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Multiple Intelligences and Academic Achievement: Investigating Multidimensional Relationships and Predictive Among Undergraduate Students in STEAM Disciplines in Punjab, Pakistan

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Abstract: *The concept of multiple intelligence (MI) has significantly altered the educational paradigm by acknowledging that students have diverse cognitive strengths and learn styles in different ways. The present study aimed to establish the relationships between multiple intelligences and academic performance in a multidimensional context study among undergraduate students pursuing STEAM disciplines in Punjab, Pakistan. It also involved a comparison based on gender. Students from the Pure sciences and arts & humanities departments of the University of Sargodha were conveniently selected to be the participants. A self-report checklist of 80 items adapted from Armstrong's (1993) Multiple Intelligence Checklist, which was pilot-tested and shown to have high reliability (Cronbach's Alpha = 0.89), was used for data collection. Various statistical techniques, such as the T-test, correlation, and ANOVA, were used to investigate group differences and relationships between variables. It was found that there was a very weak and statistically insignificant association between multiple intelligences and academic achievement, and that female students had higher overall intelligence scores than males. Besides that, only the verbal-linguistic intelligence type showed a slight positive correlation with academic marks, and no significant difference was observed across educational boards or academic grades. University teachers should introduce multiple intelligence-based teaching methods in their classrooms, not only for the sake of accommodating different learning styles but also for the purpose of enhancing students' engagement and thus improving learning outcomes in STEAM education.*

Introduction

Human potential knows no bounds, and our abilities are like hidden gems waiting to shine. The concept of multiple intelligence, as proposed by Howard Gardner in 1983, altered our entire perspective on cognitive abilities. It declares that everyone holds a unique mixture of intelligence far outside the predictable measures of IQ. Such multiplicity in intelligences interacts with one another, thereby initiating a complex Composition of human cognition. These patterns accept an education process that goes away from the one-size-fits-all approach. All approaches to a personalized journey of exploration blunt the full faculties of every mind. The relevance of multiple intelligences (MI) to learning styles and academic outcomes in higher education is highly apposite in the context of STEAM education. The literature indicates that when different learning styles and MI are considered, teaching will be more effective, student engagement will increase, and therefore academic performance will improve (Rohaniyah, 2017; Pilozo et al., 2024). According to Gardner, people have several different intelligences: musical, linguistic, and interpersonal, and this ought to have an influence on the instructional strategies that would better fit these differences (Pesantez, 2024). It includes creating an environment where students can develop their critical strengths in knowledge society-included skills, more specifically, what relates to MI (Vera et al., 2024). And the evidence is good; MI is positively related to academic performance, providing a strong impetus for specific pedagogical approaches designed with consideration of MI and other personality traits (Rodríguez & Arias, 2023). Thus, the integration of MI within STEAM education can significantly enhance educational practices and outcomes.

Previous numerous studies examine Multiple Intelligences (MI) as predictors of undergraduate academic achievement in STEAM domains. While Berkowitz and Stern argue for the importance of cognitive abilities, primarily spatial, verbal, and numerical reasoning, in predicting success within the STEM domains, the impact of MI in this regard remains an under-researched area (Berkowitz & Stern, 2018). Nasri et al. found that a Universal Design for Learning Multiple Intelligence-centered STEAM program boosts students' attitudes toward STEM, suggesting that MI might influence student engagement rather than the actual academic results (Nasri et al., 2021). Moreover, Ayasrah and Aljarrah's study shows that the MI of students is indeed different but does not have any statistically significant association with most attributes of academic achievement (Ayasrah & Aljarrah, 2020). Multiple Intelligence might influence predispositions and participation in STEAM; however, further empirical research is warranted into the actual predictive power of MI on academic outcomes.

