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Seamless Learning to Enhancing Resilience and Professional Ethics in Higher Education Students

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Abstract

This research explores the impact of seamless learning on resilience and professional ethics among polytechnic students by integrating the Transdisciplinary Learning Approach with the Aptitude Treatment Interaction (ATI) Model. The study employs a quasi-experimental design with a sample of 100 students, utilizing SMART Poltekad. This seamless learning platform facilitates experiences through its interactive features. Seamless learning, characterized by continuous, cross-context learning experiences, supports a cohesive and adaptive learning environment that fosters holistic student development. Using Two-Way MANOVA analysis, findings reveal significant improvements in academic achievement ($\varrho = 0.000$, $\varrho < 0.05$), resilience ($\varrho = 0.000$, $\varrho < 0.05$), and professional ethics ($\varrho = 0.000$, $\varrho < 0.05$) in students exposed to the ATI and Transdisciplinary models compared to a control group. Learning motivation, however, did not demonstrate a statistically significant difference ($\varrho = 0.052$, $\varrho > 0.05$), suggesting context-dependent factors may influence motivation within the seamless learning framework. These findings underscore the potential of seamless learning, particularly when paired with seamless learning tools, to enhance resilience and professional ethics in polytechnic education. Future research could further explore the applicability of seamless learning models in diverse educational settings and examine long-term impacts on students' professional and ethical development.

Keywords: *Academic Achievement; Aptitude Treatment Interaction; Seamless Learning; Professional Ethics; Transdisciplinary Learning Design.*

Introduction

The 21st century has ushered in significant shifts in educational paradigms due to rapid technological advancements, increasing societal complexity, and global interconnectedness. Higher education institutions are tasked with equipping students with domain-specific knowledge, interdisciplinary skills, and adaptable thinking to address complex real-world problems (Dagarova et al., 2023) The adoption of interdisciplinary approaches has expanded into transdisciplinary learning, which combines knowledge across multiple fields to foster holistic problem-solving. The educational paradigm needs to adapt to these changes (Jordi et al., 2022). This approach is essential for developing solutions that transcend traditional academic boundaries, offering students a more comprehensive understanding of interconnected global challenges.

The global economic crisis has created a need for new educational techniques due to the increasing societal complexity, environmental conflicts, and uncertainties. The transdisciplinary approach emphasizes collaborative, multi-perspective learning that draws on various academic fields to tackle practical, real-world problems (Nicolescu, 2018). Transdisciplinary learning is the process of combining several academic fields to tackle intricate challenges, which reflects the interconnectedness of contemporary knowledge and society. In this model, students are encouraged to work across disciplines to build a cohesive understanding of issues like environmental sustainability, technological ethics, and social equity.

However, implementing this approach effectively requires institutional support, collaboration, and the flexibility to integrate diverse perspectives (Fam et al., 2018). This strategy promotes interdisciplinary collaboration, facilitating a holistic comprehension that surpasses conventional disciplinary limits. Transdisciplinary learning seeks to generate novel solutions to modern problems by integrating knowledge

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from different fields. The Aptitude Treatment Interaction (ATI) model complements transdisciplinary learning by tailoring educational methods to align with individual student aptitudes. The ATI model asserts that effective learning occurs when teaching strategies are customized to meet students' specific cognitive abilities, making the learning process more personalized (Brandt et al., 2013). Together, the transdisciplinary and ATI models offer a promising framework for higher education, providing students with both broad knowledge and individualized instruction. A comprehensive perspective is crucial for tackling the complex difficulties of globalization, technological progress, and societal change.

Seamless learning, supported by platforms such as SMART Poltekad, further enhances this educational experience by combining online and in-person learning environments. This blended model enables flexible, accessible learning that can accommodate students' diverse schedules, learning styles, and progress rates (Mashau, 2023). SMART Poltekad, in particular, integrates interactive modules and personalized resources that support the transdisciplinary and ATI methods, making it suitable for this study.

