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EXPLORING AUTOMATED SHORT ESSAY SCORING (ASES) TECHNOLOGY BASED ASSESSMENT MODEL: THE ROLE OF OPERATIONAL MANAGEMENT STRATEGIES TO IMPROVE QUALITY AT UNIVERSITIES

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Abstract: *Over the past couple of decades, technological advancements have proliferated across all fields and domains; consequently, the evolving technological environment has also impacted the education sector. This study investigates the role of operational management strategies in educational institutions' adoption of digital technologies such as automated short essay scoring (ASES). A self-administered questionnaire was used to collect quantitative data from various educational institutions in Indonesia for this quantitative study. According to the study's findings, operational management strategies such as organizational ambidexterity, strategic leadership, quality assurance, and digital competence play a significant and positive role in educational institutions' adoption of ASES. In addition, the moderating function of strategic agility was confirmed. The study contributes significantly to the body of knowledge because the existing literature on ASES is limited, and no prior study has investigated the relationship between operations management strategies and the adoption of digital technologies in automated technology-based assessment models such as ASES.*

Keywords: *automated short essay scoring (ASES), Operational management strategies, education, technology adoption, organizational ambidexterity, strategic agility*

1. Introduction

The rapid development of digital technologies has compelled businesses to

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improve their current operations, monitor the shifting environment, and reformulate their strategies accordingly so as not to fall behind the competition (Arbussa, Bikfalvi, & Marquès, 2017). Organizations that exploit the full potential of emerging opportunities continue to advance and obtain a competitive advantage. Over the past couple of decades, technological advancements have proliferated across all fields and domains; consequently, the evolving technological environment has also impacted the education sector. Digitalization and automation in the education sector have radically altered the online mode of teaching and learning and how students are communicated with and evaluated (Lim et al., 2021). Historically, automated student assessment consisted only of multiple-choice questions, which required fundamental programming functions like pattern matching. However, modern technologies have made it possible to evaluate essay-type responses from students autonomously. In this regard, machine learning and artificial intelligence play a crucial role. Automating and digitizing the assessment process eliminates the prospect of human error and bias, making it more accurate and reliable. Nevertheless, despite the advantages of automated assessment, especially of essays, also known as automated short essay scoring (ASES), it has not yet been widely implemented (Machicao, 2019). This study seeks to investigate the organizational level factors, specifically operations management strategies, that can promote or influence the adoption of digital technologies such as ASES in educational institutions. Organizational ambidexterity refers to an organization's ability to balance exploitation and exploration strategies (Clauss et al., 2019). Strategic leadership, quality assurance, and digital competence are other factors that will be investigated. Strategic leadership refers to the capacity of leaders to anticipate and scan the business's internal and external environment, know the existing capabilities and potential, and make strategic decisions based on this information (Nwachukwu & Vu, 2020; Soria-García & Martínez-Lorente, 2014). Quality assurance is concerned with maintaining the highest potential quality at all levels of an organization in order to provide customers with a superior product or service. Lastly, digital competence refers to a person's familiarity with technology and ability to utilize it easily and comfortably (Blayone et al., 2018). In addition, this study seeks to examine the moderating effect of strategic agility, which is the capacity of an organization to remain fluid and adaptable and to modify its strategies in response to the changing demands of its environment (Arbussa et al., 2017). The present study contributes to the existing body of knowledge because the literature on ASES is already limited, and no prior study has investigated the relationship between operations management strategies and the adoption of digital technologies in automated technology-based assessment models like ASES.

1.1. Objectives of the Research

The study's primary objective is to investigate the role/influence of organization-level factors, i.e., operations management strategies, in implementing digital technologies in educational institutions, specifically adopting ASES. The following are the objectives of the study.

- To determine the influence of organizational ambidexterity on adopting ASES in educational institutions.
- To determine the influence of strategic leadership on adopting ASES in

educational institutions.

- To determine the influence of quality assurance on adopting ASES in educational institutions.
- To determine the influence of digital competence on adopting ASES in educational institutions.
- To determine the moderating role of strategic agility in adopting ASES in educational institutions.

2. Literature Review

2.1 Digital Teaching/Learning Method: Automated Short Essay Scoring (ASES)

The global trend toward digitalization and automation is constant. In this regard, the education sector has not lagged far behind. Many educational institutions worldwide have increasingly adopted online learning and education, notably after the Covid-19 outbreak (Ramesh & Sanampudi, 2022). Practically observable and quantifiable advantages of online learning/teaching have led to increased efforts to digitalize and automate the education system. Not only has the method of teaching and learning evolved, but so has the method of assessing students. Educational institutions that routinely adopt technological advances have implemented automated assessments and computer-based examinations. Automating the assessment procedure eliminates assessor bias and carelessness (Lim et al., 2021). It also eliminates the need for instructors to manually grade exams. However, most automated assessments are based on multiple-choice questions, and it is difficult to automate the grading of brief and essay-style questions. Simple programming and pattern matching are insufficient to evaluate an essay-style query. "Essays are scholastic compositions with a narrow focus on a particular phenomenon. They provide students with the opportunity to demonstrate in-depth knowledge of a subject" (Ifenthaler, 2022). Consequently, intricate language programming techniques, such as natural language processing (NLP) and machine learning, are necessary.

