Vol. 5, No. 3 (2025)
EDUCATIONAL RESEARCH AND INNOVATION (ERI)
e-ISSN:2710-4354
p-ISSN:2076-9660
Received: 23/07/2025 Accepted: 08/09/2025

BEYOND THE CONVENTIONAL APPROACHES: ENHANCING BIOLOGY LEARNING THROUGH MULTIPLE INTELLIGENCE-BASED APPROACH IN PAKISTAN

Fahim Khatoon[1], Dr. Munzza Ambreen[2]

Abstract

This study aims to examine the effect of the Multiple Intelligence Approach (MIA) on the attitudes of secondary-level students towards learning biology in Islamabad, Pakistan. The study employs a true experimental design to compare the attitudes of students taught through MIA with those taught using conventional methods. The comparison is based on several dimensions of the Biology Attitude Scale (BAS), such as interest, career inspiration, perceived importance, and perceived difficulties in biology. A cohort of 70 ninth-grade students was segregated into experimental and control groups, and 35 students in each group underwent analysis by independent sample t-tests. Results showed that students in the MIA group had significantly higher average scores in all aspects compared to the control group, underscoring the efficacy of MIA in improving students' interest, career ambitions, and perceived significance of biology, while also decreasing learning challenges. These findings emphasise the significance of including MIA in teaching methods to enhance students' attitudes and involvement in science education. This study provides theoretical validation of MIA in the educational setting of Pakistan and has practical implications for educators and policymakers. Nevertheless, the constraints of limited sample size, a short-term study, and limited generalizability indicate the need for additional research to investigate the long-term effects and wider relevance of MIA in various educational environments.

Keywords: *Multiple Intelligence based Approach, Attitude of students, Biology Attitude Scale (BAS)*

Introduction

Biology is widely selected as an elective subject among students at the secondary education level in Pakistan and is often preferred over computer science. Notwithstanding this widespread appeal, there is an ongoing apprehension over the academic performance of students in the field of biology, as evidenced by their results in the Secondary School Certificate (SSC) exams (Ilyas, Sadique, Masood, Qamar, & Chohan, 2011; Poupova, 2018; Shah, Riffat, Ghafar, & Kazmi, 2018; Treibergs, Esparza, Yamazaki, & Smith, 2023). The learning results of students in biology are influenced by several elements, and one of the most widely discussed aspects in current literature is the attitudes of students (Zia, Anwer, & Butt, 2023). Within the realm of education, attitude refers to an individual's subjective evaluation of a subject, which can be categorised as positive, negative, or neutral. It includes cognitive, affective, and behavioural aspects (Güngör, 2021; Khan & Ali, 2012). The challenge of precisely defining "attitude" is well-recorded, as it is a complicated and multidimensional concept. As defined by Salta and Tzougraki (2004) and VandenBos (2020) attitude is the inherent tendency to think, feel, or behave in a positive or negative manner towards things in one's surroundings. Furthermore, the concept of "attitude

[1] Ph.D. Scholar Department of Secondary Teaching Education AIOU Islamabad Pakistan.
fahim.khatoon.phd@gmail.com
[2] Assistant Professor, Department of Secondary Teaching Education AIOU Islamabad Pakistan

Vol. 5, No. 3 (2025)
EDUCATIONAL RESEARCH AND INNOVATION (ERI)
e-ISSN:2710-4354
p-ISSN:2076-9660
Received: 23/07/2025 Accepted: 08/09/2025

towards science" has been thoroughly investigated, as Osborne, Simon, and Collins (2003) emphasised that attitude encompasses several sub-constructs, each of which contributes to an individual's comprehensive attitude towards science. Attitude is seen as a crucial factor in determining students' academic achievement in science. For instance, Alemayehu (2021) observed that attitude represents cognitive, emotional, and action-oriented inclinations, all of which exert an impact on behaviour. Getie (2020) proposed that attitude is influenced by learning experiences and can be altered by utilising different educational strategies. Crucially, the academic performance of pupils is more highly influenced by their attitudes towards science rather than the other way around (Sahin & Yilmaz, 2020). Intelligence plays a vital role in academic success and attitudes toward learning, as it encompasses various cognitive abilities that influence how students engage with educational content. The concept of multiple intelligences, proposed by Howard Gardner, is widely accepted in educational theory and practice, emphasizing that individuals possess different types of intelligences—such as linguistic, logical-mathematical, spatial, and interpersonal—that can be nurtured to improve learning outcomes (Vadivukarasi & Gnanadevan, 2022). By catering to the diverse needs of learners through a multiple intelligences-based approach, educators can enhance students' attitudes toward learning and foster an environment where all students can thrive academically. Research indicates that when teaching methods are aligned with students' dominant intelligences, there is a significant positive correlation with academic achievement and improved attitudes toward learning (Yavich & Rotnitsky, 2020).