Learning is a distinctive and intricate process, where each person has unique cognitive, emotional, and physical capacities. Teachers have a crucial role in establishing ideal learning environments, which have a major influence on student results (Granena & Yilmaz, 2018). Traditional educational approaches frequently struggle to suit each student's unique needs and characteristics, resulting in disinterest and diminished drive. Teaching practices that align with students' aptitudes should be used to optimize learning results. With the evolution of educational environments, there is a growing focus on adaptable learning processes that accommodate students' varied demands (Loughland, 2019).

The transdisciplinary approach to education is defined by its collaborative and multi-perspective nature (Ciesielski et al., 2017). Its main goal is to integrate different scientific fields to tackle complicated, real-world problems (Clarke & Ashhurst, 2018). This approach surpasses conventional educational limitations by incorporating information from other disciplines to offer a comprehensive learning encounter (Gonçalves et al., 2017) Although putting it into practice may be challenging, such as obstacles within institutions and interpersonal relationships, the advantages of a transdisciplinary approach are significant. In higher education, this strategy requires leaders who have a clear vision and can promote collaboration and allow the joint development of knowledge.

The Aptitude Treatment Interaction (ATI) model enhances the transdisciplinary approach by customizing instructional methods to align with the particular aptitudes of learners (Vatz et al., 2013). ATI asserts that the most effective learning takes place when teaching approaches are in harmony with the individual abilities of pupils (Hwu & Sun, 2012a). This concept emphasizes the significance of individualized education, wherein instructional approaches are tailored to accommodate the varied requirements of students (Shute, 2013). ATI prioritizes personalized learning to ensure that every student, irrespective of their initial level, can reach their maximum capabilities (Yeh & Lin, 2015).

Implementing a seamless learning approach can significantly augment the educational experience by utilizing e-learning platforms like SMART Poltekad. Seamless learning is a method that blends in-person teaching with online elements, providing the advantages of adaptability and ease of access (Klimova & Kacetl, 2015). This technique facilitates a highly individualized learning experience, catering to diverse learning styles and rates of progress. E-learning platforms enhance the incorporation of a wide range of instructional resources, creating a more interactive and captivating learning environment (Stockhammer, 2011).

Universities worldwide increasingly use transdisciplinary and ATI methodologies to better equip students for the challenges of current professional careers. These methods are highly efficient, especially in sectors such as Engineering English, where the seamless integration of technical knowledge and language abilities is crucial (AlNajdi, 2014). Through active involvement in practical challenges and interdisciplinary teamwork, students cultivate essential cognitive abilities such as analytical thinking, innovation, and effective resolution of complex issues. Graduates of this comprehensive educational program acquire the necessary skills and knowledge to effectively navigate and make meaningful contributions to a dynamic and evolving society (Raes et al., 2020a).

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Although transdisciplinary and ATI techniques offer evident advantages, various obstacles hinder their effective application. Institutional administrative problems and interpersonal hurdles among teachers, practitioners, or researchers can impede collaboration and involvement. Higher education institutions must tackle these obstacles by employing forward-thinking leadership and implementing supportive policies. Fostering a culture that promotes collaboration and ongoing learning can assist in overcoming these challenges, therefore facilitating the implementation of successful transdisciplinary education.

Incorporating transdisciplinary learning and the ATI paradigm signifies a notable change in educational strategy. This strategy not only improves academic performance but also promotes resilience, professional ethics, and lifelong learning (Raes et al., 2020b). By synchronizing pedagogical approaches with students' aptitudes and harnessing cooperative, interdisciplinary viewpoints, educators can establish more comprehensive and efficient learning settings (Shahzadi & Ahmad, 2011). This paradigm shift is essential for developing flexible and talented workers, which is necessary in today's global economy (Hwu & Sun, 2012b).

