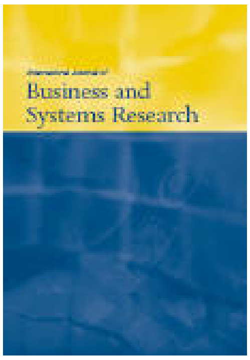

International Journal of Business and Systems Research

ISSN online: 1751-2018 - ISSN print: 1751-200X
https://www.inderscience.com/ijbsr

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DOI: 10.1504/IJBSR.2025.10067826

Article History:

Received:	31 March 2023
Last revised:	13 July 2024
Accepted:	14 July 2024
Published online:	30 December 2024

Computer aptitude, positive affect, and openness personality traits on learning enterprise resource planning systems

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Abstract: Enterprise resource planning (ERP) systems are intricate information systems integral to organisations, supporting functions like accounting, sales, materials management, and HR. This study explores the relationships between computer aptitude, positive affect, and the openness personality trait in successfully learning ERP systems. Data from students at two US universities were analysed using structural equation modelling. Findings indicate that users' computer aptitude and positive affect positively correlate with ERP learning performance, with openness influencing positive affect, which in turn impacts learning success. One significant contribution of this research is the exploration of non-technical factors, such as affect and personality, in learning complex systems. Additionally, the study supports the notion that positive affect and openness personality traits are influential predictors of ERP system learning success, emphasising the importance of critical thinking and analytical skills. This research provides a deeper understanding of the cognitive and emotional components that contribute to ERP system learning performance.

Keywords: enterprise systems; computer aptitude; positive affect; personality traits.

Reference to this paper should be made as follows: Lea, B-R., Sumner, M. and Mirchandani, D.A. (2025) 'Computer aptitude, positive affect, and openness personality traits on learning enterprise resource planning systems', *Int. J. Business and Systems Research*, Vol. 19, No. 1, pp.1–22.

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1 Introduction

Enterprise resource planning (ERP) systems are the backbone for running most enterprises today as they support integrated business processes across the supply chain. Organisational success in the implementation and adoption of ERP systems depends upon a talented workforce of end-users who understand the underlying business processes these systems are designed to support and who can learn how to use these complex systems as a platform for accomplishing these business processes (Schlichter and Kraemmergaard, 2010; Sumner, 2018).

Many educators who teach complex ERP systems know that some students learn how to use these systems with ease, while other students struggle to learn how to use them successfully. The learning curve is steep because of the complex processes the software is designed to support. The integration of processes incorporated into the system is particularly challenging for students who have no work experience and are learning business processes for the first time (Léger, 2006). For example, a change in one ERP-based process can have a cascading effect on other system-supported processes. Additionally, one error can have multiple effects, and diagnosing these effects can take ingenuity, problem-solving skills, and openness to exploring the inter-relationships among the processes. That is why many ERP educators are intrigued by the question, 'What is the combination of skills and behaviours which distinguishes the students who learn how to use these complex systems relatively quickly as compared to students who struggle?' This question lingers in the minds of faculty who teach classes using commercial ERP systems such as SAP S/4HANA ERP, Oracle NetSuite ERP, or Microsoft Dynamics 365.

Studies have shown that certain factors influence the successful use and learning of complex ERP systems. Some of these factors are personality traits (Lea et al., 2022), educational background (Cronan, 2012; Kang and Santhanam, 2003), demographic characteristics, work experience (Lea et al., 2022; Seethamraju, 2011; Léger, 2006), and cognitive aptitude (White, 2002; Bock et al., 2003).

This research seeks to look beyond technology adoption factors by exploring the relationships between computer aptitude, Positive Affect, and personality traits in the successful learning of complex enterprise systems. This research is organised as follows: first, a literature review is presented leading up to the research questions; next, the research model, hypotheses, and methodologies are provided along with a discussion of the results, and, finally, the summary and implications of the study are provided.

2 Literature review and research questions

2.1 Challenges in ERP education

To sustain the successful implementation and use of ERP systems, researchers report that top management support, user involvement, project management, business process re-engineering, and support are critical (Shao et al., 2016; Leyh and Sander, 2015; Sun et al, 2015). Furthermore, leaders need to foster a learning organisation (Kareem, 2016), recognise the importance of cultural changes and organisational readiness (Gargeya and Brady, 2005), take into consideration human factors such as knowledge transfer, communication effectiveness, and conflict resolution (Maditinos et al., 2012), user satisfaction (Saade and Nijher, 2016), and user education and training (Leyh and Sander, 2015). Researchers Schichter and Kraemmergaard (2010), Sumner (2018) have also described the role of 'super-users' who can help end-users by coaching and mentoring them in navigating complex ERP systems, processes, and workflows.

Enterprise system users often have a steep learning curve as they need to possess not only technical knowledge of software operations and transaction execution (Cronan and Douglas, 2012; Léger, 2006; Boyle and Strong, 2006; Kang and Santhanam, 2003), business process knowledge related to the application context (Lea et al., 2022, Cronan, 2012; Kang and Santhanam, 2003) but also the ability to understand the interdependencies of tasks and users (Lea et al., 2022; Charland et al., 2015; Kang and Santhanam, 2003). The need for interpersonal skills and teamwork skills further deepens the learning curve of enterprise system users (Lea and Eng, 2021; Boyle and Strong 2006). As a result, it is challenging for educators to prepare graduates and student learners to master ERP knowledge which has limited the ability of higher education to address the industry need for a workforce skilled in ERP (Lea et al., 2022; Charland et al., 2015).

Calisir et al. (2009) have examined the factors which affect users' behavioural intention to use ERP systems utilising the technology acceptance model (TAM), theory of reasoned action, and innovation diffusion theory. Their results indicate that perceived usefulness, subjective norms, and educational level are determinants of the behavioural intention to use the system. Perceived usefulness affects attitude toward use while perceived ease of use and compatibility influence perceived usefulness. Furthermore, educational level has a significant effect on perceived ease of use and behavioural intention and subjective norm influences behavioural intention to use the ERP system. It is therefore important to consider behavioural factors while examining the successful learning and use of complex enterprise systems.

As a result, the factors contributing to ERP usage and thereby implementation success are not necessarily technological factors; these factors are cultural (Gargeya and Brady, 2005), human and behavioural (Almajali et al., 2016; Leyh and Sander, 2015; Maditinos et al., 2012), and organisational (Kareem, 2016; Gargeya and Brady, 2005) factors that not only impact implementation success, but also ongoing sustainable use of the system. Therefore, our study addresses the 'learning component' of ERP systems implementation success, particularly the success in learning how to use such enterprise systems.

