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RESEARCH PAPER

Investigating the Effect of Transversal Competencies on Undergraduate Science Students' Intended Learning Efforts

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ABSTRACT

Over the past decade, substantial research has focused on students' transferable skills, often termed transversal competencies, encompassing critical thinking, innovation, global citizenship, and interpersonal abilities. Recent studies on lifelong learning highlight the importance of these competencies in fostering holistic development. Aligned with this, the objectives of this study were to investigate the relationship between students' perceived transversal competencies and their influence on intended learning efforts and motivation. A quantitative correlational research design was employed, using a five-point Likert scale questionnaire with 56 items adapted from existing studies. Data were collected from 615 science students from different universities in Lahore through a multistage non-probability sampling technique. Analyses, including descriptive statistics, t-tests, and correlation and regression analyses, reveal that students perceive themselves to possess a high level of transversal competencies (M=3.7), for instance, critical thinking, innovation, global citizenship, and interpersonal abilities are particularly valued. Furthermore, competencies such as lifelong learning and interpersonal skills are strongly associated with enhanced learning efforts. The findings suggest incorporating experiential learning techniques, such as internships, group projects, and volunteer work into curricula to foster the development of these competencies among students.

KEYWORDS 21st Century Skills, Intended Learning Efforts, Transversal Competencies

Introduction

Transversal competencies referred to the set of skills that are transferable between jobs such as knowledge, attitudes, critical thinking, and future skills (Care & Luo, 2016). To increase an individual's long-term employability and boost organizational productivity, these competencies are crucial as they shape a person's capacity to apply information in various situations and solve problems. Ashworth (2023) argues that these competencies are not just certain abilities and knowledge. These include mobilizing and utilizing certain psychosocial resources comprising attitudes and skills to fulfil some indicate needs in any given context. Providing detailed farmwork on creativity and education, the Durham Commission (2019) states that practical skills, akin to transversal competencies, are transferable to other industries and help graduates adjust to complex and dynamic environments in both formal and informal settings.

UNESCO's reports on transversal competencies provides seven different categories of transversal competencies, including critical and inventive thinking skills (C&ITS),

interpersonal skills (Inter-P S), interpersonal skills (intra-PS), global citizenship skills (GCS), media and information literacy skills (MILS), digital literacy skills (DLS), and lifelong learning skills (LLS) (e.g., lifelong learning), which may be tailored to national or local needs (Care & Luo, 2016, p. IV). Many education systems incorporate transversal competencies into their curricula, with various nations defining these competencies according to their educational policies. UNESCO underlines the importance of these skills in enabling children, adolescents, and adults to secure good employment and engage in a society that supports sustainable development and global citizenship (UNESCO et al., 2017). The effective and critical use of information, communication, and technology has been emphasized in 21st-century skills, as students who lack these talents are less likely to succeed in the future.

Today's educational institutions must teach students the skills necessary to fulfill their obligations in life in a variety of circumstances. These skills include critical thinking, problem-solving, communication, successful group work, self-awareness, creativity, and lifelong learning.

Chalkiadaki (2018) discusses that it has become an integral part of regular education for students to learn necessary skills to perform everyday tasks. Particularly, they need to acquire interdisciplinary and transferable skills. These competencies enable them to apply their knowledge across a wide range of jobs and in various aspects of their overall life. Alfitriyani et al.'s (2022) findings, however, indicate that most students' critical and creative thinking abilities are still lacking globally, which is why educational institutions are building curricula that give graduates a certain professional profile. People have to balance knowledge, abilities, attitudes, and values in their daily lives (Chalkiadaki, 2018). In the contemporary era, students in higher education can enhance their ability to meet real-world expectations by acquiring a diverse set of skills, including critical and creative thinking, effective communication and cooperation, interpersonal and self-management abilities, media and information literacy, digital competency, teamwork, and ongoing learning (Economou, 2021).