Ultimately, the changing requirements of the 21st century require a fundamental shift in teaching methodologies. By combining transdisciplinary techniques with the ATI paradigm and leveraging seamless learning systems such as SMART Poltekad, student outcomes can be greatly improved. Higher education institutions can enhance student preparedness for the contemporary world by promoting a complete, flexible, and tailored learning experience.

This study aims to examine the combined effects of transdisciplinary learning and the ATI model on academic achievement, motivation, resilience, and professional ethics among 7th Batch D4 students at the Official State Polytechnic. By investigating these outcomes, the research seeks to understand how these instructional models can prepare students for complex professional environments and contribute to their overall development.

Method

This study employs an exploratory sequential design, integrating both qualitative and quantitative approaches. The research begins with qualitative methods, including a literature study, interviews, and focus groups, to identify key themes and support the development of quantitative instruments. The subsequent quantitative phase is a quasi-experimental design, comparing the effects of transdisciplinary and ATI-aligned learning (experimental group) with conventional methods (control group) among the 7th batch of D4 students at the Official State Polytechnic, Malang, East Java, Indonesia (Bazeley, 2020).

The study sample consists of 100 students, selected through cluster random sampling, divided into an experimental group using the ATI model with the transdisciplinary approach and a control group using traditional instruction. Learning was delivered using a seamless learning model on the SMART Poltekad platform, which integrates digital resources and allows flexible, interactive learning.

The learning process employed a seamless learning facilitated by the e-learning platform SMART Poltekad. This method combined traditional face-to-face instruction with online learning components, providing flexibility and an interactive learning environment. The seamless learning enabled the integration of diverse educational resources and personalized learning experiences.

Data collection involved both qualitative and quantitative methods. Pretest and post-test scores were collected to measure academic achievement. Questionnaires assessed learning motivation, student resilience, and professional ethics. Classroom observation sheets were used to record interactions and classroom dynamics. Interviews and focus group discussions were conducted to gather deeper insights from students and lecturers regarding the impact of learning design. These qualitative findings were used to support and expand upon the quantitative data.

Data collection included pretests and post-tests to measure academic achievement, as well as validated questionnaires assessing learning motivation, resilience, and professional ethics. Classroom observations

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followed a structured protocol to capture student interactions and engagement and focus group discussions provided insights into students' and lecturers' perceptions of the learning model's effectiveness. These qualitative findings informed and supported quantitative analysis (Creswell & Creswell, 2017).

Data were analyzed using the Two-Way MANOVA technique to determine the effects of the different learning methods on the four outcomes. Statistical significance was set at 0.05. F calculations and F table values were compared to assess overall differences between the experimental and control groups. Significance tests (p-values) were conducted for each outcome variable to identify specific impacts.

Qualitative data from literature studies and interviews provided contextual understanding and supported the quantitative findings. Integrating these data sources strengthened the research conclusions by adding depth and identifying additional influencing factors. Quantitative data were analyzed using Two-Way MANOVA to assess the impact of the learning model on multiple outcomes. The level of statistical significance was set at 0.05, with F calculations and p-values used to determine differences between groups. SPSS software ensured accuracy in data analysis and reliability of results. Qualitative findings from literature, interviews, and focus groups provided contextual insights, strengthening the interpretation of quantitative results (Martin & Bridgmon, 2012).

Result

Data analysis used two-way Manova. The variables used in this study are learning models that integrate ATI and a Transdisciplinary Learning Approach (for experimental class groups) and conventional learning models (for control class groups). Dependent variables are Academic Achievement, Learning Motivation, Student Resilience, and Professional Ethics in D4 Engineering Students at the Polytechnic of the Ministry of Education. The requirements for analyzing research data using Two-Way Manova are the linearity test, normality test, and data homogeneity test.

3.1 Linearity Test

The results of the scatter plot show a linear relationship, as shown by the graph, which has a straight-line trend.