Biology, being a fundamental discipline at the secondary level, carries great importance in the educational system by equipping students with the knowledge to comprehend fundamental life processes and ecosystems (Mišianiková, Kimáková, & Lešková, 2021). Moreover, existing studies have examined gender disparities in attitudes towards biology, revealing that female students tend to show a greater affinity for biology compared to male students (Kleespies & Dierkes, 2020; Soylu Yalcinkaya & Adams, 2020) . Nevertheless, the findings regarding the impact of gender on students' attitudes towards science are not uniform in distinct cultural and educational settings. Therefore, this study aimed to investigate the impact of an MIA on the attitude of 9th-grade students towards biology in Islamabad, Pakistan, considering the significance of attitude in influencing students' involvement and achievement in biology. This study gathered data from students attending Islamabad Model College for Girls and considered more than 30 students, explicitly examining their perspectives on studying biology and four dimensions of BAS were used. The findings showed that students who were instructed utilising the MIA demonstrated notably superior attitude outcomes in all evaluated aspects as compared to those who were taught using conventional approaches. More precisely, the experimental group showed a higher level of interest in biology ($M = 8.00$ compared to $M = 6.00$, $p = 0.008$), a greater degree of career inspiration in biology ($M = 14.75$ compared to $M = 12.42$, $p = 0.0024$), and a lower report of perceived challenges in biology ($M = 11.00$ compared to $M = 8.00$, $p = 0.001$). Furthermore, the experimental group had a higher positive perception of the significance of biology ($M = 12.71$ compared to $M = 9.67$, $p = 0.001$). These results indicate that MIA has a

Vol. 5, No. 3 (2025)
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significant favourable impact on students' attitudes towards biology in comparison to conventional teaching methods. These findings emphasise the practical importance of including the MIA in scientific teaching in Pakistani schools, particularly at the secondary level.

The further sections of the study are outlined below. The second section is dedicated to the literature review and hypothesis formulation. In this paper, Section 3 outlines the methodology, Section 4 offers the results and discussion of the study, and Section 5 addresses the conclusion.

2. Literature Review and Hypothesis Development

Biology holds a pivotal position in science education; nevertheless, the academic performance and attitudes of students towards the subject have proved troublesome in different situations. Several studies, have documented that a significant number of students see biology as being abstract, tedious, and challenging to understand (Byukusenge, Nsanganwimana, & Paulo Tarmo, 2023). The perception of biology as unattainable results in disinterest and unsuccessful academic achievement, so emphasising the need to comprehend student attitudes towards the subject. As identified by Longobardi, Settanni, Lin, and Fabris (2021), attitudes have a crucial role in predicting student success. Therefore, cultivating a favourable attitude towards studying biology can be essential for enhancing academic results.

The attitude of students is frequently a critical factor in determining their success in scientific disciplines, such as biology. For instance, Nja et al. (2022) suggest that the attitudes of pupils in secondary school significantly impact their future academic achievement and level of involvement in a particular subject. According to Liou (2021), the significance of attitude is underscored since students' learning experiences are greatly influenced by their positive or negative attitudes towards science. Given the extensive impact of attitudes on both academic success and future professional ambitions, educators must prioritise the identification and cultivation of positive attitudes. Yet, current studies emphasise the difficulties linked to conventional teaching approaches in biology. Many students perceive biology education as lacking inspiration and relevance to their everyday lives, reducing their enthusiasm for the subject (Mutanen & Uitto, 2020). Traditional teaching, characterised by a teacher-centred approach and reliance on lectures, fails to cater effectively to the varied learning requirements of students, thereby leading to disengagement (Hoidn & Reusser, 2020). This problem highlights the need to use creative teaching methods, such as the Multiple Intelligence (MI) based curriculum, which aims to include students by addressing their individual abilities and preferred ways of learning.