It has been noted, meanwhile, that undergraduate science students prioritize cognitive over non-cognitive skills, which limits their potential to become lifelong learners. Both Dewey and Vygotsky (as cited in Klimkowski, 2019) stress the value of social interactions in helping students expand their knowledge by putting an emphasis on collaborative learning, active engagement, and learning from real-world experiences. Therefore, it is critical to assess the perceived role of transversal competencies in undergraduate students' lives and how these competencies may influence their efforts to perform academic tasks and achieve success.

Literature Review

Transversal Competencies

Transversal competencies are crucial skills that enable learners to apply their knowledge and abilities in a variety of contexts or settings, allowing them to gain new information, skills, values, and attitudes (Halinen, 2018). The United Nations' Sustainable Development Goal for Quality Education (SDG 4) considers access to high-quality education and lifelong learning as essential for transmitting knowledge and achieving sustainable development (see Saini et al., 2022). Sá and Serpa (2018) argue that although transversal competencies are already informally integrated into some teaching practices, it is critical to target and reinforce them in educational practices to help learners better adapt

to changing workplaces and develop essential skills such as responsibility, initiative, autonomy, adaptability, and competence transfer.

McGivney and Winthrop (2016) draw attention to the competencies people need in order to meet the intricate demands of modern society. These competencies stand for the knowledge, skills, values, and attitudes that students will need to improve themselves and society as a whole. Transversal talents are important due to their applicability to various situations. Sá and Serpa (2018) emphasize the importance of focusing on transversal competencies, which should be incorporated into training programs at higher education institutions. Additionally, it is essential to ensure that college graduates are well-prepared with updated organizational efficiency and professional skills. Care and Luo (2016) identified five transversal skills: critical thinking, intrapersonal, interpersonal, media and information literacy skills, and global citizenship.

i) Critical and innovative thinking skills: Creativity and innovation are the talents needed to develop fresh and useful ideas through thinking, cooperation, and bringing innovations to life (Ausat et al., 2022). These abilities include creating, refining, assessing, and analyzing ideas; being open to new ideas; and having a constructive attitude toward failure. Azizi et al. (2022) found that critical thinking education improves students' problem-solving skills, self-esteem, and classroom happiness. UNESCO (United Nations Educational, Scientific and Cultural Organization), CUE (Center for Universal Education), and GEFI-YAG (Global Education First Initiative Youth Advocacy Group) encourage the use of information and communication technology (ICT) for problem-solving and creative thinking. Critical thinking entails thinking deeply from several angles to generate successful answers in science (UNESCO et al., 2017).

ii) Interpersonal skills: These include effective presentation, organization, and teamwork, all requiring strong communication skills. Time management, resource allocation, and deadline compliance are all examples of organizational abilities. Teamwork involves group work to achieve common goals, necessitating compromise, agenda adherence, and consensus building (Khasanzyanova, 2017, p. 363). Collaboration entails working with diverse teams while remaining flexible and adaptable. Effective communication, flexibility, accountability, and individual contributions are all essential for successful collaboration. Othman and Ruslan (2020) argue that effective interpersonal skills are vital for fostering a positive, effective team environment. To successfully execute newly acquired abilities, learners must practice them.

iii) Intrapersonal skills: Intrapersonal abilities, such as self-discipline, enthusiasm, persistence, and self-motivation, are critical for managing a workload, creating objectives, and attaining success (UNESCO et al., 2017). Individuals with these talents can learn on their own, prioritize work, and adjust to changing environments. Flexibility and adaptability are essential for adjusting to varied occupations and situations. Self-awareness is necessary for comprehending one's own emotional and motivational states. According to Wicaksana et al. (2020), intrapersonal skills are competencies that may be acquired through formal education and practice rather than being innate personality traits.

iv) Global citizenship skills: Global civic education focuses on diversity, intercultural understanding, democratic participation, conflict resolution, and environmental stewardship (UNESCO et al., 2017). It necessitates cultural awareness, collaboration with people from various backgrounds, and political engagement. Information and communication technologies may promote global involvement by enabling regular updates to educational procedures and activities. Sustainability and global citizenship are best taught through programs that incorporate Global Citizenship