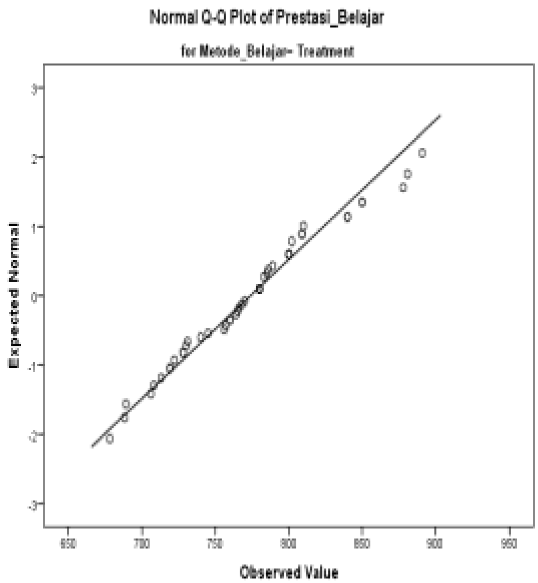

Fig 1. Linearity test on learning achievement

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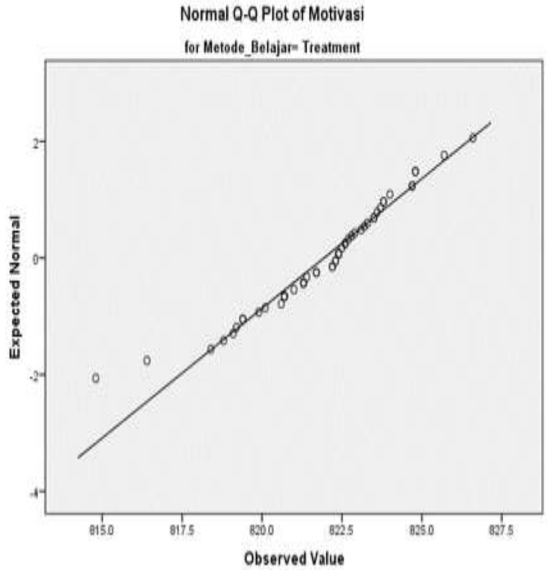

Fig 2. Linearity Test on Learning Motivation

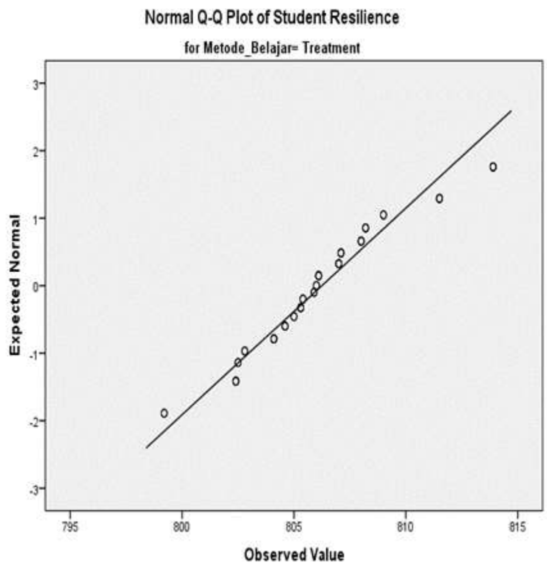

Fig 3. Linearity Test on Student Resilience

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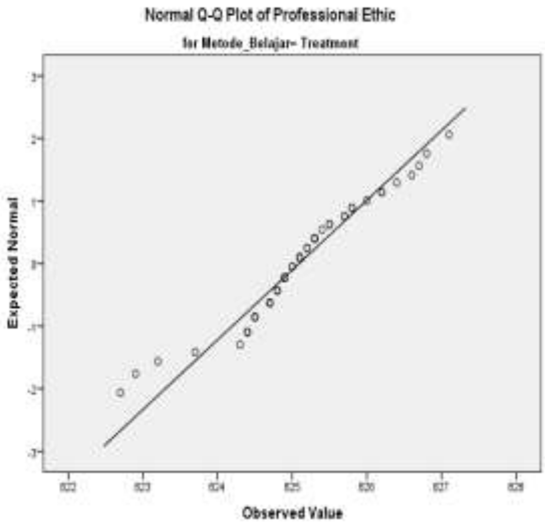