2.2 Cognitive aptitude, learning, and job performance

Cognitive aptitude is recognised as a strong predictor of job performance (Chung-Yan and Cronshaw, 2002). In a study linking cognitive skills to job performance, Lang et al. (2010) examined an established taxonomy of 7 narrower primary mental abilities (Thurstone, 1938), broader general mental ability (GMA), and job performance. Their study revealed that GMA accounted for a significant proportion of the total variance explained in job performance. Other research has added even more evidence that cognitive abilities predict job performance (Bertua et al., 2005; Salgado et al., 2003).

Prior research has also considered the cognitive requirements for success in learning computer applications in college courses. White (2002) investigated cognitive characteristics for learning C++ programming and reported that cognitive development correlated significantly with the first test grade in the course. Further, White and Ploeger (2004) replicated White's earlier study of C++ in the context of learning a visual programming language (visual basic). In the latter study, they found that cognitive development was not significantly correlated with the test score from the course. These findings suggest that different cognitive characteristics are required for different programming language paradigms.

In a study predicting database designer potential, Bock et al. (2003) used the Berger Aptitude Test (B-APT) and grade point average (GPA) to predict proficiency in E-R database modelling. While GPA correlated highly with the individual B-APT scores, the results of the correlation between the aptitude assessment and E-R database modelling were inconsistent, but still suggest that different cognitive characteristics apply to database modelling as well.

Based upon research showing the connection between cognitive aptitude and proficiency in learning computing skills, it seems that different cognitive characteristics apply to learning procedural languages, visual programming languages, and database modelling skills. As an ERP system is procedural-, process-, and detail-oriented (Lea et al., 2020), the researchers hypothesise that computer aptitude predicts success in learning to use an ERP system as it can capture a learner's ability to

1. mitigate or prevent problems
2. recognise patterns
3. pay attention to detail
4. follow procedures that are complex.

Therefore, this research seeks to further assess the connection between computer aptitude and learning complex enterprise systems as stated in the first research question below:

What is the effect of users' computer aptitude on their ERP system learning performance?

2.3 Affect, learning, and performance

Emotions are central to human behaviour and have been investigated in psychology, philosophy, sociology, and the scientific disciplines. Researchers highlight the sustainable value of understanding how emotions affect learning and achievement over time (Goetz et al., 2023). Psychology and neuroscience reinforce the concept that emotions can enhance learning and memory retention (Oudeyer et al., 2016). Emotions like novelty and surprise can trigger curiosity and active learning and such positive emotions, known as Positive Affect, can influence cognition. This interchangeable use of positive emotion and positive affect is adopted in this study as it is grounded in the understanding that both terms describe the experience of pleasurable emotions such as joy, enthusiasm, and contentment, which generally reflect a person's overall mood and emotional state, which influence learning and cognitive performance.

Pekrun et al. (2006) proposed the control-value theory (CVT) of achievement emotions to provide a framework for understanding the effect of emotions on learning and achievement. According to the CVT, appraisals of control and values are central to triggering Positive Affect, such as enjoyment and pride, which are positively associated with learning and achievement or vice-versa, Negative Affect, such as frustration and hopelessness, which are negatively associated with learning (Camacho-Morles et al., 2021; Hagger et al., 2014; Pekrun et al., 2006, 2002). Researchers posit that positive affect systematically influences performance on many cognitive tasks, including problem-solving (Ashby et al., 1999; Isen et al., 1987) and, thus, improves the task and learning performance that leads to better achievement (Pekrun, 1992; Isen et al., 1987). Shen et al. (2009) further suggest that emotion during the learning process and emotional feedback improve learning experiences. Emotions have been identified as having an effect on the logical reasoning of people and the way they think, decide, and solve problems (Jung et al., 2014). Furthermore, Lajoiea et al. (2020) report that emotions impact learning across different learning environments, including technology-rich learning environments in their meta-analysis of the literature from the period 1965 to 2018 on measuring the impact of emotions in technology-rich environments.

Positive Affect has also been shown to alleviate the tunnel vision fostered by mindsets. A mindset is defined as an efficient strategy for solving a problem. Hagger et al (2014) reported that participants experiencing positive affect were less likely to stick with practiced or acquired problem-solving strategies, compared to participants experiencing negative affect, and favoured available simple solutions. With the complexity and interdependencies of a complex enterprise system such as an ERP system, debugging system operation issues often requires not only practiced scripted problem-solving strategies, but also creative, flexible, and novel approaches.

Olafson and Ferraro (2001) found that affective states influence cognitive and motivational processes relevant to cognitive performance. They suggest that positive affect can enhance task motivation as well as thinking in creative, flexible, and holistic ways (Fiedler, 2001; Ashby et al., 1999). Further, positive emotions facilitate the use of deep learning strategies (Frederickson, 2001), such as applying content to prior learning, organisation of learning materials, and critical thinking skills. Positive emotions enhance flexible thought and action, promoting students' self-regulation, planning, and monitoring of learning activities (Pekrun, 2002). Because emotions influence attention, motivation, and learning strategies, they promote achievement.

Many studies have focused on examining cognitive factors such as intellect and working memory in influencing achievement and performance; yet, non-cognitive factors, like emotions, have been neglected (Pekrun et al., 2017). Therefore, this study incorporates Positive Affect in the research model and the research question is stated below.

What is the effect of users' positive affect on their ERP system learning performance?

2.4 Effect of openness personality trait on learning and performance

The big five personality traits model, comprising the traits of openness, conscientiousness, neuroticism, extraversion, and agreeableness, has been applied by industrial and organisational psychology, education, and health researchers for over twenty years. Openness measures a person's intellectual curiosity, preference for novelty and variety, and emphasises imagination and insights. Conscientiousness measures a person's organisation, discipline, and achievement-orientation (Komarraju et al., 2011). Neuroticism measures a person's degree of emotional stability and impulse control. Extraversion measures a person's degree of sociability and assertiveness (Komarraju et al., 2011), and Agreeableness measures a person's helpfulness, cooperativeness, and sympathetic nature.