Education (GCED), a transformative, lifelong endeavor that blends classroom instruction with real-world application to foster a perspective for protecting people and the environment, and Education for Sustainable Development (ESD), which is essential for a sustainable society, necessitating formal and informal education at all levels to maintain and improve our quality of life and that of future generations (Gadotti, 2008). Teachers play an important role in infusing these ideas into their courses because they foster community and prepare students for future problems. Teachers who receive training on inclusive and emerging trends are better prepared for future issues, and students learn qualities such as peace, tolerance, and cultural respect (Durrani, Malik, & Jumani, 2019).

v) Media and information literacy skills: Media and information literacy abilities include the capacity to identify, access, and assess information, as well as to critically evaluate media content (UNESCO et al., 2017). The ability to acquire knowledge and information using information and communication technologies (ICTs) includes finding, discovering, and accessing relevant sources, assessing material, and forming conclusions. Critical assessment involves evaluating the quality and relevance of information and media resources. Information and communication technologies in science should promote active, engaged, and meaningful learning. ICT-based instructional materials enhance students' competencies and make their learning easier by promoting active engagement, monitoring progress, and enabling communication (Arimbawa & Widhiyani, 2021; Ugwu & Nnaekwe, 2019; Syahgiah & Asrizal, 2023). Technologies should facilitate peer communication, assessment, and exchange to promote cooperation and improve presentation and self-representation abilities. Information literacy, according to UNESCO (2018), is the combination of abilities, attitudes, and knowledge needed to identify information needs, express those needs in language that can be found online, search effectively, retrieve information, interpret it, comprehend it, organize it, judge its authenticity and credibility, determine its relevance, and share it with others as needed.

vi) Digital literacy skills: Digital literacy is a critical skill for enabling digital citizenship, and it has become an essential component of teaching and learning in a variety of educational fields. It entails using technology to complete tasks, resolve problems, and communicate. Digital literacy is used differently by employees and lifelong learners (Morales-Franco, 2021). There are variances and similarities in the literacy development of young people and adults, and these distinctions are used in their formal and non-formal situations (Cetindamar Kozanoglu & Abedin, 2021). According to Esteve-Mon et al. (2020), digital teacher competences are a collection of abilities needed by educators to support student learning in a society that is increasingly technologically advanced, create and modify classroom practices, and enhance professional development. In order to create talent management programs that concentrate on particular digital skills required in the workplace, digital literacy is also used in workplace education (Morales-Franco, 2021).

vii) Lifelong learning skills: Lifelong learning skills are critical for scholastic progress and achievement, and many nations emphasize their development throughout life (Syahgiah & Asrizal, 2023). However, the lifelong learning capabilities of various programs or industries may differ. Lifelong education should aim to reduce societal conflicts and maximize the interplay between tradition and innovation (Voitovska et al., 2018).

Importance of Developing Transversal Competencies for Undergraduate Students

The accreditation of study programs and future employment at higher education institutions (HEIs) all depend on transversal competencies. Tsankov (2017) argues that HEIs must reevaluate their educational goals, attend to students' needs, employ adaptive

teaching techniques, establish a dynamic learning environment, meet new monitoring and evaluation thresholds, and shift from results-oriented to competence-oriented teaching.

Students with transversal competencies are more capable of critical thinking, creativity, and flexibility, which will benefit them in both academic and professional endeavors. To achieve these aims, higher education should follow the constructivist paradigm, which emphasizes integrative and transdisciplinary knowledge, student autonomy, and active learning. To help students develop transversal talents, the curriculum, learning environment, and instructor profile must all be reviewed (Crasovan, 2016).

Material and Methods

This study was quantitative in nature and employed a causal-comparative research approach. An ex-post facto study design was utilized, along with a survey approach, to collect students' opinions on transversal competencies and intended learning efforts at the university level. A multistage sampling strategy was employed. Initially, four universities based in Lahore (two public and two private) were chosen using a convenience sampling approach. In the second phase, a purposive sampling approach was utilized to select the departments' disciplines, i.e., mathematics, physics, chemistry, zoology, and botany, for data collection. Finally, a sample of 615 male and female students was conveniently selected from these universities.