According to Gardner (1993) theory of MI, linguistic, logical-mathematical, interpersonal, and bodily-kinesthetic intelligences are among students' many intelligences. MI based instruction promotes the development of activities by teachers that effectively engage different intelligences, therefore providing a more individualized learning experience. Studies investigating the effects of MI techniques in science education demonstrate encouraging outcomes. For instance, Gurcay

Vol. 5, No. 3 (2025)
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and Ferah (2017) discovered that pupils instructed in physics using MI-based teaching methods had more positive attitudes and attained superior outcomes in comparison to those taught using conventional techniques. Similarly, Al-Nakhbi and Barza (2016) discovered that students in science classrooms who used MI techniques displayed more positive attitudes towards the subject. This implies that these strategies have the potential to increase student involvement.

However, despite the possible advantages they offer, there is a significant lack of studies on the use of MI-based methods in biology instruction. The majority of studies investigating MI-based approaches concentrate on broad scientific topics or particular domains such as physics and chemistry, leaving the distinct difficulties of teaching biology understudied. Moreover, much of the available research on MI techniques tends to concentrate on short-term results, raising concerns about the long-term viability of beneficial changes in attitudes and performance (Yavuz, 2010).
Furthermore, there are apprehensions regarding the pragmatic obstacles of incorporating MI-based approaches into daily instruction. However, some opponents contend that the theory of Multiple Intelligences lacks empirical rigour and may be challenging to use in conventional classroom environments, despite its flexible instructional framework (Nyhammer, 2022). The implementation of MI-based instruction necessitates substantial resources and teacher training, which may not always be practical, particularly in educational systems with limited funding. Clarifying these pragmatic issues will be crucial for comprehending how MI-based approaches might be efficiently expanded in actual classrooms.

Ultimately, although the MI-based approach shows potential for enhancing student attitudes and performance in biology, further study is necessary to investigate its long-term impacts and practicality in various educational settings. Hence, this study aims to investigate the impact of MIA on the attitude of secondary biology students in Islamabad, Pakistan towards learning. To accomplish this goal, the following hypotheses were proposed.

H_{01}. There is no statistically significant difference in scores of students' interest in biology instructed through the MI-based approach and traditional approach.

H_{02}. There is no statistically significant difference in scores of students' biology careers instructed through the MI-based approach and traditional approach.

H_{03}. There is no statistically significant difference in the score of difficulties in biology students instructed through the MI-based approach and traditional approach.

H_{04}. There is no statistically significant difference in the scores of the importance of biology taught through the MI-based approach and traditional approach.

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3. Methodology

The research methodology employed in this study was quantitative, following the positivistic paradigm. Sridharan (2021) proposed that the positivistic paradigm prioritises using observation and measurement to evaluate theories or depict experiences to forecast and manage environmental influences. This study utilised a true experimental design with a pretest-posttest methodology to evaluate the influence of a multiple intelligence-based strategy on the attitudes of secondary-level students towards learning biology in Islamabad.

The study included all 9th-grade biology students who were enrolled at Islamabad Model College for Girls in Islamabad. This cohort was selected to represent the specific students directly involved in biology at this educational institution. The study sample was selected from this specified population. Among the 136 secondary schools within the Federal Directorate of Education, a single school was chosen based on its significant enrolment in biology. The sample consisted of seventy pupils from this particular class. A cohort of 70 ninth-grade students was segregated into experimental and control groups. A sample size of 30 is often regarded as an optimal initial value for true experimental designs (Beca, Chan, Naimark, & Pechlivanoglou, 2021). In order to guarantee internal validity, each experimental and control group in this study comprised over thirty students and 35 students considered in each group. Data was collected using a closed-ended standarized questionnaire that utilised a 5-point Likert scale, from Strongly Disagree to Strongly Agree. This study specifically examined a single dependent variable, Attitude, and an independent variable, such as MIA lesson plan. The Biology Attitude Scale (BAS), developed by Ahmad, Sultana, and Jamil (2021), assessed attitudes and beliefs about biology students. BAS is a reliable and valid tool that consists of twenty-five questions and a five-point Likert scale. It has seven dimensions, as shown in Table 1 (see Appendix B). The researcher selected three teaching units for biology: Unit 7: bioenergetics, Unit 8: nutrition, and Unit 9: transport (Appendix C) 9th grade. After basic and advance certification in MI based lesson planning the researcher designed lesson plans on all topics of three units i.e. bioenergetics, nutrition and transport from 9th -grade biology for experimental group and discussed and overview the lesson planning of traditional control groups with biology subject teacher (Appendix E).The MI-based lesson plan was validated by MI-based lesson plan experts through email. The traditional lesson plan, on the other hand, was validated by a team of expert biology teachers. The team included two associate professors, two assistant professors, two lecturers, and one senior secondary teacher from Islamabad Model College for Girls. During the validation process, the MI-based lesson plan was reviewed and assessed by the MI-based lesson plan experts via email correspondence. Their expertise in MI-based approaches ensured the quality and effectiveness of the lesson plan.