Personality traits can influence job performance (Judge et al., 1999; Witt and Burke, 2002; Judge and Zapata, 2015; Sartori et al., 2017). While all the big five traits predict performance for unstructured work (Judge and Zapata, 2015), Openness, in particular, helps predict performance for jobs that require innovation and creativity.

Researchers have also reported that personality traits and academic success are related. The openness trait, particularly, is associated with imagination, creativity, and intellectual curiosity and is reported to be positively related with academic success (Paunonen and Ashton, 2001; Laidra et al., 2007), motivation to learn (Major et al., 2006), and collaborative learning (Komarraju et al., 2011). People who are high in Openness are likely to embrace new and unpredictable experiences and thus possess a higher level of intrinsic motivation to pursue new knowledge. Given that learning ERP systems require gaining proficiency in a variety of new skills and knowledge dimensions (Cronan, 2012; Kang and Santhanam, 2003) and thereby demands higher learning motivation, the third research question is stated below:

What is the effect of users' openness personality trait on their ERP system learning performance?

Other than the openness personality trait which is closely connected to the willingness, imagination, creativity, and intellectual curiosity to learn something new and to engage in learning, positive affect is also central to a person's willingness to learn and engage in learning which influences learning behaviour (Scherer and Tran, 2001; Ahn and Shin, 2015; Beaudry and Pinsonneault, 2010). Therefore, the fourth research question is:

What is the relationship between users' openness personality traits and positive affect?

3 Research model and hypotheses

The objective of this study is to investigate the relationship between users' computer aptitude, openness personality trait, and positive affect on learning a complex enterprise system. Four hypotheses are proposed and the research model is shown in Figure 1.

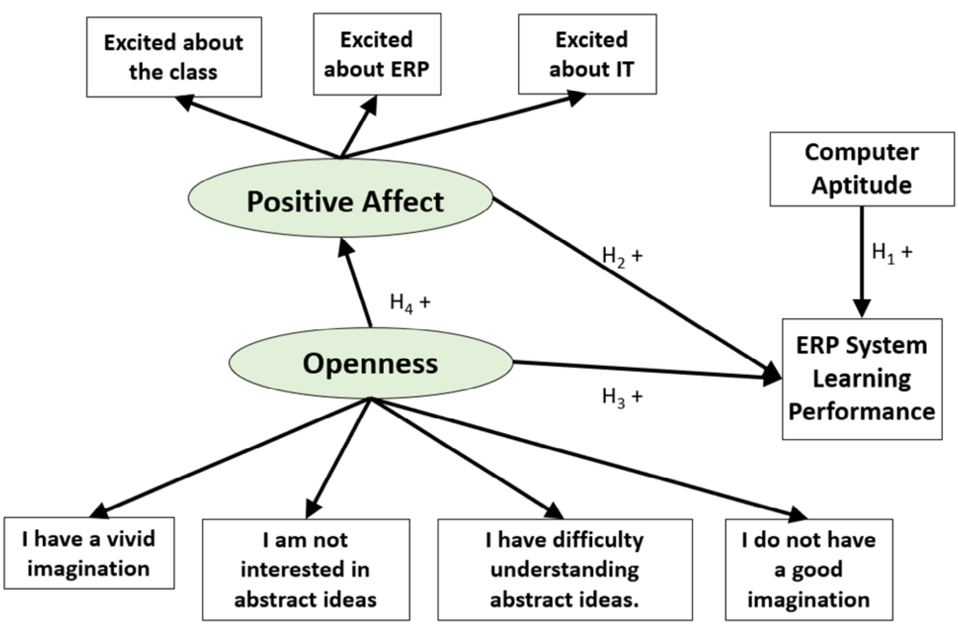
Hypothesis 1 Users' cognitive aptitude for computing positively influences their ERP system learning performance.

Hypothesis 2 Users' positive affect positively influences their ERP system learning performance.

Hypothesis 3 Users' openness personality trait positively influences their ERP system learning performance.

Hypothesis 4 Users' openness personality trait positively influences their positive affect.

Figure 1 Research hypotheses and the proposed research model (see online version for colours)



4 Research methodology

4.1 Measurement of variables

To represent a realistic ERP system used in a company setting, an SAP S/4HANA ERP system was selected and configured to include a fully integrated accounting and finance system, procurement, production planning and execution system, and sales and distribution system. ERP learning performance was measured using the standardised course grade based on conceptual ERP assessments, technical system operation assignments, individual and team case/project reports, simulation game exercises, and tests. As the course grade represents a variety of learning activities, it provides a more realistic measure of learning performance.

Positive affect was assessed through the user's attitude toward the class, which covered topics related to the use of enterprise systems and information technology in business. This assessment utilised the following three items rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

- I am excited about the class I am in.
- I am excited about the field of computers, technology, and information systems.
- I am excited about using ERP systems.

The above three items were developed and tested for validity and reliability, serving as a consistent course assessment instrument across multiple classes through multiple AACSB accreditations at one of the two universities for more than 10 years.

The openness personality trait was measured using four items from the 20-item Mini-international personality item pool (IPIP) tool that has been confirmed to have reliability and validity as the original IPIP and as an efficient yet effective personality assessment tool (Donnellan, et al. 2006). Each of the four items was rated on a 5-point Likert scale from 1 (very inaccurate) to 5 (very accurate). The four items are listed below:

- I have a vivid imagination.
- I am not interested in abstract ideas (reverse coded)
- I have difficulty understanding abstract ideas (reverse coded).
- I do not have a good imagination (reverse coded).

Cognitive aptitude was measured using a 26-item aptitude practice assessment adopted from the University of Kent (https://www.graduatesfirst.com/university-career-services/kent) with a user's score ranging from zero to 26. Demographic data, including age, gender, year in school, and prior knowledge were also collected. Data on environmental factors, including race, English language proficiency, and school location were collected to provide an understanding of the representativeness of the sample as indicative of a diverse university community population.

4.2 Data collection

Data was collected over five semesters: Fall 2016, 2018; Spring, 2017, 2019, 2020), from students attending two universities as shown in Figure 2(a). Among the 252 valid responses, 34.5% were female, 63.9% were male, and 1.59% non-disclosures as shown in Figure 2(b). About 57.9% were undergraduate students and about 42.1% were graduate students as shown in Figure 2(c). About 57.9% and 29.4%, of participants had no prior experience or had less than two years of experience working with information systems respectively as shown in Figure 2(d). About 63.9% of participants reported that English was their first language (49.2%), native language (14.7%), or primary language (14.7%) while about 16.7% reported speaking English fluently and about 4.8% reported speaking at an elementary level, as shown in Figure 2(e). White or Caucasian, Asian or Pacific Islander, Black or African American, Hispanic, and non-disclosed race accounted for about 57.5%, 28.6%, 9.1%, 2.4%, 2.4% of participants respectively as shown in Figure 2(f).