The transversal competencies among students questionnaire, which has 33 items and five factors, served as the primary model for the modified questionnaire that the researchers used. Second, a 13-item portion of the lifelong learning skills was taken from Kirby et al. (2010). Thirdly, the researchers also modified a 10-item factor measuring digital literacy skills from Vodă et al. (2022).

Finally, a construct of intended learning efforts was adapted based on Dörnyei and Németh (2006) and Islam et al. (2013), consisting of eight items, and used as a criterion measure in this study. The questionnaire used five-point Likert scales (ranging from strongly disagree = 1 to strongly agree = 5).

Pilot testing was conducted to ensure that the scale was valid and internally consistent. Expert opinions were obtained to establish validity, and confirmatory factor analysis was performed. Cronbach's alpha value was calculated to determine the questionnaire's reliability.

Table 1
Internal consistency of instrument using Cronbach's Alpha

Sr.no	Instruments	No. of items	Cronbach's alpha
1.	Critical and Innovative Thinking Skills	7	.84
2.	Interpersonal Skills	7	.82
3.	Intrapersonal Skills	6	.81
4.	Global Citizenship Skills	7	.82
5.	Media and Information Literacy Skills	6	.83
6.	Digital Literacy Skills	10	.88
7.	Lifelong Learning Skills	13	.90
8.	Intended Learning Efforts	8	.96

The questionnaire included 56 items about transversal competencies and eight items about intended learning efforts.

Confirmatory Factor Analysis of TVCs and ILE

A modified scale was piloted with data from 100 participants using confirmatory factor analysis, ensuring that reliability and variance were greater than 0.5 and 0.7, respectively.

Table 2
Factor Loading and Convergent Validity of Factors

Construct	Items	AVE Score	CR Value
Critical and Innovative Thinking Skills	7	.77	.994
Interpersonal Skills	7	.781	.991
Intrapersonal Skills	6	.786	.994
Global Citizenship Skills	7	.812	.995
Media and Information Literacy Skills	6	.806	.993
Digital Literacy Skills	10	.847	.997
Lifelong Learning Skills	13	.819	.998
Intended Learning Efforts	8	.796	.995

Table 2 shows factor loading and convergent values of eight factors, with no items removed due to low loading values. Composite reliability of these factors exceeded the 0.70 threshold, and overall fit indices and quality were found to be adequate.

Results and Discussion

Data were collected individually, with the informed approval of each department head from all universities. The questionnaires were distributed to students after receiving their and their professors' permission. Following data collection, the information was entered into SPSS for analysis. The data had been cleaned before final analysis. Descriptive statistics report mean values, and standard deviations. In inferential statistics, an independent sample t-test was used to compare male and female students, as well as the sample from public and private institutions.

Table 3
Descriptive Statistics of the Transversal Competencies and Intended Learning Efforts

Sr.no	Names of the scale	Mean	Std. Deviation
1	Critical and Innovative Thinking Skill	3.82	0.67
2	Global Citizenship Skill	3.79	0.74
3	Intrapersonal Skill	3.78	0.76
4	Life-long learning Skill	3.75	0.72
5	Interpersonal Skill	3.75	0.74
6	Digital Literacy Skill	3.68	0.77
7	Media and Information Literacy Skills	3.62	0.79
8	Intended Learning Efforts	3.84	0.71

At the undergraduate level, critical and innovative thinking skills are the most valued attribute, as evidenced by their highest mean scores (M =3.82, S.D. = 0.67). Conversely, the lowest mean score was found for "media and information literacy skills" (M = 3.62, S.D. = 0.79). The undergraduate students' intended learning efforts have the highest mean scores (M=3.84, S.D=0.71), indicating that they were very willing to put effort into their education.