Automated essay scoring (AES) or automated short essay scoring (ASES) is "a computer-based assessment system that automatically scores or grades student responses by considering appropriate features" (Ramesh & Sanampudi, 2022). Decades ago, the foundation was laid for implementing ASES in educational institutions, but its widespread implementation has not yet occurred (Machicao, 2019). The primary goal of implementing ASES in educational institutions is to reduce the time, cost, and other resources required for assessments and eradicate the reliability issues associated with manual assessment (Lim et al., 2021). The objective here is not to completely supplant human evaluators but to effectively assist them in facilitating their work and cross-examination. ASES systems, according to Lim et al. (2021), "rely not only on grammar, but also on more complex features such as semantics, discourse, and pragmatics" (p. 1876). Consequently, machine learning techniques and AI technology are required, which can be trained with several human-graded essay samples to grade future essays automatically.

While discussing the benefits of ASES, Tshibalo (2007) noted that computer-aided assessment "allows marking; immediate feedback, the recording of student scores,

and the analysis of student performance to be processed by computer, thereby reducing the workload of educators" (p. 684). Despite the benefits of implementing ASES, many educational institutions continue to resist its adoption. The primary concern is a threat to employment roles and a feeling of control, especially among teachers. As Dreher, Reiners, and Dreher (2011) noted, educators may dread being replaced by automated assessment software if they view their ability to score assessments as fundamental to their role (p. 166). Other factors contributing to resistance to adopting ASES include a lack of digital competency/literacy, decentralized decision-making that focuses on immediate matters rather than a progressive approach, a lack of responsiveness to the changing environment, and a steadfast adherence to the traditional education system. This study investigates the institution-level factors contributing to the successful acceptance and adoption of cutting-edge technologies like ASES in the education system. Insufficient research has been conducted on automated assessment, and no previous studies have linked operational management strategies with adopting ASES in Saudi Arabian educational institutions. Therefore, this research contributes significantly to the existing body of knowledge.

2.2 Organizational Ambidexterity

Innovation and environmental adaptation are essential for the survival of any organization. However, organizations must also endeavor for operational efficiency and consistency. Ambidexterity is the equilibrium between these two phenomena in an organization. "Ambidexterity is a firm's ability to exploit current business operations with ever-increasing levels of efficiency (i.e., exploitation) while simultaneously exploring new opportunities and radical innovations (i.e., exploration)" (Clauss et al., 2019). Ambidexterity is best understood when its components, exploitation and exploration, are considered.

Exploitation generally refers to incremental improvements made to an existing system to achieve optimal efficiency and continuous improvement. Many businesses prioritize exploitative innovation because it generates short-term, certain results (Paliokaitė & Pačėsa, 2015). Firms gradually modify their products/services or practices in response to market demands. The fundamental objective is efficient utilization of resources, cost reduction, and failure reduction (Claus et al., 2021). Consequently, exploitation focuses primarily on the refinement of existing competencies, low-risk innovation, certain short-term outcomes, continuous improvement, cost-leadership, operations efficiency, and the development of a substantial knowledge base (Clauss et al., 2021; O'Cass, Heirati, & Ngo, 2014; Paliokaitė & Pačėsa, 2015; Souza & Takahashi, 2019). However, exploitation innovation is not without its limitations. It can impede businesses' radical development, reduce employees' opportunities to acquire new skills and cause an organization to stagnate with diminished growth and long-term performance (Brix, 2018; Souza & Takahashi, 2019).

Exploration, on the other hand, refers to radical innovations that include searching for new opportunities, addressing the needs of emerging customers, learning new techniques and skills, and acquiring new knowledge to readily accept and receive the changes in the external environment (Benitez et al., 2018; Bican, Guderian, &

Ringbeck, 2017; Clauss et al., 2021; Jurksiene & Pundziene, 2016; Paliokaitė & Pačėsa, 2015). New information and radical/disruptive changes facilitate creativity. The limitations of exploration innovation include uncertainty about the outcomes, the potential failure of the introduction of disruptive products/services, high risk, the potential over-utilization of scarce resources, the failure to meet short-term goals, and the absence of standardization and formalization of practices (Clauss et al., 2021; Souza & Takahashi, 2019).