Figure 2 Research participants (a) data collection time (b) gender (c) age (d) graduate vs. undergraduate (e) prior experience in information systems (f) English fluency (g) ethnicity (see online version for colours)

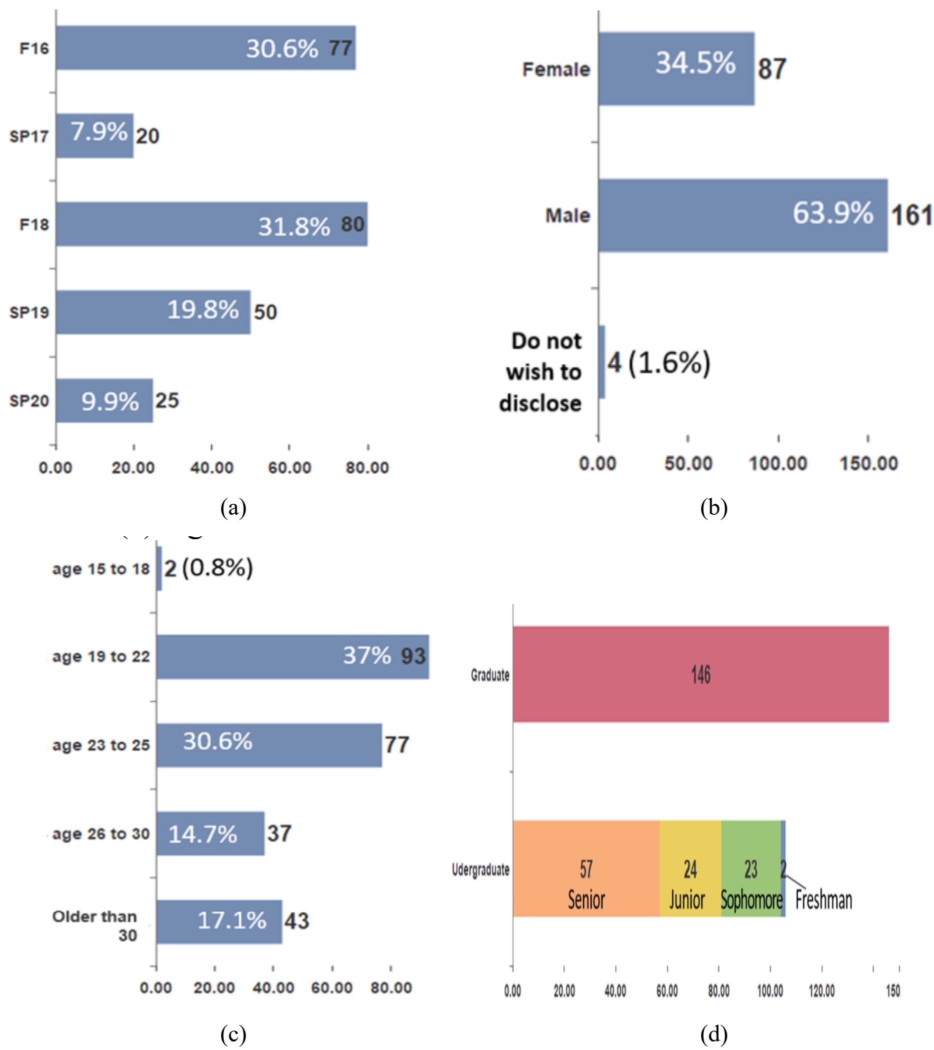
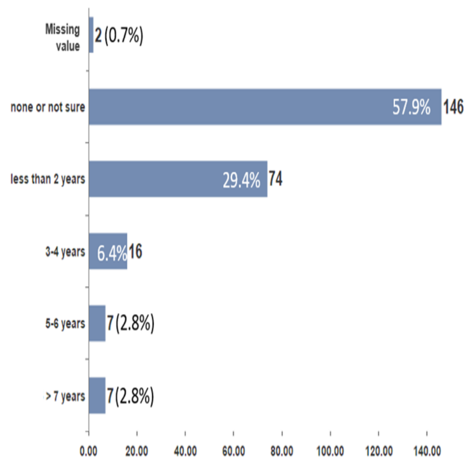
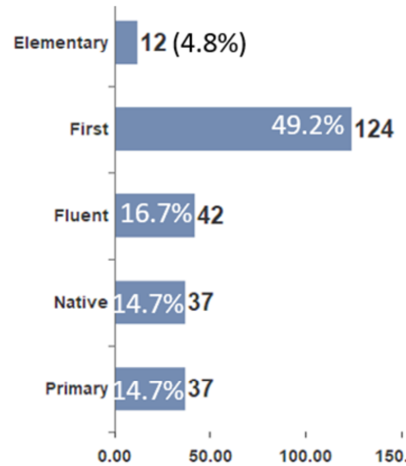


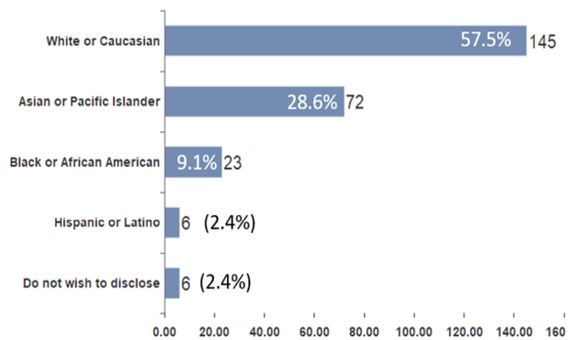
Figure 2 Research participants (a) data collection time (b) gender (c) age (d) graduate vs. undergraduate (e) prior experience in information systems (f) English fluency (g) ethnicity (continued) (see online version for colours)



(e)



(f)



(g)

5 Results and discussions

With two latent variables, 'positive affect' and 'openness,' in the model, structural equation modelling (SEM) utilising the JASP software (https://jasp-stats.org) was used to test the research model.

