrument, resulting in a reliability index of 0.73.

Control of Variables in the Study

The experiment was conducted at Government Madrassa Millia Islamia High School, F-Block Satellite Town, Rawalpindi. To reduce the impact of internal and external threats, the researcher implemented the following precautionary measures.

Control of Internal Threats

i. History: History is a threat in which unexpected events occur during the experiment. To manage this threat, the experiment was conducted over eight weeks. During this time, no events occurred that could have affected the students' academic achievement. Hence, this threat was controlled.

ii. Maturation: Maturation is a threat in which mental or physical change in the subject occurs during the experiment. To control this threat, the time duration of the 32 experiments consisted of only eight weeks. This duration was not sufficient to help the students improve their post-tests. Hence, this threat was also controlled.

iii. Testing: This threat occurs when the scores are greater in the post-test than in the pre-test.

Eight weeks is sufficient time for this purpose to forget the pre-test's unseen items. Furthermore, the students had no idea how the final post-test was administered. This threat was therefore managed.

iv. Instrumentation: This threat happens when the instrument is faulty, or the test was altered in pre-test and post-test. The standardized Subject Achievement Test (SAT) was employed for pilot testing, validated by expert review, and subjected to pilot testing before being administered to the Experimental and Control groups. Consequently, this threat was controlled.

v. Implementation: The experimental group was instructed through personalized Learning, whereas Instruction for the Control group was delivered through the traditional method. The researcher instructed both groups to control this threat. Consequently, this threat was controlled logically.

vi. Bias Selection: This threat occurs when there is personal interaction with the subject. To control this
threat, all the students participating in the study were given equal opportunity. Hence, this threat was controlled.

vii. Mortality: This threat occurs when there is dropout of the subject due to disease, injury, or death. To control this threat, the experiment was continued for eight weeks with the cooperation of the management. All the students were interested in the study, and no single student was absent in the whole study. Hence, this threat was controlled.

Control of External Threats
i. Multiple Treatment Interference: The participants could not take extra classes or tuition as extra treatment in place of the researcher or other subjects who are already enrolled in a relevant research study, which may bias the experiment's actual results. There was little chance that treatment would be impacted because the teachers at Government Madrassa

Millia Islamia High School, F-Block Satellite Town, Rawalpindi were not aware of the Personalized Learning.

ii. Experimenter Effect: The Personalized Learning model concept was not recognized within our education system, and the teachers at the selected school were also uninformed about this concept. The researcher examined this model and acquired profound insights through literature, a reputable supervisor, and experts in critical thinking. To ensure uniformity in the experiment, the researcher intended to instruct the experimental group utilizing the Personalized Learning, whereas the control group was educated through the traditional technique. Regulation of several variables, including the quantity of lesson plans, duration of lessons, timing and location of interventions, scheduling of pre-tests and post-tests, heterogeneous student abilities, and instructional materials, through comparative analysis of the effects in experimental and control groups.

iii. Specificity of Variables: Every stage of the process was carefully carried out to prevent any external threats. The pre-test was pilot-tested and given at random, and the lesson ideas were confirmed. The experiment's conclusion and the post-test were identical. Detailed descriptions were provided for the Experimental pre-test, post-test, and retention test, as well as for Personalized Learning and the intervention time.

Data Collection
Data for this research were collected by administering a pre-test, post-test, and retention test to both the Control and Experimental groups. The personalized learning intervention was carried out over eight weeks, after which the post-test was administered to both groups to record their post-test scores. After a one-month interval, the retention test was administered to both groups to assess students' retention of mathematical knowledge. The purpose of this approach was to evaluate students' ability to retain the material learned and measure the

degree of knowledge retention based on their test scores.

Retention Test

To assess retention, the post-test was re-administered to both the Control and Experimental groups after an interval of one month. The purpose was to assess the effect of the personalized learning intervention on students' academic achievement and the retention of knowledge over time. The results offered experimental evidence of the intervention's effectiveness in promoting long-term retention of mathematical concepts.