Correlation Analysis

According to the statistical findings, the intended learning efforts are positively correlated in a moderate way with the following: media and information literacy skills (M&ILS) (r = 0.522, sig = 0.00), digital literacy skills (DLS) (r = 0.576, sig = 0.00), lifelong learning skills (LLS) (r = 0.74), interpersonal skills (Intra-PS) (r = 0.576, sig = 0.00), global

citizenship skills (GCS) (r = 0.571, sig = 0.00), and critical and innovative thinking skills (C&ITS) (r = 0.433, sig = 0.00).

Table 4
Pearson Correlation between Transversal Competencies and Intended Learning Efforts

Variables	C&ITS	Inter-PS	Intra-PS	GCS	MILS	DLS	LLLS	ILE
C&ITS	1							
Inter-PS	0.58**	1						
Intra-PS	0.544**	0.67**	1					
GCS	0.487**	0.637**	0.737**	1				
MILS	0.427**	0.564**	0.591**	0.672**	1			
DLS	0.436**	0.597**	0.633**	0.633**	0.744**	1		
LLS	0.496**	0.645**	0.699**	0.679**	0.641**	0.740**	1	
ILE	0.433**	0.576**	0.625**	0.571**	0.522**	0.575*	0.736*	1

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

Furthermore, there is a significant positive association between intended learning efforts and lifelong learning (r = 0.736, sig = 0.00).

Regression Analysis

The findings of regression analysis show that only three out of the seven scales significantly predicted the sample's reported intended learning efforts.

Table 5
Effect of the Intended learning and Transversal Competencies

	Unstandardized Co-efficient		Standardized Co-efficient		
Variable	**B**	**Std. Error (B)**	**β**	**t**	**P**
1. Lifelong Learning skill	0.330	0.028	0.54*	11.9	0.000
2. Intrapersonal Skill	0.192	0.056	0.15*	3.40	0.001
3. Interpersonal Skill	0.104	0.044	0.09*	2.34	0.019

R^2= .572, F=115.96

The influence of these three scales was statistically significant ($p < 0.05$). The results indicated that the effects of intrapersonal skills, interpersonal skills, and lifelong learning were $\beta = 0.096$ ($p < 0.05$), $\beta = 0.155$ ($p < 0.05$), and $\beta = 0.54$ ($p < 0.05$), respectively. The greatest difference in intended learning efforts was contributed by skills related to lifelong learning, which accounted for 54% of the difference. Interpersonal skills and intrapersonal skills contributed 15.4% and 9.6%, respectively, to intended learning efforts.

Gender-Based Difference in Intended Learning Efforts and Transversal Competencies

An independent sample t-test was used to examine the differences between male and female students' intended learning efforts and transversal skills. The following table presents the findings as reported:

Table 6
Gender-based Difference in the Intended Learning Efforts and Transversal Competencies

Variables	Gender	N	Mean	SD	t-value	df	Sig.	Cohen's d
Critical and Innovative	Male	232	3.77	0.77	-1.31	612	0.00	0.10
Thinking Skill	Female	382	3.85	0.61				
Interpersonal Skill	Male	232	3.79	0.76	1.04	612	0.43	…..
	Female	382	3.73	0.73				
Intrapersonal Skill	Male	232	3.81	0.73	0.72	612	0.46	…..
	Female	382	3.77	0.78				
Global citizenship	Male	232	3.84	0.75	1.47	612	0.50	…..

	Female	382	3.75	0.73				
Media and information	Male	232	3.71	0.75	2.22	612	0.16	……
literacy skill	Female	382	3.57	0.80				
Digital literacy skill	Male	232	3.77	0.73	2.31	612	0.16	…….
	Female	382	3.62	0.78				
Lifelong learning skill	Male	232	3.77	0.74	0.49	612	0.41	…..
	Female	382	3.74	0.71				
Intended Learning	Male	232	3.83	0.68	0.045	612	0.61	…..
Efforts	Female	382	3.85	0.73				

The results of critical and innovative thinking demonstrated a notable disparity. In this case, it appears that female students had marginally better critical and innovative thinking abilities. On the other hand, no discernible gender difference was discovered in the remaining skills. In a similar vein, there was no noticeable difference between male and female undergraduate students' intended learning efforts. It suggests that male and female students behave similarly when it comes to their attempts to work on these skills.