5.1 Model fit

The goodness-of-fit of the research model was tested and the results indicated a good fit based on various measures as shown in Table 1. The Chi-square difference between the proposed research model and the baseline model was significant ($p = 0.004$). The goodness of fit index (GFI), comparative fit index (CFI), and McDonald fit index (MFI) were all above 0.95. The Tucker-Lewis Index (TLI), and Parsimony GFI were above

0.90. The root mean square error of approximation (RMSEA) and the standardised root mean square residual (SRMR) were both smaller than .08. The Akaike information criteria (AIC), Bayesian information criteria (BIC), and sample-size adjusted Bayesian (BIC) of the proposed model were smaller than the comparative models.

Table 1 Proposed model versus baseline model

Goodness-of-fit measures	*Statistics*
χ^2 Test statistics	48.217 (df = 25, p = 0.004)
Goodness of fit index (GFI)	0.956
Comparative fit index (CFI)	0.955
McDonald fit index (MFI)	0.954
Tucker-Lewis Index (TLI)	0.935
Parsimony goodness of fit index (GFI)	0.920
Root mean square error of approximation (RMSEA)	0.061 (upper–lower 90% Confidence Intervals: 0.087 – 0.034)
Standardised root mean square residual (SRMR)	0.053
Akaike information criteria (AIC)	3,844.098
Bayesian information criteria (BIC)	3,910.776
Sample-size adjusted Bayesian (BIC)	3,850.546

Figure 3 SEM analysis results of Hypotheses 1–4 (see online version for colours)

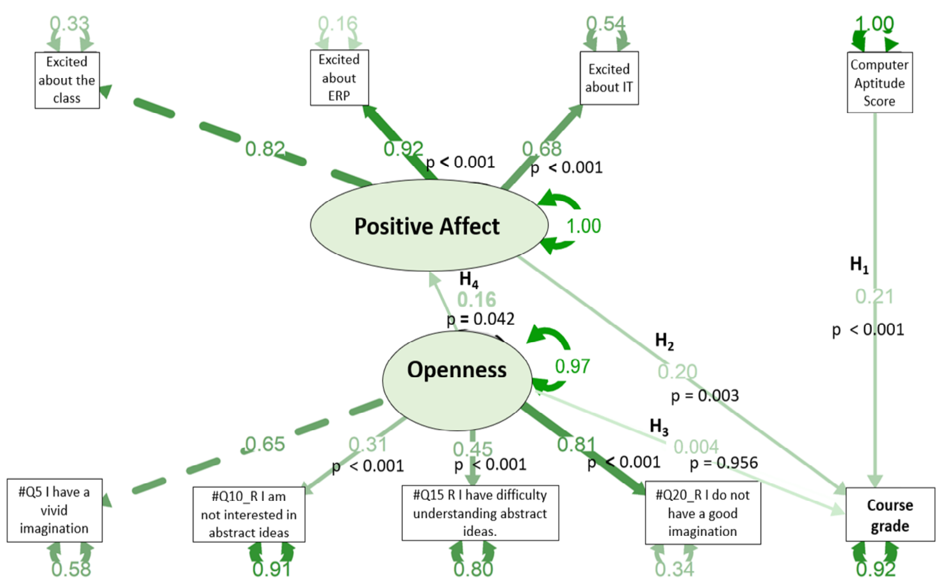


Table 2 Parameters estimates and hypotheses test

			Estimate	*se*	*z*	*p*	*CI (lower)*	*CI (upper)*	*Std. (LV)*	*Std. (all)*	*Std. (Nox)*
Openness	=~	Q5_vivid_Imagination	1	0			1	1	0.673	0.648	0.648
Openness	=~	Q10R_interest_abstract_idea	0.459	0.114	4.026	*< 0.001*	0.236	0.683	0.309	0.308	0.308
Openness	=~	Q15R_understand_abstract_idea	0.641	0.114	5.625	*< 0.001*	0.417	0.864	0.431	0.449	0.449
Openness	=~	Q20R_no_good_imagination	1.278	0.211	6.073	*< 0.001*	0.866	1.691	0.86	0.814	0.814
Positive affect	=~	excited about the class	1	0			1	1	0.71	0.821	0.821
Positive affect	=~	excited about using ERP	1.06	0.08	13.296	*< 0.001*	0.904	1.216	0.753	0.916	0.916
Positive affect	=~	excited about IT	0.818	0.073	11.271	*< 0.001*	0.676	0.96	0.581	0.682	0.682
H1: Learning performance	~	Cognitive_Aptitude_Score	0.004	0.001	3.431	*< 0.001*	0.002	0.007	0.004	0.209	0.038
H2: Learning performance	~	Positive affect	0.031	0.01	2.987	*0.003*	0.011	0.052	0.022	0.199	0.199
H3: Learning performance	~	Openness	6.547e -4	0.012	0.055	*0.956*	–0.023	0.024	4.405e -4	0.004	0.004
H4: Positive affect	~	Openness	0.17	0.083	2.037	*0.042*	0.006	0.333	0.161	0.161	0.161
Q5_vivid_Imagination	~~	Q5_vivid_Imagination	0.625	0.088	7.073	*< 0.001*	0.452	0.798	0.625	0.58	0.58
Q10R_interest_abstract_idea	~~	Q10R_interest_abstract_idea	0.915	0.085	10.71	*< 0.001*	0.747	1.082	0.915	0.905	0.905
Q15R_understand_abstract_idea	~~	Q15R_understand_abstract_idea	0.737	0.073	10.044	*< 0.001*	0.593	0.88	0.737	0.798	0.798
Q20R_no_good_imagination	~~	Q20R_no_good_imagination	0.376	0.115	3.28	*0.001*	0.151	0.601	0.376	0.337	0.337
excited about the class	~~	excited about the class	0.244	0.036	6.705	*< 0.001*	0.173	0.315	0.244	0.326	0.326
excited about using ERP	~~	excited about using ERP	0.109	0.034	3.216	*0.001*	0.043	0.176	0.109	0.161	0.161
excited about IT	~~	excited about IT	0.389	0.04	9.674	*< 0.001*	0.31	0.468	0.389	0.535	0.535
Course_Grade_percent	~~	Course_Grade_percent	0.011	0.001	11.054	*< 0.001*	0.009	0.013	0.011	0.916	0.916
Openness	~~	Openness	0.453	0.104	4.341	*< 0.001*	0.248	0.657	1	1	1
Positive Affect	~~	Positive Affect	0.492	0.069	7.177	*< 0.001*	0.357	0.626	0.974	0.974	0.974
Cognitive_Aptitude_Score	~~	Cognitive_Aptitude_Score	29.904	0			29.904	29.904	29.904	1	29.904