Fig 4. Linearity Test on Professional Ethics

3.2 Normality Test

The normality test The Shapiro-Wilk test produces data as follows: Learning Result with Treatment [W(50)=0.974, p=0,328]; Student Resilience with Treatment [W(50)=0,951, p=0,057]; Learning Motivation with Treatment [W(50)=0,962, p=0,108]; and Professional Ethics with Treatment [W(50)=0,957, p=0,065]. The data are distributed with a Normal distribution (ρ > 0,05).

Table 1. Normality Test

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Learning Method	Statistic	df	Sig.	Statistic	df	Sig.
Prestasi_Belajar	No_Treatment	.096	50	.200*	.946	50	.024
	Treatment	.094	50	.200*	.974	50	.328
Student Resilience	No_Treatment	.122	50	.059	.905	50	.001
	Treatment	.118	50	.080	.951	50	.057
Motivation	No_Treatment	.118	50	.078	.954	50	.049
	Treatment	.126	50	.046	.962	50	.108
Professional Ethic	No_Treatment	.088	50	.200*	.980	50	.552
	Treatment	.120	50	.069	.957	50	.065

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

3.3 Homogeneity Test

The resulting Box'M value is 71.828 (p=0.062) ↔ ρ > 0.05. Thus, the covariance matrix between groups is assumed to be equal or homogeneous.

Table 2. Homogeneity Test

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Box's Test of Equality of Covariance Matricesa

Box's Test of Equality of Covariance Matrices[a]	
Box's M	71.828
F	6.866
df1	10
df2	45915.538
Sig.	.062

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Learning Method

3.4 Hypothesis Test

Hypothesis testing in this study used the Manova test. Manova stands for multivariate analysis of variance. In this study, the Manova test was used to test the first, second, third, and fourth hypotheses (H0: there is no significant difference in each dependent variable, namely academic achievement, learning motivation, Student Resilience, and Professional Ethic between the group of students who followed the transdisciplinary approach learning design integrated with the ATI learning model and the control group who followed the conventional learning method).

Table 3. Univariate Calculation

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[e]
Corrected Model	Student Achievement	34894.240[a]	1	34894.240	13.379	.000	.120	13.379	.952
	Student Resilience	79163.450[b]	1	79163.450	10784.905	.000	.991	10784.905	1.000
	Motivation	18.662[c]	1	18.662	3.865	.052	.038	3.865	.495
	Professional Ethic	33.293[d]	1	33.293	25.643	.000	.207	25.643	.999
Intercept	Student Achievement	57029683.240	1	57029683.240	21866.652	.000	.996	21866.652	1.000
	Student Resilience	60545517.210	1	60545517.210	8248474.139	.000	1.000	8248474.139	1.000
	Motivation	67487539.406	1	67487539.406	13975197.235	.000	1.000	13975197.235	1.000
	Professional Ethic	67982498.522	1	67982498.522	52362210.084	.000	1.000	52362210.084	1.000
Learning Method	Student Achievement	34894.240	1	34894.240	13.379	.000	.120	13.379	.952