Analysis of Data

The Statistical Package for the Social Sciences (SPSS) was used to analyze the data in this study. Descriptive and inferential statistical methods, such as the mean, SD, SE, and SEM, were applied to interpret the results. Inferential analyses comprised analysis of variance (ANOVA), To analyze differences in students' academic achievement, Levene's test was conducted to determine the equality of variances, followed by the independent samples t-test for equality of means. Pre-test, post-test, and retention test scores were collected and analyzed independently.

Descriptive Statistics for Academic Achievement across High, Average, and Low Achievers in the Context of Personalized Learning

Groups	N	Mean	S.D	S.E
Low	4	9.6667	1.44338	.83333
Average	13	21.5385	6.17947	1.71388
High	13	38.6538	13.73467	3.80931
Total	30	27.9828	14.33370	2.66170

The mean score for the low achievers group (N = 4) was 9.67 with a standard deviation of 1.44, indicating a lower level of academic achievement. The average achievers group (N = 13) attained a mean score of 21.54 with a standard deviation of 6.18, reflecting moderate performance. In contrast, the high achievers group (N = 13) demonstrated the highest mean score of 38.65 with a standard deviation of 13.73, highlighting significantly higher academic achievement.

The overall mean score for all students (N = 30) was 27.98 with a standard deviation of 14.33. These findings suggest that personalized learning had varying effects across different achievement groups, with a noticeable increase in academic achievement observed among the high achievers as compared to the low and average achievers.

This indicates that personalized learning appears to be more effective for high achievers, while its impact on low achievers remains relatively limited. The standard deviation values further reveal that the scores for high achievers were more widely dispersed compared to those of the low and average achievers.

H_{01}: There is no significant effect of personalized learning on the academic achievement of high, average, and low achievers among secondary school students.

The Effect of Personalized Learning on Academic Achievement of High, Average, and Low Achievers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3026.652	2	1513.326	14.433	.000
Within Groups	2726.090	26	104.850		
Total	5752.741	28			

The results of the one-way ANOVA presented that there is a statistically significant difference in the academic achievement scores of high, average, and low achievers under personalized learning (F = 14.433, p = .000).

The between-groups sum of squares is 3026.652 with a mean square of 1513.326, while the within-groups sum of squares is 2726.090 with a mean square of 104.850. The significance value (p = .000) is less than the alpha level of 0.05, leading to the rejection of the null hypothesis (H_{01}).

The findings suggest that personalized learning significantly impacts the academic achievement of students in the high, average, and low achiever groups. The significant F-value suggests that at least one of the groups differs significantly from the others in terms of academic achievement.

Post Hoc Tests: Multiple Comparisons Using LSD for Personalized Learning and Academic Achievement

LEVELS	LEVELS	M.D	S.E	Sig.
Low	Average	-11.87179	6.55860	.082
	High	-28.98718	6.55860	.000
Average	Low	11.87179	6.55860	.082
	High	-17.11538	4.01631	.000
High	Low	28.98718	6.55860	.000
	Average	17.11538	4.01631	.000

The results of the LSD post hoc test provide further insight into the differences in academic achievement between the three groups—low achievers, average achievers, and high achievers—under personalized learning.

1. **Low Achievers vs. Average Achievers:** With a mean difference of -11.87 (p = 0.082), the result is not statistically significant at the 0.05 level, suggesting no significant difference in academic achievement between low and average achievers.

2. **Low Achievers vs. High Achievers:** The mean difference is -28.99 (p = 0.000), which is statistically significant. The negative mean difference indicates that high achievers scored significantly higher than low achievers. The 95% confidence interval (-42.47 to -15.51) confirms this significant difference.

3. **Average Achievers vs. Low Achievers:** The mean difference is 11.87 (p = 0.082), which mirrors the earlier comparison and is not statistically significant.

4. **Average Achievers vs. High Achievers:** The mean difference is -17.11 (p = 0.000), which is statistically significant. High achievers outperformed average achievers, as indicated by the negative mean difference. The confidence interval (-25.37 to -8.86) further supports this finding.

5. **High Achievers vs. Low Achievers:** The mean difference is 28.99 (p = 0.000), consistent with the earlier result showing a significant difference. High achievers scored substantially higher than low achievers.