Research has shown that the larger the female representation in STEM disciplines, the better the academic achievements of the learner, especially females, indicating that gender dynamics strongly factor into educational results (Bowman et al., 2022). Beyond cognitive outcomes, interest, motivation, and self-efficacy are some non-cognitive variables investigated, but researchers have remained inconclusively divided on the aspects' predictive value when controlling for cognitive variables (Willems et al., 2019). Gender differences appear in motivation profiles, in which motivation is lower in girls despite similar scores, giving rise to interventions directed at enhancing women's participation in STEM fields (Hermans et al., 2022). In the same vein, social support is a critical influence on expectations of STEM careers with unique predictors for male and female students, further emphasizing a critical appreciation of these dynamics (Lv et al., 2022).

Objective of the Study

This study pursues three core objectives: (i) To examine the relationship between multiple intelligences and academic achievement among undergraduate students in STEAM disciplines; (ii) To compare the levels of multiple intelligences across gender among undergraduate students, and (iii) To investigate the predictive role of different types of multiple intelligences in determining students' academic performance.

Research Questions

1. What is the connection between diverse intelligence and the academic performance of students in undergraduate STEAM majors?
2. How much can the various forms of multiple intelligences serve as predictors of the academic success of the undergraduate students in the STEAM fields of Punjab, Pakistan?

Literature Review

Link between MI and Academic Achievement in STEAM Undergraduates

Experiential studies topic with the connection of Multiple Intelligences (MI) to achievement among undergraduates of STEAM records a number of significant correlations proving the necessity of applying varied learning strategies. His research shows a well-founded correlation existing between MI-related learning strategies employed with the full development of the learner; the Pearson correlation index computes r=0.770, though it was determined that the direct link is not as strong to actual academic performance (Beriña, 2025). According to Rayyan's findings, within all intelligences, it is the intrapersonal intelligence that is most predictive of self-organized learning skills and academic achievement, indicating that huge educational outcomes could be expected by boosting this intelligence in students (Rayyan 2013.

In addition, Rodríguez and Velandia Arias found several intelligences to be significantly correlated with academic performance, noting that kinesthetic intelligence negatively predicted academic achievement (Rodríguez & Arias, 2023). The study by Salas and Campana Concha confirms these results, finding a strong correlation (Rho = 0.782) between multiple intelligences and performance in mathematics and the argument for tailoring educational approaches to maximize student potential (Salas & Concha, 2021).

Theoretical Models Connecting MI with Cognitive and Non-Cognitive Outcomes

Theoretical Models connecting Multiple Intelligences (MI) with cognitive or non-cognitive outcomes have broadened into the fact of the quite different capabilities that individuals possess and their implications for educational practices. According to Gardner's MI theory, there are supposedly eight intelligences, and all the other powerful forms of intelligence, like solving problems and creativity in various contexts, have so far been overlooked by traditional assessments, which mainly assessed the students' linguistic and logical-mathematical skills (Davis et al., 2011). In effect, the theory has encouraged a rethink in the way pedagogy is carried out so that inclusive teaching methods would better match different intelligences, thereby increasing engagement and motivation of the students (Walela, 2024). In addition, models such as Renzulli's Three Rings and Sternberg's Triarchic Theory supplement MI through incorporating giftedness and cognitive processing, respectively, thus denoting the importance of recognizing both cognitive and non-cognitive outcomes in the educational context (Robres & Blasco, 2020; Acat, 2005). MI continues to hold forth the concept that curricula and assessment systems are adaptable to meet the full range of human intelligence in a way that can thus promote a most equitable learning environment at the end of the day (Inteligencias múltiples y su desarrollo, 2023)

Curriculum Design and Assessment Practices Shape the Relationship Between Multiple Intelligences and Academic Achievement

Situational factors mediate the effect of Multiple Intelligences (MIs) on academic performance. The creation of curriculum and the practice of assessment are other aspects of this. Effective MI in operation demands a varied, activity-based curriculum that accommodates all MIs as well as collaborative and other resources-music and visuals involved (Gil et al., 2024). Research suggests that the performance of teachers in aligning the instruction to MI principles improves student engagement, education, and outcomes (Díaz-Posada et al., 2017; Posada et al., 2017). The MI theory relates to changes in education, as illustrated in Macao, for personalized learning that calls for various strengths and capabilities (Cheung, 2009). Further insights from neuroscience suggest that knowing the different cognitive profiles of students makes developing personalized teaching approaches that are more effective in improving learning performance possible (Shearer, 2018).