Organizational ambidexterity is concerned with the equilibrium between exploitation and exploration innovations. It is accomplished when organizations seek to increase their current operations' efficiency while seeking new opportunities. Through ambidexterity, businesses can sustain both their short-term and long-term competitive advantage (Clauss et al., 2021; Rosing & Zacher, 2017). Individuals, groups, and organizations can collaborate to help organizations become ambidextrous. Consequently, based on the preceding discussion, it can be hypothesized that ambidextrous organizations, i.e., those that seek new opportunities and seize emerging market changes while maintaining and sustaining efficiency in their current practices, will be more likely to adopt environmental changes. Therefore, the ambidexterity of educational institutions will facilitate the adoption of novel practices and evaluation methods such as ASES. Consequently, the following hypothesis is advanced:

H1: *Institutional ambidexterity is positively associated with educational institutions' adoption of ASES.*

2.3 Strategic Leadership

Firms/businesses must be proactive and address these challenges strategically due to environmental changes, particularly those that lead to cutthroat competition, altering customer needs and demands, and technological advancements (Nwachukwu & Vu, 2020). In such circumstances, strategic characteristics involving speed and adaptability are required to capitalize on emergent external opportunities ahead of competitors (Brozovic, 2018). Consequently, organizations must possess dynamic capabilities to thrive in a dynamic environment. Administrators, specifically leaders, are crucial in this regard (Pitelis & Wagner, 2019). The executives are responsible for navigating the organization through turbulent times and gaining the most advantage from the external environment. Strategic leadership is "the ability to anticipate, conceive, maintain flexibility, and permit employees to create necessary strategic change" (Nwachukwu & Vu, 2020). Strategic leaders are aware of the company's internal and external environments and existing capabilities. They can achieve both the business's short-term stability and long-term sustainability through their strategic insight and visionary approach (Carter & Greer, 2013; Ma & Seidl, 2018). "Strategic leaders anticipate, foresee, maintain flexibility, think strategically, and collaborate with others to implement changes that will positively impact the organization's future" (Nwachukwu & Vu, 2020). In times of great uncertainty and ambiguity, strategic leaders help the team comprehend the complexities and steer the organization toward innovation. They continually remind their team of the organization's vision and encourage them to capitalize on the ever-changing environment.

Prior research indicates that strategic leadership promotes innovative organizational practices (Kurzhals, Graf-Vlachy, & König, 2020). While discussing the responsibilities of

strategic leaders, Cortes and Herrmann (2021) noted that "their strategic decisions and behaviors have a direct influence on innovation (e.g., by deciding which innovation projects to pursue, allocating resources to certain innovation initiatives, or relying on their knowledge to assist innovation processes)." (p. 11). Therefore, the contribution of strategic leaders to the innovation of organizations cannot be overlooked. Based on the preceding discussion, it can be hypothesized that strategic leaders can influence innovative practices such as adopting ASES in educational institutions. The following hypothesis is therefore stated:

H2: *Strategic leadership is positively associated with adopting ASES in educational institutions.*

2.4 Quality Assurance

Quality Assurance or quality management can be defined as a "set of concepts, strategies, tools, and beliefs, etc., which are aimed at improving the quality of products and services while reducing waste and costs" (Mukhopadhyay, 2020). Quality assurance requires the entire system and procedure for producing a product or delivering a service to be effective and error-free. The fundamental concept is to use high-quality raw materials, processes, and products to satisfy customer demand without receiving any complaints. Total quality management (TQM) is a subfield of quality assurance that emphasizes quality in inputs and procedures and the incorporation of a quality culture throughout the entire organization. TQM is primarily concerned with satisfying customers with products and services to the extent that they recommend them to their social communities, thereby enhancing the organization's overall reputation (Sfakianaki, 2019). Thus, it concentrates on adapting products and services to changing environments to capture current and future demand (Mukhopadhyay, 2020). Under TQM, the quality standards are not static; rather, they are continuously defined, and efforts are made continuously to attain these new levels of quality. "Continuous improvement, systematic change, organization-wide perspective involving all, collective/team problem solving, knowledge or data supported decisions for change, the satisfaction of internal and external customers, etc. are some of the attributes of TQM" (Mukhopadhyay, 2020).