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	Student Resilience	79163.450	1	79163.450	10784.905	.000	.991	10784.905	1.000
	Motivation	18.662	1	18.662	3.865	.052	.038	3.865	.495
	Professional Ethic	33.293	1	33.293	25.643	.000	.207	25.643	.999
Error	Student Achievement	255590.520	98	2608.067					
	Student Resilience	719.340	98	7.340					
	Motivation	473.251	98	4.829					
	Professional Ethic	127.235	98	1.298					
Total	Student Achievement	57320168.000	100						
	Student Resilience	60625400.000	100						
	Motivation	67488031.320	100						
	Professional Ethic	67982659.050	100						
Corrected Total	Student Achievement	290484.760	99						
	Student Resilience	79882.790	99						
	Motivation	491.914	99						
	Professional Ethic	160.527	99						

a. R Squared = .120 (Adjusted R Squared = .111)

b. R Squared = .991 (Adjusted R Squared = .991)

c. R Squared = .038 (Adjusted R Squared = .028)

d. R Squared = .207 (Adjusted R Squared = .199)

e. Computed using alpha = .05

The results of univariate calculations show that differences in Learning Methods cause significant differences in: Academic Achievement [$F(1, 98) = 13,379$, $\varrho = 0,000$ ($\varrho < 0,05$) $\eta\varrho2 = 0,120$] ; Student Resilience [$F(1, 98) = 10784,905$, $\varrho = 0,000$ ($\varrho < 0,05$) $\eta\varrho2 = 0,991$]; Professional Ethic [$F(1, 98) = 25,643$, $\varrho = 0,000$ ($\varrho < 0,05$) $\eta\varrho2 = 0,207$]; but did not cause significant differences in Learning Motivation [$F(1, 98) = 3,865$, $\varrho = 0,052$ ($\varrho > 0,05$), $\eta\varrho2 = 0,038$].

Table 4. Multivariate Test

Multivariate Testsa

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Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Intercept	Pillai's Trace	1.000	13206777.443[b]	4.000	95.000	.000	1.000	52827109.772	1.000
	Wilks' Lambda	.000	13206777.443[b]	4.000	95.000	.000	1.000	52827109.772	1.000
	Hotelling's Trace	556074.840	13206777.443[b]	4.000	95.000	.000	1.000	52827109.772	1.000
	Roy's Largest Root	556074.840	13206777.443[b]	4.000	95.000	.000	1.000	52827109.772	1.000
Learning Method	Pillai's Trace	.992	2956.518[b]	4.000	95.000	.000	.992	11826.073	1.000
	Wilks' Lambda	.008	2956.518[b]	4.000	95.000	.000	.992	11826.073	1.000
	Hotelling's Trace	124.485	2956.518[b]	4.000	95.000	.000	.992	11826.073	1.000
	Roy's Largest Root	124.485	2956.518[b]	4.000	95.000	.000	.992	11826.073	1.000

a. Design: Intercept + learning method

b. Exact statistic

c. Computed using alpha = .05

Based on the hypothesis, the criteria used to determine the assumption is if Sig. in the table <0.05 then H0 is rejected, and if Sig. > 0.05 then H0 is accepted. Then the results of data analysis from the Multivariate test table are: $F(4, 95) = 2956{,}518$, $\varrho<0{,}05$; Wilk's $\Delta = 0{,}008$, $\eta\varrho 2 = 0{,}992$, F calculation = 2956,518, F tabel = 4, 95. F calculation > Ftabel means an overall difference between students in the experimental class group and students in the control class group. Or using the Sig. The test result is 0.000 <0.05, meaning that overall, there is a difference between students in the experimental class group and students in the control class group. The multivariate test results show a significant difference in the mastery of students who come from different learning method treatments (those in the experimental class group and students in the control class group).

Discussion

This study's seamless learning concept refers to a continuous and adaptive educational experience that bridges multiple contexts and learning environments, both physical and digital. Seamless learning supports students' ability to learn across varied situations without disruption, fostering adaptability and a holistic understanding that can be directly applied to real-world scenarios. The seamless integration of learning activities through SMART Poltekad's seamless learning platform enabled students to engage with content and resources in a fluid manner, blending in-person and online interactions in a way that strengthened resilience and professional ethics.