MI Profiles as Predictors of Academic Success

Evidence suggests that only some multiple intelligence correlates with out-and-out performance constructs, namely, the GPA. It has been found in a systematic review and meta-analysis that intels do moderately positively relate to the academic performance of students with a correlation value of $r = 0.367$; $p < 0.001$, which implies that certain forms of intelligences may exert an influence along with culture (Lozano-Blasco et al., 2022). Among the multiple intelligences being studied, intrapersonal intelligence appeared to be the best predictor of academic achievement, followed by verbal intelligence and interpersonal intelligence (Rayyan, n.d; Rayyan, 2013). This means: The better the intrapersonal skills that help self-regulated learning a student possesses, the gender was better performs. Multiple intelligences developed by Gardner stress assorted cognitive commodities, and the education in support of them would serve the purpose to teach by capitalizing on those strengths with better learning outcomes (Pizarro et al., n.d.; Cavas & Çavaş, 2020).

Research has been conducted on a number of Multiple Intelligences, which shows that some intelligence correlate more strongly with academic performance benchmarks like GPA. For instance, verbal-linguistic, visual-spatial, and logical-mathematical intelligences showed significantly positive relationships with academic achievement, asserting that these are the strongest predictors of performance in the educational environment (Ahvan et al., 2015).

The meta-analysis of several studies backing the findings shows that MI-based educational interventions offer opportunities for modifying or modifying students' attitudes and success in various subject areas, but with varying degrees of effects depending on the lesson or geographical context (Batdi, 2017; Aydin, 2019). It also follows the reasoning that a more general intelligence correlation, one of those recognized in the Cattell-Horn-Carroll model, suggests that such intelligences are intercorrelated, with the average correlations ranging from $r = 0.58$ to $r = 0.65$ (Bryan & Mayer, 2020). Putting MI theory into the practice of teaching proves beneficial in cultivating academic success through specific intelligence interventions (Cavas & Çavaş, 2020). Therefore, being educated by multiple intelligences could serve to enhance pupil performance mainly by coupling the mismatch between teaching styles and students' distinctive cognitive profiles.

MI Profiles of Undergraduate Students Predictors of Academic Success and the Validity of Specific Intelligence.

Evidence suggests that multiple intelligence dispositions and other non-cognitive variables predict undergraduate academic success. Intelligence is indeed a relevant predictor, but other factors interact, such as conscientiousness and motivation, which better explain variance in academic performance. For example, Odermatt et al. mentioned that motivation to strive for achievement accounted for variance in academic performance over and above intelligence and conscientiousness (Odermatt et al., 2024). Consonantly, Pérez-Gonzalez et al. pointed out that non-cognitive factors like self-efficacy and engagement accounted for a lot of the variance in GPA and suggested that it might be more important than cognitive abilities working alone (Pérez-González et al., 2022). Further, some cognitive abilities jointly displayed incremental validity in predicting grades for certain subjects, giving credence to the argument that specialized intelligence profiles can offer insight into variations in academic performance (Breit et al., 2024). Really, it seems that an eclectic view combining cognitive and non-cognitive factors is quite essential in forecasting the academic success of students in higher educational settings accurately (Burgoyne et al., 2023; Lydster, 2024).