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4. Results and Discussions

4.1 Pre-test Scores of Students 'attitude toward biology on the Seven dimensions of the BAS

Table 4.1 offers a concise overview of the pre-test scores pertaining to students' attitudes towards biology, as measured by BAS. These aspects include Interest, Career, Importance and Difficulties. This data offers a valuable understanding of students' initial perceptions prior to any educative intervention, emphasizing their strengths and areas for enhancement in their approach towards learning biology. One of the key dimensions assessed was interest, which has a mean score of 7.1 and a standard deviation of 2.3. The scores vary from 2.00 to 10.00, indicating a broad spectrum of academic interest in biology among pupils. The moderate average score suggests that although some students are actively involved and interested in the subject, a significant proportion lack enthusiasm for it. Such a lack of involvement could be a major obstacle to learning and indicates that methods to enhance interest in biology are required to cultivate a positive attitude among students.

In addition, the Career dimension, which measures students' perceptions of the applicability of biology to their future professional trajectories, obtained a higher average score of 13.6 and a standard deviation of 3.2. Indicating that students usually acknowledge the significance of biology in professional development, the ratings varied from 7.00 to 20.00. This implies that even if students lack a strong interest in the subject, they recognize its significance in professional settings. In comparison to Interest, the comparatively higher mean in this dimension suggests that students' involvement in biology may be influenced by practical and career-oriented motivations.
Regarding Importance, the scale obtained an average score of 10.2 with a standard deviation of 1.8, indicating a modest level of acknowledgement of the importance of biology. Scores ranging from 7.00 to 14.00 indicate that students typically acknowledge the significance of biology in their education, but there is room for improvement in this perception. Augmenting the perceived significance of biology could offer additional impetus to students and enhance their general dispositions towards the subject.

Furthermore, the dimension of difficulties in learning biology is characterized by a mean score of 9.7 and a standard deviation of 1.9, indicating significant challenges within this field. The ratings spanned from 6.00 to 14.00, indicating that students considered biology to be a difficult discipline. The perception of difficulty can have a detrimental effect on students' attitudes and involvement, underscoring the requirement of instructional methodology that streamlines intricate ideas and enhances the accessibility of learning.

Finally, the average score of 79.7 with a standard deviation of 18.2 suggests a modest general attitude towards biology among students, characterized by significant variation. To improve students' general attitudes towards biology, it is advisable to focus on addressing lower-scoring

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characteristics such as Interest and difficulties, while also reinforcing positive concepts such as methodology and career. Incorporating focused interventions that specifically target these areas has the potential to enhance student involvement, achieve superior learning results, and foster a more optimistic attitude towards the subject.

Table 4.*1*

Summary of Pretest Scores of Students 'attitude toward biology on the Seven dimensions of the BAS

Attitude aspects	*N*	Minimum	Maximum	Mean	Std. Deviation
Interest	70	2.00	10.00	7.1	2.3
Career	70	7.00	20.00	13.6	3.2
Importance	70	7.00	14.00	10.2	1.8
Bio Teacher	70	6.00	23.00	15.0	4.0
Difficulties	70	6.00	14.00	9.7	1.9
Equipment	70	3.00	12.00	8.4	1.8
Methodology	70	9.00	23.00	15.7	3.2
Total	70			79.7	18.2

4.2 Effects of Multiple Intelligence-Based Approach on the interest of Students towards Learning Biology at the Secondary Level

The study's first hypothesis posited that there is no statistically significant difference in the scores of interest in biology between students under the instruction of the MIA and those taught using the conventional approach. Nevertheless, the statistical study performed to examine this hypothesis suggests otherwise. The findings of this study indicate that the Experimental Group, which received instruction utilizing the MIA, achieved a mean score of 8.00 with a standard deviation of 1.84. By contrast, the Control Group received instruction using conventional techniques and achieved an average score of 6.00 with a standard deviation of 1.89. An analysis revealed that the mean difference (MD) between the two groups was 1.43, accompanied by a t-

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p-ISSN:2076-9660
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value of 3.23 and degrees of freedom (df) of 68. The calculated p-value was determined to be 0.008, which falls below the predetermined significance level (I = 0.05). Given that the p-value (0.008) is below the predetermined level (0.05), we can confidently reject the null hypothesis. These findings suggest that there is a statistically significant disparity in the level of interest in biology among the two groups of pupils. Significantly greater interest in biology was shown by pupils who received instruction through the MI technique than those taught using the conventional technique.