6. **High Achievers vs. Average Achievers:** The mean difference is 17.11 (p = 0.000), which is statistically significant. High achievers outperformed average achievers, as confirmed by the positive mean difference and the confidence interval (8.86 to 25.37).

FINDINGS

To investigate the effect of personalized learning on Academic Achievement of high, average and low achievers of Secondary School Students

Data analysis produced the following results:

1. The mean score for the low achievers group (N = 4) was 9.67, with a standard deviation of 1.44, indicating a lower level of academic achievement. In contrast, the mean score for the high achievers group (N = 13) was 38.65, with a standard deviation of 13.73, showing a significantly higher level of academic achievement. The difference in scores suggests that personalized learning was more effective for high achievers compared to low achievers.

2. The average achievers group (N = 13) had a mean score of 21.54, with a standard deviation of 6.18, reflecting moderate academic performance. While the scores for average achievers were higher than those of low achievers, they were notably lower than those of high achievers, suggesting that the impact of personalized learning was more pronounced for the high achievers group.

3. The overall mean score for all students (N = 30) was 27.98, with a standard deviation of 14.33, indicating a wide spread of academic achievement across all groups. This demonstrates that while personalized learning had varying effects across the groups, there was a notable increase in academic achievement for high achievers when compared to both low and average achievers.

4. The higher SD values for high achievers (13.73) as compared to low achievers (1.44) and average achievers (6.18) suggest that the academic scores for high achievers were more widely dispersed, highlighting the diverse range of performance within the group.

5. As shown in Table 4.2, the one-way ANOVA results indicate a statistically significant difference in the academic achievement of high, average, and low achievers under personalized learning (F = 14.433, p = .000), suggesting that personalized learning significantly impacts students' academic performance across these groups. The significant F-value (p = .000) leads to the rejection of the null hypothesis (H_{01}), confirming that at least one of the groups differs significantly from the others in terms of academic achievement.

6. The post hoc LSD test results (Table 4.2.1) provide further insights into the differences between the groups:

1. Low Achievers vs. Average Achievers: The MD is -11.87 (p = 0.082), which is not statistically significant at the 0.05 level, suggesting no significant difference between low and average achievers.

2. Low Achievers vs. High Achievers: The MD is -28.99 (p = 0.000), which is statistically significant, indicating that high achievers scored significantly higher than low achievers.

3. Average Achievers vs. Low Achievers: The MD is 11.87 (p = 0.082), which is consistent with the earlier comparison and not statistically significant.

4. Average Achievers vs. High Achievers: The MD is -17.11 (p = 0.000), which is statistically significant, with high achievers outperforming average achievers.

5. High Achievers vs. Low Achievers: The MD is 28.99 (p = 0.000), confirming that high achievers scored substantially higher than low achievers.

6. High Achievers vs. Average Achievers: The MD is 17.11 (p = 0.000), indicating that high achievers outperformed average achievers.

7. The LSD post hoc test results emphasize the greater impact of personalized learning on high achievers, as they consistently performed better than both average and low achievers. However, the difference between average and low achievers was not statistically significant.

DISCUSSION

The present study aimed to examine the effect of personalized learning on the academic achievement of high, average, and low-achieving secondary school students. The findings reveal that personalized learning had a differential impact across the three groups, with high achievers benefiting the most from this instructional approach. High-achieving students demonstrated notable improvements in academic performance, suggesting that personalized

learning effectively supports their ability to progress at a faster pace, engage with complex tasks, and explore learning content aligned with their strengths and interests. These results are consistent with recent research indicating that students with higher prior achievement levels tend to respond more positively to learner-centered, individualized instructional strategies, which provide opportunities for enrichment, self-directed learning, and interest-based engagement (Li et al., 2021; Chen & Zhang, 2022).

For average achievers, personalized learning produced moderate gains in academic performance. While their improvement was notable compared to low achievers, it was not as pronounced as that observed among high achievers. This suggests that personalized learning supports learners with moderate academic abilities by allowing them to progress at their own pace and providing targeted guidance, though it may not fully challenge or extend their learning as much as it does for high achievers. These findings align with recent research showing that average learners benefit from individualized instruction when it incorporates scaffolding, guided practice, and adaptive learning tasks that progressively increase in complexity (Darling-Hammond et al., 2020; Walkington, 2013).