Therefore, the use of Psychometric tools and statistical models in Multiple Intelligence-wise prediction studies for STEAM Education concerning undergraduate-level students, the enhancement of Multiple Intelligences (MI) predictions in STEAM education at the undergraduate level through the concurrent integration of psychometric tools and statistical models is yielding promising results. There exists evidence to suggest that a combination of frameworks like Universal Design for Learning (UDL) and MI theory can significantly alter students' perceptions toward STEM subjects, as was the case in a mixed-methods study employing comparative intervention designs to evaluate change in student attitudes pre- and post-intervention (Nasri et al., 2021. Hence, knowing the importance of perceived usability, real and continuous learning intentions can be cultivated through STEAM contexts (Wu et al., 2022). Moreover, structural equations modeling well substantiated the predictive effects of thinking styles and STEM attitudes on computational thinking skills, thus exposing the need for further comprehensive delineation of such constructs in higher education (Jiang et al., 2023). Altogether, these results are important for psychometric measurements as well as their analyses in developing the learning outcomes in STEAM-related disciplines.

Gender Differences in Multiple Intelligence among Undergraduate Students in Steam Education

Research conducted has suggested that significant gender differences exist among undergraduate students in STEM education in terms of Multiple Intelligence (MI) areas, self-efficacy, and perceived abilities. Women tend to develop lower self-efficacy in STEM domains than men, even though empirically, boys do better in most science courses; thus, it portrays a disconnection of performance and self-perception as affected by gender stereotypes (Stewart et al., 2020; Bloodhart et al., 2020). The impact of peer interactions that can undermine women's confidence and interest in STEM further exacerbates such stereotypes (Bloodhart et al., 2020). Stemming from the hope that Universal Design for Learning (UDL) principles increase STEM attitudes toward genders, MI theory may serve to create a more inclusive learning environment (Nasri et al., 2021). Furthermore, instrumentality has a significant positive impact on self-esteem and motivational achievement ability, especially for female students. The educational implication here is, therefore, that strategic development of such characteristics should be harnessed in supporting gender equity in STEM subjects (Streck et al., 2022).

Impact of Gendered MI Profiles on Academic Outcomes In STEAM

Any number of gendered multiple intelligence profiles indicates the academic outcomes of STEAM education, thereby revealing significant insights into the collaborative learning dynamics and performance variability. It has been revealed by research that the gender composition of the teams, particularly the mixed-gender teams, promotes cognitive and emotional engagement as it pushes the students towards higher-order thinking and interaction among others (Ma et al., 2022). The way in which gender and multiple intelligences interact also points out that some types of intelligences, such as kinesthetic and abstract reasoning, have an inverse relationship to academic performance and therefore should be considered in developing specific educational programs (Rodríguez & Arias, 2023). It was found that there were minimal differences in the integration of technology with STEAM based upon gender, but the collaborative environment would sustain individual disparity and inclusiveness as well as equal outcomes (Ulbrich et al., 2025; Beroíza-Valenzuela et al., 2025). This gender gap in STEAM additionally entails comprehensive models for non-binary identities and community interventions, which can bring culturally responsive education in support of different student trajectories (Soto et al., 2024)

The Influence of Sociocultural & Educational Factors on Gender-Based Variations in Multiple Intelligences and Academic Achievement

Sociocultural and educational factors that occur over there significantly affect the sex-based differences in one's multiple intelligences as well as in academic achievement. The results of previous studies demonstrate the effect of biological and psychosocial factors on cognition. According to studies, males perform better than females in spatial-related tasks while females excel in verbal tasks, which explains how gender identity and societal expectations work in shaping men's and women's cognitive development (Cartier et al., 2024). The Brilliance–Belonging Model further clarifies how cultural beliefs about intellectual ability undermine educational equity, particularly for girls, because they do not belong to the environment that fosters/is obsessed with "brilliance" and thus leads to decreased academic performance (Bauer et al., 2025). Similarly, exposure to high-achieving peers has asymmetric ramifications, whereby high-achieving boys adversely affect the academic aspirations of high-achieving girls, while high-achieving girls positively motivate their low-performing counterparts (Busso & Frisancho, 2021). Traditional gender norms exacerbate this issue in the STEM fields. More specifically, girls report lower self-efficacy and lower levels of interest because of the social expectations that girls acquire, which leads to a call for gender-responsive education.