Although the concept and practice of TQM originated in the business sector, its importance in the education sector is also significant. In the past decade, there has been a growing emphasis on the implementation of TQM in education (Kaiseroglou & Sfakianaki, 2020; Nasim, Sikander, & Tian, 2020). Nevertheless, the concept of TQM in education differs from that in industry. Education quality cannot be determined solely by resource quality; it also depends on resource utilization, system organization, teacher and staff training, and the involvement and support of society, particularly families (Ruben, 2019). Sfakianaki (2019) conducted a study in Greece relating TQM to primary and secondary education by creating and evaluating a 66-item instrument. This study identified the main factors of TQM in education as a focus on continuous improvement, student-centricity, leadership, teacher training, education, change management, evaluation methods, and process control (Kaiseroglou & Sfakianaki, 2020). The preceding discussion demonstrates that TQM in education is a complex concept. However, continuous improvement and change management are necessary to meet the changing requirements. Therefore, it can be hypothesized that if an

institution is committed to implementing TQM principles, it will embrace technological advances brought about by an evolving external environment. Thus, these institutions would implement automated assessment methods such as ASES. Consequently, the following hypothesis is advanced:

H3: *TQM is positively associated with adopting ASES in educational institutions.*

2.5 Digital Competence

Digitalization and automation have permeated all professions and disciplines. Organizations that fail to adapt to the shifting demands posed by technological advances fall behind those that grasp new opportunities proactively. Organizations must develop new competencies to completely capitalize on the potential of digital technology advancements (Perkin & Abraham, 2021). These competencies include innovation orientation, resourcefulness, customer orientation, and skill development for assimilating digital advancements without difficulty (Limani et al., 2019).

In the field of education, technological advancements have also emerged. Both instructional and learning methods have evolved due to digitization. Traditional educational systems were established decades ago, when technology was either nonexistent or in its infancy, necessitating the modernization and incorporation of digitalization into the sector. In their study Limani et al. (2019), discuss the advantages of technological advances in education, stating, " through digital transformation and the beginning of the use of educational new technology, teachers are beginning to make drastic changes in their institutions using platforms that enable communication and activities with students, placement of study materials, assessment tests, and even in the physical composition of their classes, and this at a rapid pace." To implement digitalization mechanisms at all levels of the education system, it is crucial to develop digital competencies (Jackson, 2019; Kühn Hildebrandt, 2019). Digital competencies can be defined as "knowledge, skills, and attitudes that support the effective and purposeful use of technology" (Blayone et al., 2018). Instructors' competencies and willingness to acquire new skills are crucial to successfully implementing digital technology in the educational system (Petko, Prasse, & Cantieni, 2018). Therefore, efforts must be made to improve instructors' ICT skills to readily implement technological advances (Tourón et al., 2018). The digital competency of educators primarily entails their proficiency and comfort with utilizing digital technologies. These skills include communicating through technology, technological literacy, content creation on digital platforms, safety and security issues, problem-solving using technology, and analyzing and contemplating. To successfully implement technology in education, instructors and pupils must possess digital competence (Blayone et al., 2018). Therefore, it can be presumed that digital proficiency is crucial for integrating digital technologies such as automated assessment models into the educational system. The following hypothesis is therefore proposed:

H4: *Digital competence is positively associated with adopting ASES in educational institutions.*

2.6 Strategic Agility

(Brand et al., 2021; Clauss et al., 2021) A strategically agile organization responds quickly to the changing demands of the environment to ultimately obtain a competitive advantage. Strategic agility "is defined as a firm's ability to continuously

renew itself and maintain flexibility without compromising efficiency" (Clauss et al., 2019). Arbussa et al. (2017) found that strategically agile organizations are better suited for business model innovation because they respond quickly to new requirements, opportunities, and trends arising from changes in their business context and adjust their strategies accordingly. Three dimensions comprise the concept of strategic agility: strategic sensitivity, leadership unity, and resource fluidity. Strategic sensitivity primarily concerns identifying environmental changes that can be exploited for competitive advantage. It also requires the prompt and thorough dissemination of such opportunities throughout the organization. Leadership unity or collective commitment is concerned with the management of an organization making bold, strategic decisions collectively. Resource fluidity concerns the flexible reallocation, mobilization, and utilization of resources and competencies (Clauss et al., 2021).

As a result of technological advancements, educational institutions must also adapt to new demands. Institutions adaptable to these changes would flourish in such a highly competitive environment. Therefore, it is essential for educational institutions to be strategically adaptive, i.e., to realign their resources following the environment's constant change (Menon & Suresh, 2020). The institute's degree of adaptability is vital to incorporating and integrating new technologies into the educational system. Only then can an institution detect and respond to changes on time. The institutes' strategic agility is also necessary to adopt cutting-edge technologies such as automated assessment models. Following Clauss et al.'s (2021) study, strategic agility is utilized as a moderator in the present investigation. Therefore, the following hypotheses are advanced:

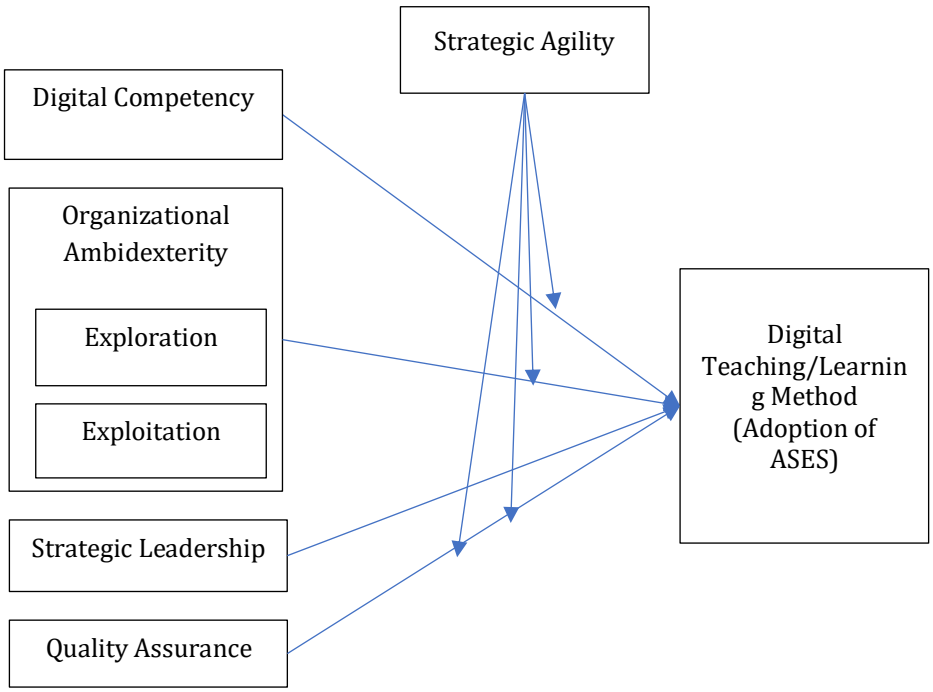

Fig.1. Conceptual model of the Study

H5: *Strategic agility moderates the relationship between organizational ambidexterity and the adoption of ASES.*
H6: *Strategic agility moderates the relationship between strategic leadership and adopting ASES.*
H7: *Strategic agility moderates the relationship between quality assurance and adopting ASES.*
H8: *Strategic agility moderates the relationship between digital competence and adopting ASES.*

3. Methodology

3.1 Research Instrument

Validated measurement questionnaires were used to collect data on the study's variables. The organizational ambidexterity variable was measured by adapting the instrument from the study by Clauss et al. (2021). The variable of strategic leadership was measured using an instrument adapted from Nwachukwu and Vu's (2020) study. The quality assurance was assessed by modifying the instrument developed by Soria-García and Martínez-Lorente (2014). The digital competence variable was measured by adapting the Rubach and Lazarides (2021) developed instrument. The variable of strategic agility was measured by modifying the instrument developed by Claus et al. The variable of ASES adoption was devised based on the research of Dreher et al. (2011). Every variable was measured using a 5-point Likert scale. Table 1 presents the corresponding measurement items and statements for each variable and their source.

Table 1 Measurement Tools

Items	References
Organizational/Institutional Ambidexterity	
Exploration	
Our institute looks for novel technological ideas by thinking "outside the box". "	(Clauss et al., 2021)
Our institute bases its success on its ability to explore new technologies.	
Our institute creates learning/teaching methods that are innovative.	
Our institute seeks creative ways to satisfy its students' learning' needs.	
Our institute aggressively ventures into new knowledge segments.	
Our institute actively targets new customer groups. (D)	
Exploitation	
Our institute commits to improving quality and lower costs.	(Clauss et al., 2021)
Our institute continuously improves the reliability of its teaching/learning methods.	
Our institute increases the levels of automation in its educational operations.	
Our institute constantly surveys existing students' satisfaction.	
Our institute fine-tunes what it offers to keep its current students satisfied.	
Our institute penetrates more deeply into its existing student base.	
Strategic Leadership	
Our leaders develop and share the mission and vision of the institute.	(Nwachukwu & Vu, 2020)
Improvements throughout the institute are monitored, reviewed, and championed by leaders.	
Our leaders ensure the institute is agile and flexible enough to face change effectively.	
Our leaders identify external shareholders and regularly engage with them.	
Our leaders inspire people and create a culture of excellence.	
Digital Competence	
Based on my information needs, I can identify and use appropriate sources in digital environments.	(Rubach & Lazarides, 2021)
I can use my search strategies in digital environments.	
I can store digital information and data securely.	
I can communicate using different digital media.	
I can edit files and documents collaboratively with others using digital media.	