This study's findings highlight that seamless learning not only supports academic achievement but also plays a pivotal role in fostering resilience. By facilitating a learning environment that adapts to students' individual needs and situational contexts, seamless learning encourages students to confront and manage challenges across diverse learning scenarios, thereby strengthening their adaptive coping mechanisms. Additionally, seamless learning aligns well with the development of professional ethics, as students are encouraged to apply ethical considerations continuously across varied learning tasks and interdisciplinary interactions. The transdisciplinary and ATI approaches, when delivered through a seamless learning model, further support this by providing structured yet adaptable learning experiences that deepen ethical understanding and reinforce the importance of professional integrity in complex, real-world applications.

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These findings suggest that the seamless learning model can be particularly beneficial in polytechnic and vocational education, where adaptability, resilience, and ethics are integral to professional readiness. Future studies could build on these results by examining specific seamless learning activities that most effectively enhance resilience and ethical reasoning across different educational contexts. Additionally, investigating how seamless learning frameworks impact long-term professional attitudes and behaviors would contribute valuable insights to the field of educational technology and pedagogy.

The study revealed significant disparities in academic performance between the experimental group, which used the ATI model with the Transdisciplinary Approach, and the control group, which followed traditional methods. The experimental group displayed superior academic performance, likely due to the ATI's individualized focus combined with the Transdisciplinary Approach's comprehensive, cooperative elements. Together, these models create a learning environment that enhances comprehension and retention, as evidenced by higher test scores and grades (Burgos & Barrera-Perales, 2023).

Although motivation did not differ significantly between groups ($\varrho = 0.052$, $\varrho > 0.05$), qualitative data indicated higher engagement among the experimental group. This suggests that while immediate motivation might not be significantly affected, students still found the seamless learning approach meaningful due to its practical relevance. Specific activities, such as interdisciplinary projects focused on real-world problems, helped students appreciate the relevance of their studies. Future studies might explore how prolonged exposure to this model influences intrinsic motivation over time.

The rise in popularity of the seamless learning technique using SMART Poltekad can be ascribed to the captivating and pertinent learning experiences it offers. The analysis of qualitative data obtained from interviews and focus group discussions indicated that students in the experimental group experienced a stronger sense of connection with the learning content and expressed a greater appreciation for the practical relevance of their studies. Although the data are not statistically significant, they emphasize the potential of integrated learning models to promote increased student involvement and interest.

The experimental group also showed greater resilience ($\varrho = 0.000$, $\varrho < 0.05$), with students demonstrating a stronger ability to adapt to challenges. The collaborative and problem-solving aspects of transdisciplinary learning likely contributed to this by encouraging students to build coping skills in a supportive environment. The ATI model's emphasis on tailored learning paths may further support resilience by aligning with individual needs and helping students approach challenges with a personalized toolkit.

The students in the experimental group exhibited a remarkable ability to handle challenges and manage pressure, a skillset nurtured by the Transdisciplinary Approach's supportive and collaborative environment. By blending perspectives from multiple fields, this approach immerses students in complex, real-world issues that demand adaptive thinking and resilience. In contrast to traditional learning, which often isolates disciplines, transdisciplinary learning encourages students to move beyond the boundaries of a single subject, fostering the ability to think critically and problem-solve in diverse contexts. This exposure to multifaceted, intricate problems cultivates robust coping mechanisms as students learn to navigate ambiguity and uncertainty, building resilience through repeated engagement with challenging, open-ended tasks. The cooperative nature of the transdisciplinary environment also fosters mutual support, as students work alongside peers with varying expertise, helping each other develop adaptive strategies and gain confidence in their ability to overcome obstacles.

Moreover, the transdisciplinary approach naturally emphasizes ethical reasoning by requiring students to consider diverse viewpoints that often include ethical dimensions. As students engage in activities that bridge multiple disciplines, they encounter real-world scenarios where ethical considerations are central, encouraging them to apply ethical principles across a range of professional and academic situations. This process strengthens their understanding of professional integrity and helps them appreciate their decisions' ethical implications, promoting a habit of thoughtful, ethical reflection. Through this ongoing practice, students are better prepared to face ethical challenges in the workforce, equipped with a grounded sense of responsibility and the capacity to make principled choices. Ultimately, the Transdisciplinary Approach

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enhances students' resilience and instills a deep, actionable understanding of ethics, preparing them to navigate both professional and personal challenges with adaptability and a commitment to integrity.