These findings indicate that the MIA is superior to traditional teaching techniques in cultivating students' interest in biology. The findings are consistent with the wider body of research that endorses novel and learner-focused instructional approaches to enhance students' involvement and attitudes towards learning (Ahvan & Pour, 2016; Awang, Abd Samad, Faiz, Roddin, & Kankia, 2017; Yavich & Rotnitsky, 2020). By harnessing a range of intelligence, the MIA not only caters to the many learning preferences of students but also cultivates a more captivating and inspiring learning atmosphere, so directly enhancing interest in the field of biology. Hence, the findings substantiate the inference that the MIA benefits students' enthusiasm for biology, establishing it as a feasible substitute for conventional instructional methods in secondary education.

Table 4.*2*

Significance of Difference in mean scores on Students 'interest in the subject of Biology taught through MIA and Traditional Approach.

Groups	*N*	Mean	Std. Deviation	Std. Error Mean	*M.D*	**t**	Df	Sig. (2-tailed)
Experimental	35	8	1.84	0.312	1.43	3.23	68	0.008
Control	35	6	1,89	357				

Level of significance = α = 0.05.

4.3 Effects of Multiple Intelligence-Based Approach on Careers Inspiration of Students Towards Learning Biology at the Secondary Level

The study's second hypothesis proposed that there is no statistically significant difference in career inspiration scores in biology between students who received instruction using MIA and those taught using conventional methods. Nevertheless, the statistical analysis results offer unequivocal evidence in the opposite direction.

Vol. 5, No. 3 (2025)
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As indicated in Table 4.2, there are significant differences in the Experimental and Control groups' post-test scores on the dimension of career inspiration in biology. The mean score of the Experimental Group, which received instruction utilising the MIA, was 14.75, with a standard deviation of 3.97. In contrast, the Control Group received instruction using conventional techniques and achieved an average score of 12.42 with a standard deviation of 3.87. The MD between the two groups was equal to 2.32, with a t-value of 4.11 and 68 degrees of freedom (df). The obtained p-value of 0.0024 is much below the predetermined level of $I = 0.05$.

Since the p-value (0.0024) is below the significance level of 0.05, we can conclude that the null hypothesis (H02) is not supported. This finding suggests that there is a statistically significant disparity in the scores pertaining to career motivation in biology between the two groups receiving instruction. In comparison to the Control Group, students in the Experimental Group, who were taught using the MIA, exhibited notably greater career inspiration in biology.

This study indicates that the MIA has a useful effect on students' professional ambitions and motivations towards the field of biology. Implementing this strategy, which accommodates various learning preferences, is likely to cultivate a more profound affinity for the subject by enabling students to interact with biology in a manner that corresponds to their unique abilities and intelligence. Consequently, students not only have a greater attitude toward biology but also experience heightened motivation to explore professions associated with the discipline. Consistent with other studies, the results underscore the significance of adaptive and student-centred teaching approaches in influencing students' attitudes and future ambitions (Hadi, Aryani, & Suwidagdho, 2020; Lei, Cheng, Chen, Huang, & James Chou, 2021; عفيفي et al., 2024). By deviating from conventional, standardised teaching methods and adopting a more individualised approach such as MIA, educators can more effectively motivate students to pursue professions in biology and associated sciences, ultimately leading to enhanced long-term involvement and success in the field.