I can actively participate in society using digital media. I can share my experiences with digital media in interactions with others.	
I can use familiar apps and programs according to my needs.	
I can edit and merge digital content in different formats.	
I can present digital content in different formats.	
I can protect my privacy in digital environments through appropriate measures.	
I can use digital technologies in a healthy and environmentally responsible way.	
I can independently use digital learning opportunities and appropriate tools.	
I can use digital tools and platforms according to my needs.	
I know about the functioning and basic principles of digital systems.	
Quality Assurance	
The institutional project design has been developed with the participation of the sectors involved in their future development.	
The curriculum has and develops all quality principles the education standards authority agrees upon.	
The pedagogical guidelines are clearly defined.	
The material design corresponds to quality criteria in formal aspects such as systematization, clarity, and conceptual rigor.	(Soria-García & Martínez-Lorente, 2014)
The curriculum guarantees that teachers' s actions can be participative, creative, and innovative.	
The curriculum is susceptible to being adapted to student diversity by adopting organizational and curriculum measures.	
The assessment model allows the diversity of learning through different performances in its implementation.	
Institutional projects incorporate improvements from the results of the previous year's assessment.	
The assessment analysis results involve a permanent feedback procedure to enable continuous improvement.	
Strategic Agility	
Strategic Sensitivity	
We are very sensitive to external changes (regarding Industry skills requirements, technologies, etc.) and integrate these into the strategic planning of our institute.	
We utilize different mechanisms to become aware of strategic developments early.	
Requirements for strategic adaptations are communicated fast and comprehensively through the institution.	
Collective Commitment	(Claus et al., 2021)
Our top management team can make bold and fast strategic decisions.	
Our management board collaborates for strategic decisions.	
Our management collectively solves strategic questions without being bogged down in top-level 'win-lose' politics.	
Resource-fluidity	
We can reallocate and utilize capital resources fluidly.	
Our people and their competencies are highly mobile within our institute.	
Our institute structure allows for flexible redeployment of our resources.	
Adoption of ASES	
My institution encourages me to use ASES techniques to evaluate students' learning.	
My institution explains the benefits of ASES for students and instructors.	(Dreher et al., 2011)
I think the ASES evaluation technique will facilitate me in my job/improves my efficiency.	
ASES provides me time to focus on other aspects of my learning, such as individual student guidance.	
ASES technique for assessment is more accurate and reliable.	

3.2 Target Population and Sampling Technique

Indonesian educational institutions, including schools, vocational institutes, colleges, and universities, provided the data for the present study. As the population list could not be generated (i.e., the population frame was unknown), the convenience sampling technique was utilized to capture data.

3.3 Data Collection Method

A self-administered survey was disseminated to the employees/staff/management of various educational institutions in Indonesia, including schools, vocational institutes, colleges, and universities. The data was collected with the participants' prior consent. 500 questionnaires were distributed, and 348 completed questionnaires were returned. 10 questionnaires were eliminated, leaving 338

questionnaires for analysis.

3.4 Data Analysis Method

This study's collected data was analyzed using SPSS. Cronbach's alpha was utilized for the reliability testing. Pearson's correlation test was used to determine the correlations. In addition, the study's hypotheses were evaluated using simple linear regression analysis in SPSS. Model 1 of the Hayes Process Macro was utilized to evaluate moderation.

4. Analysis

4.1. Descriptive Statistics

Table 2- Descriptive Statistics (Means, Standard Deviation, Reliability, correlations among study variables)

Variable	Mean	Std. Dev.	Reliability	1	2	3	4	5	6
Organizational Ambidexterity	3.214	0.96	0.72	1					
Strategic Leadership	4.110	1.18	0.77	0.014	1				
Quality Assurance	3.987	0.92	0.65	0.020	0.240	1			
Digital Competence	3.640	0.93	0.80	0.018	0.210	0.044	1		
Strategic Agility	3.541	0.88	0.71	0.016	0.010	0.037	0.021	1	
Adoption of ASES	3.551	0.76	1.14	0.010	0.041	0.024	0.011	0.021	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 provides descriptive statistics for the study's variables. The table reveals that all study variables have reliability statistics greater than the commonly accepted value of 0.6, indicating that the measurement items used to assess each construct are internally consistent and, therefore, reliable. In addition, the correlation statistics demonstrate a significant interrelationship between study variables. However, correlation statistics are not sufficiently high to cause multicollinearity problems.