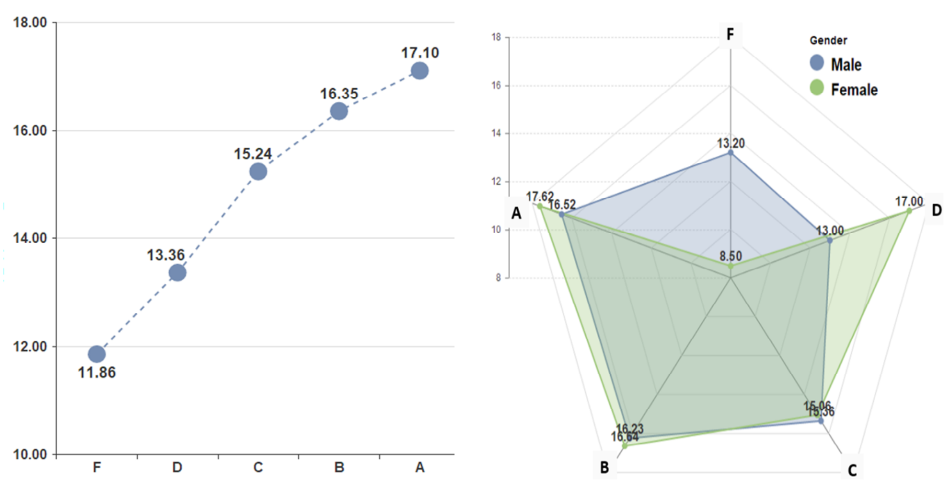
5.2 Hypotheses test and discussions

Figure 3 summarises the results of the hypotheses test and Table 2 provides detailed model testing statistics. Except for hypothesis 4, the other three hypotheses were significant at the $\alpha = 0.05$ level. That is, users' cognitive aptitude for computing (hypothesis 1) and positive affect (hypothesis 2) were positively related to their ERP system learning performance. Although Openness did not directly influence the user's ERP system learning performance (hypothesis 3), it was positively related to positive affect which in turn was positively related to ERP system learning performance (hypothesis 4).

5.2.1 Users' computer aptitude positively influences their ERP system learning performance

The relationship between users' computer aptitude and course grade was significant and positive ($p < 0.001$), as seen in Figure 3, which indicates that users who had a higher computer aptitude score achieved better ERP learning performance than others. Figure 4(a) shows participants' ERP course performance and their respective computer aptitude scores. The influence of computer aptitude is more consistent in male participants than in female participants as shown in Figure 4(b). he result also corresponds with the findings of White (2000) in computer programming learning performance.

Figure 4 Computer aptitude and ERP learning performance (a) computer aptitude and grade (b) computer aptitude and gender (see online version for colours)



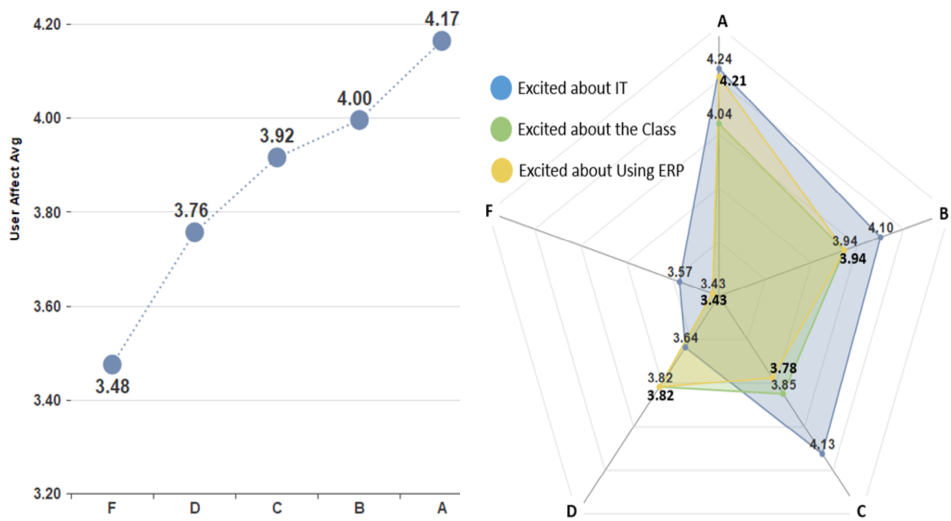
(a) (b)

5.2.2 Users' positive affect positively influences their ERP system learning performance

The relationship between excitement and ERP learning performance was significant and positive ($p = 0.003$), as seen in Figure 3, which indicates that individuals who exhibited a higher degree of Positive Affect had a better performance than others in learning the ERP system. The latent variable positive affect was measured by the degree of excitement about the class, excitement about IT, and excitement about using an ERP system. As shown in Table 2 and Figure 3, all three variables were found to load significantly on the factor at the $\alpha = 0.05$ level.

As observed in Figure 5, students who had lower ERP learning performance (i.e., a D or F grade) had a lower positive affect level on all three measures, and the lower a user's positive affect for the class and using an ERP system, the lower was their performance. The best performers (i.e., students who earned an A grade) had a consistently high level of positive affect for IT in general, using an ERP system, and the class they are taking. As the level of positive affect for using an ERP system and the class decreased, the ERP learning performance decreased regardless of Positive Affect towards IT as observed in students who earned a B or a C grade. With a similar level of positive affect on IT, the positive affect of using an ERP system distinguished the performance between students with a B grade and a C grade.