Table 4.*3*

Post-test Scores of Students, on the Dimension (careers inspiration in biology) of the BAS

Groups	*N*	Mean	Std. Deviation	Std. Error Mean	*M.D*	**t**	Df	Sig. (2-tailed)
Experimental	35	14.75	3.97	0.67	2.32	4.11	68	0.0024
Control	35	12.42	3.87	0.73				

Level of significance = $\boldsymbol{\alpha} = 0.05$

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p-ISSN:2076-9660
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4.4 Effects of Multiple Intelligence-Based Approach on Difficulties of Students Towards Learning Biology at the Secondary Level

The third hypothesis of the study investigated whether there is a significant difference in the perceived challenges in acquiring knowledge in biology between students who were taught using MIA and those who were taught using conventional techniques. More precisely, the null hypothesis posited that there would be no statistically significant difference in difficulty scores between the two groups. The statistical analysis of the data in Table 4.4 shows a notable difference in the average scores on the Difficulties in Biology subscale of BAS between the Experimental Group and the Control Group. The Experimental Group, instructed by the MIA, achieved a mean score of 11, with a standard deviation of 2.85. In contrast, the Control Group taught using conventional methods, obtained a mean score of 8, with a standard deviation of 2.4. A MD of 3 was observed between the groups, accompanied with a t-value of 4.43 and 68 degrees of freedom (df). The obtained p-value of 0.000 is far lower than the predetermined significance level of 0.05. Since the p-value (0.000) is much below the threshold of 0.05, we can conclude that the null hypothesis is rejected. The statistical results highlight a notable disparity between the groups, implying that students educated using the MIA reported fewer challenges in acquiring knowledge about biology in comparison to those taught using conventional approaches.

These findings indicate that the MIA successfully diminishes students' perceptions of the challenges linked to studying biology. By accommodating different learning styles and creating a more captivating and participatory learning atmosphere, MIA facilitates students' comprehension of intricate biological ideas, therefore reducing perceived difficulties. This method is expected to offer pupils multiple modalities to assimilate knowledge, therefore enhancing accessibility and reducing the intimidation associated with challenging material. Conversely, conventional teaching approaches, which frequently depend on one-dimensional training, may not adequately cater to the varied requirements of learners, resulting in increased ratings of perceived difficulty among students. The findings corroborate the idea that implementing more individualized and varied instructional approaches can greatly mitigate students' learning challenges, therefore improving their overall experience and achievement in biology (Hadi et al., 2020). In general, the findings are consistent with the growing body of studies that emphasizes the advantages of varied instruction and adaptive learning models in addressing academic difficulties (Shahzada, Khan, Islam, & Faqir, 2014; 2021 ,عبدالله & ,الأسمري ,خليل ,الفراني). The adoption of the MIA by educators can establish a learning environment that is more conducive and efficient, therefore mitigating students' perceived challenges and ultimately resulting in improved educational achievements in biology and other disciplines.

Table 4.*4*

Posttest Scores of Students, on the Dimension (difficulties in biology) of the BAS

Vol. 5, No. 3 (2025)
EDUCATIONAL RESEARCH AND INNOVATION (ERI)
e-ISSN:2710-4354
p-ISSN:2076-9660
Received: 23/07/2025 Accepted: 08/09/2025

Groups	*N*	Mean	Std. Deviation	Std. Error Mean	*M.D*	**t**	Df	Sig. (2-tailed)
Experimental	35	11	2.85	0.48	3	4.43	68	0
Control	35	8	2.4	0.45				

Level of significance = α = 0.05.

4.5 Effects of Multiple Intelligence-Based Approach on the Importance of Students Towards Learning Biology at the Secondary Level

The fourth hypothesis posited that no statistically significant difference exists in the perceived significance of biology between students given instruction using the MIA and those taught using the conventional methods. The statistical analysis of the data in Table 4.5 reveals a notable difference in the average scores on the Importance of Biology between the Experimental and Control groups. The Experimental Group, which was instructed using MIA, achieved an average score of 12.71 with a standard deviation of 1.8. In contrast, the Control Group, which was taught using conventional methodology, obtained a lower average score of 9.67 with a standard deviation of 2.66. The MD between the two groups was 3.03, with a t-value of 5.15 and 68 degrees of freedom (df). The calculated significance level (p-value) was determined to be 0.000, substantially below the predetermined threshold of 0.05. Given that the p-value (0.000) is less than the significance level ($\alpha = 0.05$), we can conclude that the null hypothesis is rejected. These findings suggest that there is a statistically significant disparity in students' views of the significance of biology between those instructed using the MIA and those instructed using conventional approaches.
The findings indicate that students who are exposed to the MIA consider biology to be of more importance in comparison to their peers in the Control Group. This finding is consistent with the fundamental concepts of the MIA, which highlights the utilisation of students' chosen learning styles to actively include them and enhance the relevance and significance of the material (Ibenegbu & Nzewi, 2020; Khatoon & Ambreen, 2023; Obimalume, 2021). By attending to a wide range of learning demands, MIA is expected to cultivate a more profound understanding and acknowledgement of the subject's significance, hence augmenting students' general involvement and passion for biology.