4.2. Hypothesis Testing

Table 3 Regression Analysis

Regression Statistics					
Multiple R			0.54		
R Square			0.36		
Adjusted R Square			0.68		
Standard Error			0.24		
Observations			300		
ANOVA					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	25	42.31	9.57	58.64	7.2
Residual	75	12.3	0.34		
Total	100	54.61			
	Coefficients	***Standard Error***	***t Stat***	***P-value***	
Constant	0.034	0.51	12.34	0.021	
Organizational Ambidexterity (OA)	0.022	0.11	3.55	0.020	
Strategic Leadership (SL)	0.030	0.13	2.97	0.019	
Quality Assurance (QA)	0.028	0.21	4.56	0.040	
Digital Competence (DC)	0.033	0.34	5.64	0.041	
Strategic Agility (SA)	0.041	0.44	5.01	0.021	

P<0.05 (Hair et al., 2007)

t> 1.96 (Hair et al., 2007)

The regression analysis for all study variables is presented in Table 3. Regression analysis is utilized to test a study's hypotheses, i.e., to determine the relationship between independent and dependent variables. The table demonstrates that organizational ambidexterity is positively and significantly associated with adopting ASES in educational institutions at p< 0.05, supporting the study's null hypothesis. Similarly, strategic leadership is positively and significantly associated with educational institutions' adoption of ASES at p< 0.05, supporting the study's second hypothesis. The hypothesis that quality assurance is positively and significantly related to adopting ASES in educational institutions is supported by the finding that p <0.05. In addition, digital competence is positively and substantially associated with adopting ASES in educational institutions (p <0.05), supporting the fourth hypothesis of the study. Strategic agility is also positively correlated with educational institutions' adoption of ASES.

4.3. Moderating Effect of Strategic Agility

The Hayes (2017) moderation statistical model was used to measure the moderating effects of strategic agility between independent variables (i.e., organizational ambidexterity, strategic leadership, quality assurance, and digital competence) and the dependent variable (adoption of ASES).

The function of strategic agility as a moderator is evaluated in Table 3 as part of the Process Macro moderation test. The results indicate that strategic agility moderated the relationship between organizational ambidexterity and the adoption of ASES in educational institutions in a positive and statistically significant manner, supporting Hypothesis 5 of the study. The results, however, do not provide significant evidence for the moderating effect of strategic agility on the relationship between strategic leadership and the adoption of ASES in educational institutions, thus refuting the study's hypothesis 6. In addition, the results indicate that strategic agility moderated the relationship between quality assurance and adoption of ASES in educational institutions in a positive and statistically significant manner, supporting Hypothesis 7 of the study. In conclusion, the results indicate that strategic agility moderated the relationship between digital competence and the adoption of ASES in educational institutions in a positive and statistically significant manner, supporting Hypothesis 8 of the study.

Table 4 Moderation test

Dependent Variable	R^2	Variables	B	Std. Error	t	F	P
Adoption of ASES	0.28	Constant	3.52	0.35	15.005	36.74	0.01
		OA	0.041	0.05	2.35		0.03
		SA	0.034	0.02	3.21		0.01
		OA x SA	0.022	0.06	3.55		0.02
Adoption of ASES	0.32	Constant	**3.66**	**0.24**	**21.03**	**31.05**	**0.03**
		SL	**-0.034**	**0.01**	**4.55**		**0.04**
		SA	**0.024**	**0.04**	**3.67**		**0.02**
		SL x SA	**-0.014**	**0.03**	**1.01**		**0.27**
Adoption of ASES	0.39	Constant	4.67	0.39	29.34	33.21	0.01
		QA	0.041	0.03	2.66		0.02
		SA	0.027	0.04	2.97		0.02
		QA x SA	0.031	0.01	3.45		0.03

Adoption of ASES	0.25	Constant	3.66	0.03	18.64	21.02	0.04
		DC	0.021	0.01	3.44		0.02
		SA	0.031	0.02	3.67		0.03
		DC x SA	0.016	0.03	2.99		0.03

5. Discussion

This study sought to investigate the role of operational management strategies in educational institutions' adoption of ASES. To achieve this objective, the study examined the impact of organizational ambidexterity, strategic leadership, quality assurance, and digital competence on adopting ASES. In addition, the moderating effect of strategic agility on the relationship between independent and dependent variables was evaluated. 348 respondents from Indonesian educational institutions, including schools, vocational institutes, colleges, and universities, provided data for testing the study's hypotheses. To evaluate the study's hypotheses, an SPSS regression analysis was performed.

The results support the hypothesis that organizational ambidexterity is positively associated with adopting ASES in educational institutions (H1). This finding is consistent with previous research, which indicates that for an organization to implement the most recent innovations, such as digital technologies, it must balance exploitation and exploration (Clauss et al., 2019). Focusing on a single aspect is insufficient to seize the opportunities the external environment presents. Therefore, ambidexterity is essential for long-term sustainability, continuous improvement, and innovative practices (Rosing & Zacher, 2017). Additionally, educational institutions must be ambidextrous to incorporate the most recent digital technologies, such as ASES, while maintaining their standards. In this way, they can maximize the benefits of the most recent innovations, remain ahead of the competition, and provide quality education to students. In addition, the results support Hypothesis 2 of the study, which asserts that strategic leadership positively correlates with adopting ASES in educational institutions. This finding is also consistent with previous research, which indicates that for organizations to survive in a dynamic environment, it is essential that executives make sense of the situation and capitalize on it (Brozovic, 2018; Nwachukwu & Vu, 2020). Strategic leaders have a vision and an understanding of the complexities of the organization's environment; consequently, their influence is significant in seizing opportunities, such as incorporating innovative technologies (Kurzhals et al., 2020). Therefore, the function of educational institution leaders is of the utmost importance. As with any other organization, the administration and leadership of the school must also make strategic decisions. They must thoroughly comprehend the institute's context and constantly monitor the external environment for emerging opportunities. Adopting digital technologies is essential for survival in this dynamic environment.