Moreover, culturally, and educationally driven gender differences affect multiple intelligences and academic performances in STEAM education for girls and boys. Studies have shown that female students tend to perform better than male students in many aspects, especially in STEM subjects; however, they are relatively underrepresented in these fields mainly because of socio-cultural perceptions and self-concept problems. For instance, girls in many countries perform equally well in or outperform boys in science; however, in countries that provide quite an equal opportunity for both genders, the participation of girls in STEM falls, indicating an adverse societal pressure that serves to threaten their participation (Stoet & Geary, 2018). Not enough emphasis can be placed here on the fact that although no gender differences exist in average math results, women are consistently underrepresented among the high achievers, showing that these inequities are ultimately wider than for just professional interest (Breda et al., 2018). In addition, there is evidence that teachers frequently underestimate girls' capabilities in mathematics, perpetuating the gender gap in early education (Robinson-Cimpian et al., 2014). Most recently, the variability hypothesis proposes that despite usually showing greater performance variability, the boys somehow do not account for the gender imbalance in STEM fields since there are equal amounts of high achievers in the subjects between the opposite genders (O'Dea et al., 2018). On the whole, the gender dynamics in STEAM education are therefore shaped by the interrelationship between societal norms, self-concept, and educational practices (Niepel et al., 2019).

Computational Framework of Multiple Intelligence (MI)

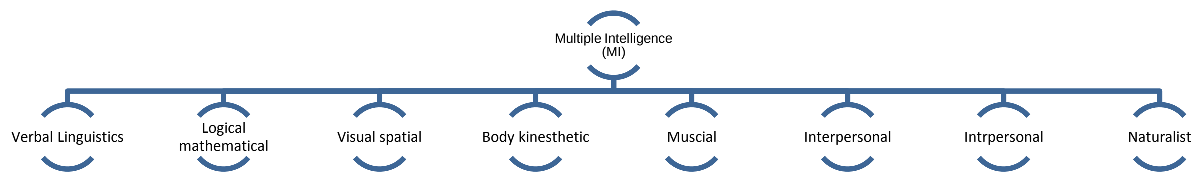

Figure 1.1: Conceptual Framework of Multiple Intelligences

Multiple intelligence (MI) provides conceptual frameworks that play important roles in determining academic achievement in different contexts. Research has established that different dimensions of MI, such as intrapersonal intelligence, naturalistic intelligence, and logical-mathematical intelligence, are positively associated with achievement, capturing substantial variation in academic performance (Nezhad et al., 2016; Vadivukarasi & Gnanadevan, 2022). One of the studies, for instance, revealed that intrapersonal intelligence was the strongest predictor of academic performance, emphasizing its role in self-organized learning skills (Rayyan, 2013).

Moreover, integrating MI with all educational practices enhances engagement and performance, as indicated by studies showing positive prediction by all forms of intelligence to academic achievement in various subjects, including science (Doblon, 2023). It follows then that an additional neuroscience-based argument suggests personalized education that takes advantage of personal strengths could better optimize one's learning outcomes (Shearer, 2018). Thus, utilizing an MI framework in educational settings will allow an even better academic achievement through recognizing and nurturing diverse student capabilities.

Statement of the Problem

The present study is delimited to undergraduate students who are pursuing STEAM (Science, Technology, Engineering, Arts, and Mathematics) disciplines in specific universities of Punjab, Pakistan, with the University of Sargodha of undergraduate students. The study seeks the connection between the students' Multiple Intelligences (MI) profiles and their results in Steam disciplines. The research focuses on a specific discipline and institution that will enable a detailed discussion about the different intelligence dimensions and their impact on students' academic performance at the undergraduate level. The research also aims to provide Pakistan's changing higher education system with an academic outcome where MI plays a major role through its targeted approach of being actionable.