Conversely, conventional instructional approaches may not sufficiently link the content to students' diverse interests and cognitive abilities, which could result in a reduced sense of the subject's significance. The conventional methodology frequently prioritises memorization and passive acquisition of information, which may not resonate with all pupils, thereby lacking the ability to foster a robust understanding of the subject's significance.

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These results strengthen the need to use contemporary, learner-focused instructional methods, such as MIA, that accommodate various intelligences, therefore enabling students to derive personal meaning from their learning. The perception of the significance of a subject by students is positively correlated with their motivation, active participation, and academic performance. This result emphasizes the crucial significance of teaching methods in both academic success and the formation of students' attitudes towards learning. Therefore, it implies that educational interventions that acknowledge and adjust to the varied abilities of learners can greatly influence their understanding of the significance of subjects such as biology.

Table 4.*5*

Posttest Scores of Students, on the Dimension (importance of biology) of the BAS

Dimension (importance of biology) of the Biology attitude scale

Groups	*N*	Mean	Std. Deviation	Std. Error Mean	*M.D*	**t**	Df	Sig. (2-tailed**)**
Experimental	35	12.71	1.8	0.305	3.03	5.15	68	0
Control	35	9.67	2.66	0.504				

Level of significance = $\boldsymbol{\alpha}$ = 0.05.

5. Conclusion

This study aimed to investigate the impact of a multiple intelligence-based approach (MIA) on the attitude of 9th-grade students towards biology in Islamabad, Pakistan, considering the significance of attitude in influencing students' involvement and achievement in biology. This study gathered data from students attending Islamabad Model College for Girls, comprising over thirty students, explicitly examining their perspectives on studying biology. Four dimensions of BAS were used to examine the attitude of the students. The findings show that students who were instructed utilising the MIA demonstrated notably superior attitude outcomes in all evaluated aspects as compared to those who were taught using conventional approaches. More precisely, the experimental group showed a higher level of interest in biology (M = 8.00 compared to M = 6.00, p = 0.008), a greater degree of career inspiration in biology (M = 14.75 compared to M = 12.42, p = 0.0024), and a lower report of perceived challenges in biology (M = 11.00 compared to M = 8.00, p = 0.001). Furthermore, the experimental group had a higher positive perception of the significance of biology (M = 12.71 compared to M = 9.67, p = 0.001). These results indicate that MIA has a significant favourable impact on students' attitudes towards

Vol. 5, No. 3 (2025)
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p-ISSN:2076-9660
Received: 23/07/2025 Accepted: 08/09/2025

biology in comparison to conventional teaching methods. The study results emphasise the practical importance of including the MIA in scientific teaching in Pakistani schools, particularly in secondary biology. By accommodating various learning styles, MIA greatly amplifies students' engagement, diminishes perceived challenges, and fosters positive views towards biological professions. This strategy can be implemented by educators to establish a more captivating and nurturing learning atmosphere, which may result in enhanced student achievements and motivation. Policymakers can use these findings to support the implementation of more comprehensive, learner-focused instructional approaches, departing from the conventional memorization-based learning practices commonly found in Pakistani education. Theoretically, this study provides evidence in favour of Gardner's Theory of MIA by showing its beneficial influence on students' perspectives on biology, therefore validating the efficacy of varied teaching approaches customised to individual aptitudes within the Pakistani setting. The current study expands upon prior studies by highlighting that MIA improves cognitive results and profoundly influences students' emotional and attitudinal aspects towards learning. This supports the idea that the advantages of MIA extend beyond academic achievement and have a favourable impact on students' attitudes, confirming its relevance in many educational environments. Despite contributions, this study also has some limitations. One of the limitations of the study is the small sample size, which is limited to a single school in Islamabad. This restricts the generalizability of the results to other places in Pakistan. The short-term evaluation concentrated on the immediate effects after the intervention without considering the long-term consequences, therefore leaving the sustainability of the benefits of MIA indeterminate. In addition, the study focused on students' views without a thorough examination of academic performance results, and it did not investigate the particular functions of various intelligences in the process of acquisition of biological knowledge. Moreover, the level of proficiency with which teachers apply MIA, which can substantially impact outcomes, was not comprehensively examined, suggesting a necessity for additional study in these domains.

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