Nonetheless, only strategic leaders can anticipate the future. Therefore, strategic leadership in educational institutions is essential for adopting cutting-edge technologies such as ASES to enhance education quality. In addition, the results support Hypothesis 3 of the study, which states that adopting ASES in educational institutions positively correlates with quality assurance. Quality assurance focuses on continuous improvement, training, skill development, and delivering exceptional services (Sfakianaki, 2019). Following Mukhopadhyay (2020), institutions committed to TQM maintain a concentration on adapting products and services to changing

environments to capture current and emerging demand. For an institution to adopt digital technologies such as ASES, it must prioritize quality and excellence. They can only assess the advantages of implementing such technologies in enhancing education quality. In addition, the results support Hypothesis 4 of the study, which asserts that digital competence was positively associated with adopting ASES in educational institutions. This finding is also consistent with prior research demonstrating that the development of digital competence is necessary to successfully implement any digital technology (Perkin & Abraham, 2021). To successfully adopt ASES, it is necessary to cultivate the digital competency of the entire faculty and student body (Blayone et al., 2018; Jackson, 2019). A technology's implementation cannot be successful without the skills and knowledge required to administer it. To ensure the successful integration of digital technologies such as ASES, educational institutions must provide training for the digital skill development of all involved parties.

In addition, the study examined the moderating effect of strategic agility. The results support the moderating role of strategic agility in the relationship between organizational ambidexterity and the adoption of ASES (H5), quality assurance and the adoption of ASES (H7), and digital competence and the adoption of ASES (H8), but not in the relationship between strategic leadership and the adoption of ASES (H6). Arbussa et al. (2017) found that strategically agile organizations are better adapted for business model innovations. The organization's adaptability and fluidity are crucial to successfully incorporating the latest digital technologies into its system (Menon & Suresh, 2020). The present study's findings are consistent with those of Clauss et al. (2021), who also discovered the positive moderating function of strategic agility in digital technology adoption. In educational institutions, management must be nimble and adaptable enough to adapt to shifting environmental demands to remain ahead of the competition and provide high-quality education. In order to adopt cutting-edge technologies such as ASES with ease and without disruption, an institution's resources must be adaptable and malleable.

Implications

No prior study has empirically examined the relationship between operational management strategies and the adoption of ASES in educational institutions, so the findings of this study are a significant contribution to the academic literature. Such factors have been examined in the context of other organizations in prior research, but operational management strategies in the education sector remain unexplored. In addition, ASES is a novel field that has not been adequately studied in the past, particularly in the Indonesian context. Therefore, this investigation contributes to the body of knowledge in multiple ways.

This study's findings have numerous practical implications. The study begins with an overview of the benefits and advantages of implementing the latest digital technologies in educational institutions, such as ASES. Second, the study identifies factors that can facilitate the adoption of digital technologies in educational institutions, such as ASES. Significant roles are played by organizational ambidexterity, strategic leadership, quality assurance, and digital competence in this regard, which means that in order for educational institutions to adopt digital

technologies, they must first work on organizational-level factors in order to create a conducive environment and culture for the successful implementation and acceptance of digital technologies like ASES. Digital competence development throughout the organization is a prerequisite for successfully implementing any digital technology. In addition, the commitment and strategic orientation of upper management/leaders are of the uttermost importance. In addition, the institution must adapt to a changing environment to readily implement any new innovations.

5.2. Limitations and Future Research Directions:

No scientific investigation is devoid of limitations. The current study has the following limitations, which provide opportunities for future research. First, while the present study is quantitative, future researchers may take a qualitative approach to studying the factors that contribute to adopting ASES in educational institutions. The qualitative method permits open-ended inquiries, which facilitates the emergence of numerous factors. Future research could integrate personal-level factors, such as the digital skills and literacy of teachers and students who are the end users of ASES. Additionally, the function of students' parents can be evaluated. Thirdly, the present study is cross-sectional; however, future studies can evaluate the impact/effectiveness of adopting ASES and its facilitators in educational institutions that have already implemented it for an extended period to carefully and practically investigate what helped and hindered its successful implementation.

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