Methodology

The nature of the study was a qualitative survey. The students from the Science and Arts department of undergraduate programs were the sample of study from the University of Sargodha, Pakistan was selected as the population of study. Through convenient sampling techniques, available students of the Science and Arts department were selected for data collection. For data collection, the scale, developed by Thomas Armstrong (1993), consists of 80 items and comprises eight intelligences that were adapted. The 80-item checklist of Multiple Intelligence (MI) of Armstrong (1993) was adapted and made bilingual (English & Urdu) for a clear and better understanding of the students. The instrument was discussed with five experts with Ph.D. qualifications and ample experience in teaching and pilot tested on 100 students of the same population but not included in the actual sample. The Cronbach alpha value for this adapted bilingual research instrument was (0.89), which is acceptable and very good. This permitted the investigation of patterns and associations relevant to the research objectives within a natural educational context. Sargodha University has 8 faculties, but 6 faculties were selected from two faculties. From each selected faculty, two departments were selected, and 50% of bachelor students of each department were randomly selected. However, only 25 undergraduate students from the pharmacy department were selected from the bachelor's program. The total number of students across all faculties is 275. The faculty-wise number of students in the sample is given on the following table.

Table 1 Selection of faculties for sampling in terms of STEAM discipline

Faculty Name	Departments	Steam Discipline	No of Students	Total Std
Faculty Social and Behavioral Sciences	Dept of Criminology Dept of Psychology	Social Science	25 25	50
Faculty of Agriculture	Dept of Food Science and Bio-Tech	Science	25	50
	Dept of Human Nutrition and Dietitian		25	
Faculty of Engineering and Technology	Dept of Computer Science	Tech and Engin	25	50
	Dept of Software Engineering		25	
Faculty of Art and Humanities	Dept of English Literature	Arts	25	50
	Dept of Department of Linguistics		25	
Faculty of Pure Science	Dept of Statistics Dept of Zoology	Pure Science	25 25	50
Faculty of Pharmacy	Single dept.	Science	25	25
Total				275

Table 1 presents the distribution of sampled faculties and departments included in the study according to the STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework. A total of six faculties from the University of Sargodha were selected to ensure representation across diverse academic disciplines. From each faculty, two departments were chosen, except for the Faculty of Pharmacy, which consisted of a single department.

An equal number of students were selected from each department to maintain balance and comparability across disciplines. Specifically, 25 students were taken from each department, resulting in a total of 50 students per faculty, except for Pharmacy, which contributed 25 students. The overall sample size across all faculties was 275 undergraduate students.

Table 2 Reliability of the Multiple Intelligence Checklist

Instrument	Cronbach's Alpha	Decision
Multiple Intelligence (MI) Checklist	0.89	Very Good

Table 3.2 shows the reliability analysis of the instrument measuring Multiple Intelligences (MI). The evaluation of the instrument using Cronbach's Alpha produced a coefficient of (0.89), indicating a high level of internal consistency among its items. This result indicates strong inter-item correlation, thereby affirming the questionnaire's power to measure the underlying construct of MI within. In social science research, a Cronbach's Alpha score greater than (.80) is seen to reflect acceptance; values approaching (.90) are viewed as denoting a highly reliable instrument. Accordingly, the reliability coefficient established in this undertaking substantiates the constructs of stability, dependability, and validity in measuring MI among the target population.

Results

In this section, we discussed the demographic information of the data. Also, show the descriptive statistics of questionnaire items.

Table 3 Gender based comparison of overall intelligence.

Gender	Freq	Mean	SD	T	df	Sig. (p-value)
Male	87	108.28	11.37	-2.149	273	0.033
	188	110.90	8.35			

Table 3 indicated that the significant difference between male and female students' overall intelligence was shown by t-value = -2.149, df = 273, and p-value 0.033 < 0.05. The greater mean score of 110.90 and SD = 8.35 indicated that females had better overall intelligence compared to males, who had a mean score of 108.28 and SD = 11.37.

Table 4 Correlation between intermediate marks and total intelligence

Variables	N	r-value	Sig (P-value)
Total intelligence			
Academic achievement marks	275	.081	.178

According to Table 4, the correlation analysis done between the intermediate marks and the total intelligence indicates a very weak positive correlation (r = 0.081). Nevertheless, this correlation cannot be considered statistically significant since the p-value (0.178) is higher than the usual limit of 0.05). Hence, it can be concluded that there is no significant relationship between the intermediate marks and the total intelligence.