Public and Private University-Based Differences in the Transversal Competencies and Intended Learning Efforts

Table 7 presents the results of the independent sample t-test conducted to compare public and private university students. This test provides statistical details on intended learning efforts and transversal competencies, offering insights into which group possesses more of these skills.

Table 7
Public and Private University-Based Differences in the Transversal Competencies and Intended Learning Efforts

Variables	Universities	N	Mean	SD	t-value	df	Sig.	Cohen's d
Critical and Innovative	Public	370	3.76	0.72	-2.49	613	0.01	0.21
Thinking Skill	Private	245	3.90	0.58				
Interpersonal	Public	370	3.75	0.76	-0.25	613	0.81	….
Skill	Private	245	3.76	0.72				
Intrapersonal	Public	370	3.74	0.81	-1.80	613	0.007	….
Skill	Private	245	3.85	0.67				
Global	Public	370	3.75	0.77	-1.44	613	0.22	….
Citizenship	Private	245	3.84	0.69				
Media and Information	Public	370	3.61	0.81	-0.63	613	0.107	….
Literacy Skill	Private	245	3.65	0.74				
Digital literacy	Public	370	3.66	0.80	-0.59	613	0.18	….
Skill	Private	245	3.70	0.71				
Lifelong	Public	370	3.70	0.77	-2.01	613	0.01	0.17
Learning skill	Private	245	3.82	0.62				
Intended Learning	Public	370	3.74	0.74	-3.84	613	0.019	0.32
Efforts	Private	245	3.96	0.63				

There was a significant difference in the results of critical and innovative thinking and lifelong learning skills. However, the effect sizes of these differences were small. There was also a significant difference between students who put in their efforts and invest their time to learn transversal skills at public and private universities. The students from private sector universities appeared to be more willing to invest their efforts and time in their academic tasks. There was no significant difference in other transversal skills on the basis of public and private universities.

Discussion

The study has shown that undergraduate science students in a Pakistani context are robust in innovative and critical thinking abilities, which remain greatly valued everywhere as they are important skills in the domain of academic or professional practices. Despite some contextual limitations such as underdeveloped infrastructure, limited global relevance, and an outdated educational system, the study's findings support the idea that students with an interest in skills like critical thinking and technology are more motivated to learn and put more effort into improving their educational skills than those with lower levels of transversal competencies.

These skills provide the individual with the ability to gather independent views regarding the availability of information, give arguments, and come up with suitable judgments. This finding aligns with UNESCO's (2018) report, which revealed that students with innovative thinking were more able to generate new ideas, think outside the box, and advance creative solutions to problems. In contrast to the study by Yudha et al. (2018), which claimed that 21st-century students had low critical and innovative thinking skills, this study finds that Pakistani undergraduate science students have high critical thinking abilities. This is because students are often encouraged to ask questions, engage in classroom discussion, and enjoy more freedom inside and outside the classroom compared to some other contexts. Another factor might be the gap in competence between students with arts backgrounds and those with science backgrounds. In the Pakistani context, students with stronger academic abilities often pursue science subjects during their matriculation and intermediate studies. Consequently, it is evident that these students may have a greater interest in and knowledge of transversal competencies. This is also endorsed in Akram's (2011) study, which found that science students not only outperform arts students in study habits but are also more intelligent. Although this study does not directly compare the transversal skills of art and science students, the difference in their backgrounds can be an influential factor.

However, on media and information literacy skills, participants indicated relatively lower mean values. These results are similar to those of Ozor and Toner (2022), who suggested that students probably would not have had adequate opportunities to acquire such skills in earlier education. Often, students from developing contexts struggle to use information and communication technology safely and effectively or use these tools critically to consume information and media content. For instance, Mahwasane (2017) reported that postgraduate students at the University of Ghana have low levels of information literacy competence due to a lack of systematic information literacy education.