Figure 5 Positive affect and ERP learning performance (see online version for colours)



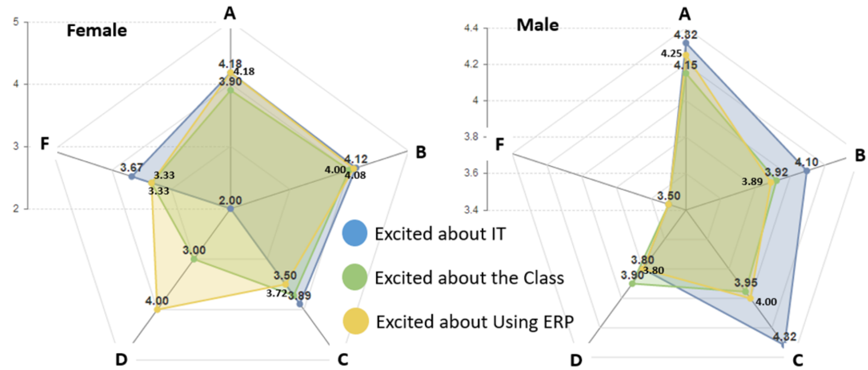
(a) (b)

Notes: Scale: strongly agree – agree -neutral—disagree – strongly disagree (5-4-3-2-1).

Additional analyses shown in Figure 6 indicated that male participants followed the same pattern of overall results shown in Figure 6. For participants who earned A, B, or C grades, male participants seem to have a higher positive affect for IT than for the class they are taking and the use of ERP systems while female participants showed a more consistent positive affect for all three dimensions. Participants who failed the class were those who were indifferent and neutral on all three positive affect dimensions across both male and female respondents, which reinforces the importance of positive affect.

These results are consistent with prior research that has found positive affect to be related to learning performance (Camacho-Morles et al. 2021; Hagger et al., 2014; Pekrun, 2006, Pekrun et al., 2002) and extends this association to the learning of complex enterprise systems.

Figure 6 Positive affect and ERP learning performance by gender (see online version for colours)

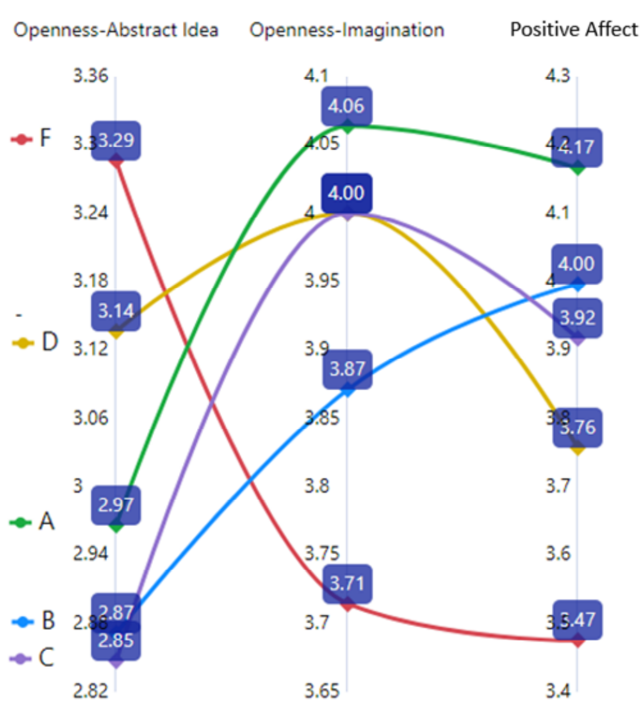


Note: Scale: strongly agree – agree -neutral—disagree – strongly disagree (5-4-3-2-1).

5.2.3 Users' openness personality trait positively influences their ERP system learning performance

The hypothesis 'users' openness personality trait positively influences their ERP system learning performance' was not supported (p = 0.956, α = 0.05). That is, the openness (intellect/imagination) personality trait did not influence positive affect which is related to ERP learning performance as seen in Figure 3.

Figure 7 Positive affect and openness on ERP learning performance (see online version for colours)



The openness trait encompasses two characteristics: imagination and abstract ideas. In Weick's (2006) exploration of the role of imagination in knowledge, he suggested that suggested that obstacles to imagination hinder organisational responses to challenges. Gogan (2006) noted that complex enterprise systems support highly structured, highly standardised processes and are contrary to imaginative use, but learning complex enterprise information systems also requires experimentation, exploration, and analytics which are related to imagination and intellectual curiosity. This presents a paradox where imagination is both necessary and seemingly contrary to the structured nature of enterprise systems.

To gain deeper insights, this research examined the openness trait through its imagination characteristic and the abstract ideas characteristic. Figure 7 reveals a negative relationship between these two characteristics. Students reporting a lower degree of abstract ideas exhibited a higher level of imagination ability. Furthermore, Figure 7 indicates that the imagination characteristic and the Positive Affect personality trait complement each other to enhance learning performance. For example, students with a higher degree of imagination and a higher degree of positive affect perform better than their peers. These findings suggest that the imagination aspect of openness is closely associated with positive affect, which measures motivation (Olafson and Ferraro, 2001), and creative, flexible, and holistic ways of thinking (Fiedler, 2001; Ashby, et al., 1999).

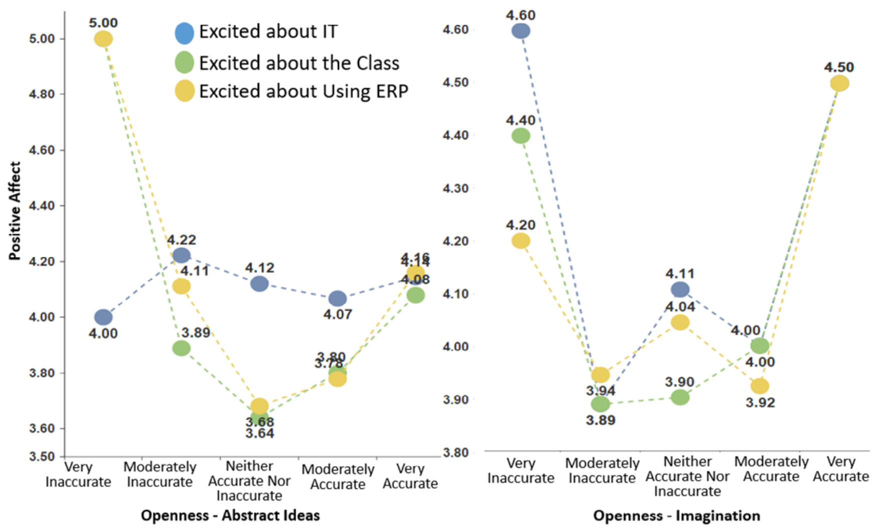
5.2.4 Users' openness personality trait positively influences their positive affect (mediation of positive affect in the influence of openness on ERP learning performance)

The structural equation model revealed a significant positive path ($p = 0.042$, $\alpha = 0.05$) between the openness personality trait and positive affect. This indicates that individuals with higher openness exhibit higher levels of positive affect, which in turn enhances ERP learning performance, demonstrating that positive affect serves as a mediator.