Table 5

Correlation between HSSC Marks of entrant's university student and Multiple Intelligence

Variables	intermediate Marks	verb_linguitics	log Mathematical	Spitial	Bk	Musical	Interpersonal	Intrapersonal	Naturalist
intermediate Marks	1								
verb_ling	.150*	1							
log Mathematical	.012	.170**	1						
Spitial	.013	.202**	.209**	1					
Bk	.047	.284**	.236**	.333**	1				
Musical	-.025	.198**	.111	.166**	.165**	1			

Interpersonal	.105	.211**	.169**	.073	.210**	.140*	1		
Intrapersonal	.043	.218**	.285**	.293**	.228**	-.052	.143*	1	
Naturalist	.029	.177**	.259**	.172**	.268**	.125*	.181**	.253**	1

Correlation is significant at the 0.05 level (2-tailed).

*****Correlation is significant at the 0.01 level (2-tailed).***

According to the table 5 there are several significant correlations between HSSC scores, and different types of intelligence presented in Table 4.3. HSSC scores correlated positively and significantly with verbal linguistic intelligence (r = 0.150). All other intelligence types, including logical-mathematical (r = 0.12), visual spatial (r = 0.13), body kinesthetic (r= 0.47), musical (r = -.025), interpersonal (r = .105), intrapersonal (r = .043), and naturalist (r = .029), showed no significant correlation with HSSC scores. Verbal linguistic intelligence correlated significantly with logical-mathematical (r = 0.170), spatial (r = 0.202), body kinesthetic (r = 0.284), musical (r = 0.198), interpersonal (r = 0.211), intrapersonal (r = 0.218), and naturalist intelligence (r = 0.177).

Similarly, (r =0.012) showed that there is no significant relationship of logical-mathematical with HCCS marks, whereas significant correlations were found with spatial (r = 0.209), body kinesthetic (r = 0.236), intrapersonal (r = 0.285), and naturalist intelligence (r = 0.259). Therefore, Visual Spatial (r =0.013) showed that there was no significant relationship with HCCS marks, but Logical mathematics has a significant relationship with body kinesthetic (r = 0.333), musical (r = 0.166), interpersonal (r = 0.73), intrapersonal (r = 0.293), and naturalist intelligence (0.172).

Musical intelligence (r = 0.025) did not indicate any significant correlation with HCCS marks and intrapersonal (r = -0.52) but rather a notable relationship with interpersonal (r = 0.140) and naturalist intelligence (r = 0.125). Additionally, Interpersonal intelligence went on to have a significant correlation with intrapersonal (r =0.143) and naturalist intelligence (r =0.181) but no significant correlation with HCCS marks. Hence, intrapersonal intelligence (r =0.0.43) showed no HCCS marks as significant, while the correlation with naturalist intelligence (r =0.253) was significant.

Overall, the results showed that while HSSC marks are weakly associated with verbal linguistic intelligence, they do not significantly relate to other intelligence types, and strong interrelationships exist among various multiple intelligence types, indicating that strengths in one area of intelligence may often agree with strengths in others.

Table 6

Anova between Total intelligence and HSSC agencies (Sargodha, Faisalabad & others).

Source of Variation	Sum of Squares	df	Mean Square	F	P-Value
Between Groups	67.263	2	33.632	.373	.689
Within Groups	24526.977	272	90.173		
Total	24594.240	274			

Table 6, there was an absence of any significant variation in total intelligence scores among the groups, F (2, 272) = 0.373, p = .689. The sum of squares between the groups was 67.263, whereas the sum of squares within the groups was 24526.977. The small F-value and high p-value indicate that the effect size is small, and this suggests the differences in total intelligence scores among the groups are not significant.

Table 7

ANOVA between HSSC students' academic marks and total intelligence.