Higher mean scores on global citizenship skills by the participants rationalize with Goren and Yemini's arguments, which stress that global citizenship skills underline cultural awareness, intercultural communication, and social responsibility (Goren & Yemini, 2017). Such skills allow students to be critical thinkers about global issues and thereby interact normally with diverse groups.

The study has also found that these undergraduate science students have very high motivation to put effort into learning, which is similar to the results of Islam et al.'s (2013) study in a similar motivational self-systems context of Pakistani students. In this regard, the transversal competencies, such as intrapersonal skills, lifelong learning skills, and interpersonal skills, showed a moderately positive relation with intended learning efforts. Besides, transversal competencies deepen the understanding and application of know-how towards real life by letting learners set goals, make use of relevant knowledge, work in a

self-directed manner, search for information, and monitor the efficiency of tactics and strategies. These findings are supported by UNESCO (2018).

Additionally, it can be argued that effective lifelong learning skills enhance students' motivation to achieve their learning objectives. For instance, efficient intrapersonal skills in areas of self-awareness, self-management, and self-motivation sustain focused learning efforts and help individuals take control of their learning paths in life so that they may maximize their growth and development potential. It has been a tradition in typical education to concentrate on cognitive skills and stifle critical and creative thinking and other vital skills like global citizenship, media and information literacy, and digital literacy. For teachers who are less well-trained or less well-supported, these skills are very difficult to teach within the context of traditional courses. Therefore, the study argues that greater emphasis on strengthening transversal competencies and lifelong learning skills may result in increased learning outcomes and personal development for students.

The study also shows that students from private institutions performed slightly higher in innovative and critical thinking skills and lifelong learning skills than students from public universities. These findings align with the ongoing debate on the limited resources and more traditional context of public sector institutions compared with the private sector. Traditional public institutions generally lack the capabilities to empower transdisciplinary skills among most students, but private universities, on the other hand, provide supplementary resources and opportunities for research and also facilitate flexible study models that enhance lifelong learning skills among their graduating students. Traditional institutions are also characterized by the inability to offer students employment skills diversification, but interactive lessons can enhance their social and cognitive talents, hence preparing them for diverse professional contexts.

Conclusion

The study aimed to investigate how transversal skills impact the intended learning goals of science undergraduates. The results indicate that students most commonly exhibit competencies such as innovative and critical thinking, global citizenship, intrapersonal, lifelong learning, and interpersonal skills, while media and information literacy skills are less prevalent. Students expressed a strong willingness to acquire these skills, demonstrating their understanding of their importance for future success. Among these competencies, lifelong learning, intrapersonal skills, and interpersonal skills were found to have the most significant positive effect on students' intended learning efforts. The findings underscore the relevance of constructivist educational approaches and the role of transversal competencies in shaping students' motivation and learning efforts. These results further highlight the contributions of social constructivism, social cognitive theory, and self-efficacy theory in promoting knowledge creation and motivating students in the learning process.

Recommendations

Based on the findings, a shift from traditional teacher-centered approaches to more student-centered pedagogies in Pakistani science classrooms is recommended. Teachers should incorporate collaborative group work, enhance presentation skills, and promote self-discipline to foster transversal skills. To further support this pedagogical shift, institutions could provide specialized coaching focused on students' personality development, equipping them with essential personal and social skills. Additionally, experiential learning activities such as group projects, volunteer work, and internships

should be integrated into the curriculum to encourage the development of transversal skills. Interdisciplinary courses can also broaden students' awareness of academic and professional learning areas. Moreover, seminars and workshops aimed at enhancing media and information literacy skills, particularly in areas like information evaluation and bias detection, should be organized. Teachers are also encouraged to adapt their pedagogical approaches to better support students' personal development and meet the professional demands of the 21st century.

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