In terms of professional ethics, the experimental group exhibited significantly higher levels ($\varrho = 0.000$, $\varrho < 0.05$), likely due to the interdisciplinary and practical nature of the Transdisciplinary Approach, which promotes ethical behavior across varied contexts. This approach enables students to understand ethics within real-world scenarios, supported by ATI's structured guidance, helping them apply ethical principles in diverse settings (Niu, 2024). The practical experience, along with the systematic direction of the ATI model, enhanced students' comprehension and admiration for professional ethics.

Qualitative insights from interviews and focus groups corroborated these findings, with students expressing increased engagement and appreciation for interdisciplinary learning. They noted that collaborative, real-world projects improved their problem-solving skills and teamwork abilities, highlighting the importance of instructor facilitation in creating an inclusive and supportive learning environment.

The combination of the ATI model and Transdisciplinary Approach appears effective for diverse educational outcomes, providing a flexible, supportive learning environment that caters to individual needs while fostering collaboration and critical thinking. SMART Poltekad's seamless learning format further enriched this experience by offering flexible, resource-rich access to learning materials.

Some challenges were encountered, including administrative and interpersonal obstacles. For effective implementation, higher education institutions should provide ongoing support and training for instructors, create clear guidelines for collaborative learning, and foster a culture of continuous improvement.

Future studies could explore long-term effects on professional ethics and resilience, as well as examine the impact of ATI and Transdisciplinary models in other disciplines. Additionally, research into specific project-based activities that enhance motivation and ethical understanding across diverse learning environments would further contribute to the literature on integrated learning models.

Conclusions

The rapid evolution of information technology and cultural paradigms in the 21st century has necessitated a shift in educational approaches to better prepare students for the complexities of modern life. Higher education institutions must adopt innovative teaching models that impart discipline-specific knowledge and foster critical thinking, adaptability, and ethical understanding. This research examined the integration of the Aptitude Treatment Interaction (ATI) model with the Transdisciplinary Approach, supported by the seamless learning platform SMART Poltekad, to evaluate its impact on academic achievement, learning motivation, student resilience, and professional ethics.

Our findings indicate that this integrated approach significantly enhances academic achievement, student resilience, and professional ethics among higher education students. These outcomes demonstrate the effectiveness of combining personalized learning strategies with interdisciplinary collaboration and practical applications. Although the increase in learning motivation was not statistically significant, qualitative data revealed a positive trend, suggesting that students felt more engaged and connected to the material.

Opposing viewpoints might argue that traditional learning models are sufficient and that the complexities of integrating multiple disciplines and personalized approaches could pose logistical challenges. However, our research highlights the shortcomings of conventional methods in accommodating individual student differences and preparing them for real-world problems. The evidence strongly supports the adoption of integrated and adaptive learning models to address these gaps.

In light of these findings, educational institutions are encouraged to explore and implement similar integrated approaches to enhance student outcomes. Future research could further investigate the long-term effects of these methods on various student populations and disciplines. Additionally, studies could explore the specific components of the ATI and Transdisciplinary Approaches that contribute most significantly to positive outcomes, providing a more nuanced understanding of their impact.

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In conclusion, integrating the ATI model and the Transdisciplinary Approach, facilitated by seamless learning, offers a promising avenue for educational innovation. By embracing these adaptive and comprehensive learning models, educators can better equip students with the skills and knowledge needed to thrive in an increasingly complex and interconnected world. The positive impacts observed in this study underscore the importance of developing and refining these approaches to ensure that higher education remains relevant and effective in addressing contemporary challenges.

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