Low-achieving students also showed improvement under personalized learning, though their gains were comparatively smaller. This indicates that while personalized learning can provide the additional support and attention these students require, the approach may need further adaptation to maximize its effectiveness for struggling learners. The results suggest that low-achieving students may benefit from additional instructional scaffolding, frequent formative feedback, and structured guidance to fully engage with the learning material and strengthen their foundational knowledge. Research has highlighted that learners with lower prior achievement levels often require more intensive support to achieve meaningful gains, even in personalized learning environments (Hattie, 2009; Pane et al., 2015).

An important observation from the study is that the variation in performance within the high-achieving group was more diverse compared to the other groups. This suggests that while high achievers benefit most from personalized learning, individual differences within this group remain substantial. Some students may progress quickly when provided with challenging tasks, whereas others may require additional support or time to fully benefit from personalized instruction. These findings underscore the need for ongoing differentiation within personalized learning strategies, even for students with higher prior achievement (Li et al., 2021; Chen & Zhang, 2022).

Although personalized learning produced the greatest gains for high achievers, it is noteworthy that the differences between average and low achievers were less pronounced. This indicates that personalized learning may have a more limited effect on students whose academic abilities fall in the lower spectrum, suggesting the need for additional support mechanisms tailored specifically for these learners. For instance, integrating structured scaffolding, peer-assisted learning, or additional teacher guidance could enhance the benefits of personalized learning for average and low-achieving students (Tomlinson, 2014; Hattie, 2009).

Overall, the findings underscore the potential of personalized learning as an effective instructional strategy for enhancing academic achievement, particularly among high-achieving students. The approach encourages student autonomy, engagement, and self-directed learning, which appear to be key factors contributing to higher performance. However, to ensure that students across all achievement levels can fully benefit, educators must carefully design personalized learning interventions that include differentiated support, adaptive instruction, and ongoing monitoring of individual student progress. By doing so, personalized learning can serve as a powerful tool for promoting academic growth, reducing learning gaps, and catering to the diverse needs of students in secondary education (Pane et al., 2017).

CONCLUSION

1. Personalized learning enhanced academic achievement among high achievers, who demonstrated stronger academic performance compared to average and low achievers.

2. Clear differences in academic achievement were observed among high, average, and low achievers, indicating variation in how students responded to personalized learning.

3. High achievers consistently outperformed both average and low achievers under the personalized learning approach, whereas the performance gap between average and low achievers was comparatively minimal.

4. These findings indicate that personalized learning is particularly effective for high achievers, while its impact on average and low achievers appears less pronounced.

RECOMMENDATIONS

The current study has significantly added to the body of knowledge on student achievement, retention, traditional and personalized learning, and secondary school students. For academics, teachers, and practitioners looking to improve academic performance and retention—especially for children with different levels of prior achievement—it provides helpful advice. The results highlight the significance of evidence-based teaching strategies that are customized to meet students' various learning requirements.

The following recommendations may be made in light of the study's findings and conclusions:

1. Personalized Learning for High-Achieving Students: Schools and educators may implement personalized learning strategies for high-achieving students to further enhance their academic potential. Such strategies may include the provision of challenging tasks, the use of adaptive learning technologies, and opportunities for independent exploration to deepen conceptual understanding.

2. Support for Low and Average Achievers: For low and average achievers, personalized learning may be complemented with scaffolding techniques, remedial programs, and motivational strategies to address foundational learning gaps and improve engagement. Structured activities targeting basic skills may be integrated into personalized learning models to support continuous academic progress.

3. Policy Integration: Policymakers may consider integrating personalized learning frameworks, including differentiated instruction and adaptive learning platforms, into the national curriculum. Such integration may help address learner diversity more effectively and expand opportunities for academic success.

4. Resource Allocation: Adequate resources, such as educational technology, professional development funding, and instructional materials, may be allocated to support the equitable implementation of personalized learning strategies across schools. This may assist in reducing disparities and improving access to quality learning experiences.

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