Further analysis, as shown in Figure 8, indicates that the abstract ideas and imagination characteristics of openness influence positive affect towards IT, the business class, and ERP systems differently. For the abstract ideas characteristic, positive affect towards IT did not change significantly when the degree of a user's abstract ideas characteristic increased, possibly because users did not perceive abstract ideas as necessary for IT tasks. Conversely, users with lower imagination reported higher excitement towards the business class and ERP systems, suggesting they perceived these as less abstract and more structured. Furthermore, users with a higher degree of imagination characteristic (i.e., those who answered 'very accurate' or 'moderately accurate') reported increased excitement, indicating they valued the imaginative aspects of ERP learning.

For users with a lower level of abstract ideas characteristic (i.e., those who answered 'very inaccurate' and 'moderately inaccurate'), higher positive affect towards the business class and ERP systems was noted, possibly because they perceived these subjects and environments as structured and less abstract. For users who are more open to abstract ideas (i.e., those who answered 'very accurate' or 'moderately accurate') exhibited higher positive affect, likely due to their appreciation for the complexity and interconnectedness of ERP systems and business classes, which align with their abstract thinking abilities.

Figure 8 Openness and positive affect (see online version for colours)



These findings align with prior research indicating a positive correlation between openness and positive affect. Therefore, while openness may not directly influence ERP learning performance, it indirectly does so through its positive impact on positive affect, which mediates the relationship by enhancing motivation and engagement in learning complex enterprise systems.

6 Summary, implications, and future research directions

This research explored the relationships between computer aptitude, positive affect, and the openness personality trait in the successful learning of complex enterprise systems. Data were collected from students enrolled in two different universities over five semesters between 2016 and 2020. Using SEM, the results indicated that users' computer aptitude and positive affect positively correlated with ERP system learning performance. Additionally, the openness personality trait was positively related to positive affect, which in turn influenced ERP learning success.

One significant contribution of this research is that it looked beyond technology adoption factors to explore the relationships between aptitude, affect, and personality on successful learning and the use of complex enterprise systems. In learning psychology literature, positive affect has been shown to impact learning success and performance (Camacho-Morles et al. 2021; Hagger et al., 2014; Pekrun et al., 2006, 2002). This study extends prior research by examining the role of positive affect in learning complex enterprise systems. Our findings show that positive affect significantly influences learning success of complex enterprise systems.

Furthermore, this research provides insights into successful learning and use of a complex enterprise system by incorporating the openness personality trait along with users' positive affect. Openness is closely associated with the willingness to learn something new and therefore to engage in learning a complex system. Including and exploring the relationship between positive affect and openness contributes new concepts to the nomological network of user behaviour, engagement, and successful learning outcomes. These findings enhance the understanding of individuals who can successfully adopt and use complex enterprise systems.

Learning to use complex enterprise information systems goes beyond the rote and mechanical use of standard processes. Whereas using a complex ERP system such as SAP S/4HANA ERP requires the user to conform with the standardised processes that the ERP system is designed to support, effectively leveraging these systems demands critical thinking and analytical skills. This study supports the notion that positive affect, the openness personality trait, and their interdependencies are influential predictors of successful enterprise information system usage, providing insights into optimising business and organisational performance.

A limitation of this research is that this study was conducted with college students from two universities in the USA, which may not fully represent the learning experiences and behaviours of working professionals in different organisational settings. Future research could expand on this study by investigating the relationships between computer aptitude, positive affect, and the openness personality trait among working professionals over time. Such longitudinal studies would provide deeper insights into how these factors influence the continuous learning and adaptation required for using complex enterprise systems in real-world business settings. Furthermore, conducting cross-cultural comparisons can help determine if the relationships are consistent across diverse cultural settings, thereby enhancing the generalisability of the findings.

Although training programs have been utilised in industry to improve performance, the study did not explore how different training methodologies might impact the relationships between the variables studied. It is valuable to explore different training methodologies and examine the effectiveness of targeted training programs designed to enhance positive affect and leverage openness traits among users learning ERP systems. A valuable extension of this research is to develop and test psychological interventions such as mindfulness training, positive reinforcement strategies, and resilience-building exercises aimed at increasing positive affect and Openness among ERP system learners.

As shown in Figure 3, two of four items MEASURING the ‘openness’ personality trait were retained to maintain their theoretical significance and contribution to the construct’s validity (Byrne, 2010; Bollen and Lennox, 1991), ensuring a comprehensive measurement model. To enhance ‘openness’ personality constructs with low factor loading indicators, future research should focus on refining and developing items through qualitative methods, such as focus groups and interviews, to better capture theoretical aspects. Employing mixed-methods approaches and advanced statistical techniques like confirmatory factor analysis (CFA) and item response theory (IRT) can improve item precision. Additionally, testing in diverse contexts, conducting longitudinal studies, and integrating alternative measures will help validate and strengthen the construct’s reliability and validity, ensuring comprehensive measurement models.

The study primarily examined individual factors without considering the impact of team dynamics and collaboration on learning ERP systems. As Lea and Eng (2021) have reported that team dynamics influenced learning performance in an accounting and an ERP class, future studies can be valuable in exploring how positive affect and openness within team settings influence collective learning outcomes and system adoption, which is particularly relevant for organisational implementations of ERP systems.

The results of this study provide valuable insights for human resources professionals to understand the skills and attitudes contributing to success in using complex enterprise systems. As enterprise systems are essential for supporting the core business processes of organisations of all sizes, from small and mid-sized enterprises to large global corporations, finding the right talent to operate these systems is therefore critical. Reports from Harvard Business School (2023), Boston Consulting Group (2023), and McKinsey (2023) highlight the increasing prevalence of skills-based hiring in building a capable and adaptable workforce in today's fast-changing job market. The skill-based hiring trend highlights the growing importance of specific skills and competencies over traditional theory-based university education. Research findings on the impact of personality traits and emotional affect on learning success in ERP systems suggest that university education can be reshaped to bridge the gap with industry needs. By balancing skill-based and theory-based education, universities can better prepare students for the demands of the modern workforce. Understanding the combination of attitudes and emotions that contribute to successful skill development is thus crucial for shaping the future workforce and enhancing university education.

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