Source of Variation	Sum of Squares	df	Mean Square	F	P-Value
Between Groups	335.491	4	83.873	.934	.445
Within Groups	24258.749	270	89.847		
Total	24594.240	274			

Table 7, it is evident that the total intelligence scores of the HSSC academic grade groups did not differ significantly, F (4, 270) = 0.934, p = .445. The between-groups sum of squares was 335.491, while the within-groups sum of squares was 24258.749. The small F-value and the high p-value mean that the total intelligence scores of HSSC students' academic grade groups are not significantly different and that it is likely that they are due to random variation rather than the effect of the academic grade.

Discussion and Conclusion

The relationship between multiple intelligences and academic achievement was the focus of study among the undergraduate students in different Steam disciplines. A Cronbach's Alpha value of 0.89 was determined through the reliability analysis of the Multiple Intelligence Checklist, which verified that the instrument was very reliable and consistent for drawing different domains of intelligence among the respondents. The internal consistency of the instrument used in the study was thus very strong. Male and female students were compared on the basis of their gender, and a significant difference was found in the case of overall intelligence, where females scored higher on average than males. This may indicate that female students in this sample may be better than male students across different intelligence domains. The same phenomenon has been noted in previous studies in which females are reported to have greater verbal and interpersonal abilities, thus contributing to their higher overall intelligence scores.

The correlation analysis between intermediate marks (academic achievement) and total intelligence revealed a very weak and statistically insignificant positive correlation. This indicates that academic marks do not necessarily reflect or predict the entire spectrum of multiple intelligences that a student can have. It strengthens the argument that intelligence is a complex construct and that academic performance is the only limited dimension of it. The further correlation analysis of HSSC marks and individual intelligence types only revealed a weak but significant positive correlation between verbal-linguistic intelligence and HSSC marks. Thus, it can be inferred that the students, who are at the secondary level and are good in academics, are likely to have better verbal skills, possibly because of the language-based nature of most educational assessments. The other types of intelligence, like logical-mathematical, spatial, musical, and bodily-kinesthetic, did not have any significant correlation with HSSC marks. On the contrary, the strong intercorrelations among the different kinds of intelligence imply that different intelligences are often developed together, and they are not completely separate. For example, verbal-linguistic intelligence had positive connections with several other types of intelligence, indicating that learners may have overlapping cognitive strengths across the various domains.

The ANOVA results showed that there were no significant differences in total intelligence scores among students from different educational boards (Sargodha, Faisalabad, and others) or by academic grades. It can be inferred from these results that the intelligence of children is more or less the same regardless of their being from different backgrounds or having different achievement levels. This also reinforces the idea that intelligence is spread out in the population and is not influenced by the particular educational environment or grades.

Overall, these findings imply that multiple intelligence expresses different human capabilities that are not necessarily reflected in traditional academic performance. The educational systems that place high reliance on test-based evaluation may not be able to identify other forms of intelligence like those mentioned earlier (spatial, musical, bodily-kinesthetic, or interpersonal).

Recommendations

1. Future researchers are advised to use advanced statistical methods like regression analysis or structural equation modeling (SEM) to investigate whether the different types of multiple intelligences have the same predictive power and causal relationship with academic achievement in STEAM disciplines. It would take a deeper insight into how the different intelligences are connected with each other and demographics like gender, locality, and discipline in terms of students' academic outcomes.
2. It is recommended that subsequent inquiries should not only take Punjab as their area of focus but also bring in participants from other areas and different grades. Such inter-provincial, inter-institutional, and inter-academic-level research would open the door to better comprehension of the impact of the occasionality and institutionality character of Pakistan on the situations where learners developed and manifested their multiple intelligences.
3. It is recommended that scholars should produce and carry out intervention-based or longitudinal studies to assess the effectiveness of multiple intelligence-led teaching methods in STEAM education. The results of such experimental studies would inform whether the application of MI-oriented methodologies in teaching and learning leads to a rise in students' creativity, critical thinking, and general academic success, thus giving implications for curriculum revision and teacher training in practice.

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