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-RESEARCH ARTICLE-

ARTIFICIAL INTELLIGENCE, LEARNING STRATEGIES, AND DEVELOPMENT OF VOCATIONAL SKILL LESSONS WITH MULTIMEDIA SOFTWARE IN INDONESIA

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─Abstract─

This study intends to investigate the impact of artificial intelligence (AI) on learning processes in educational institutions. This study is based on primary data acquired through a questionnaire from a sample of 208 faculty members. Confirmatory factor analysis and structural equation modeling techniques were utilized for further comprehension, and the resulting findings were given. It has been found that AI deployment (institutional, student support, and instructional methods) in educational institutions have a significant and good impact on planning and executing learning strategies. However, reflection-based learning is not largely characterized by AI deployment. In addition, this research aimed to use multimedia software (Macromedia Flash) to create an interactive multimedia learning environment at the Medan 10 State Vocational High School. (1) The validation findings from the learning media experts were very good (89.1%); (2) the validation results from the subject matter skills experts were excellent (90%); and (3) the responses to product testing increased with each iteration, reaching a maximum of 97.3% favorable replies. Thus, multimedia software for the target skills constitutes effective instructional materials that involve students in the learning process in a manner that can enhance their competence. To the author's knowledge, there has been a dearth of research on the impact of AI on learning processes in educational institutions. Consequently, this study may be considered a tentative contribution to the literature on AI and learning processes in educational institutions. In addition to this research, future studies can examine AI applications in higher education and similar fields of study in greater detail.

Keywords: AI usage, learning strategies, vocational skills, CFA, Indonesia

1. INTRODUCTION

Digital technologies (DT) have become an intrinsic element of daily life. It is commonly believed that DT has altered our perspective on knowledge, communication, and other mundane concerns (Berger et al., 2018; David, 2000; Riasanow et al., 2018). In the

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meantime, the field of education has evolved due to DT, as an increasing number of educational programs include digital culture in their curriculum (Chen et al., 2019; Kellow, 2018; Reinsfield, 2019). In industrialized economies, elementary schools offer internet-related courses to their students (Berger et al., 2018). Simultaneously, high schools have mandated that students pass computer-based examinations and exams. With the rapid growth of technology, several interactive technologies are gaining popularity in educational institutions.

Simultaneously, educational organizations are integrating augmented reality, virtual reality, and artificial intelligence (AI) (Baciu et al., 2016; Basham, 2019; Le et al., 2018). In the current body of literature, the notion of artificial intelligence, or AI, is defined in various ways. For instance, it is determined that AI makes the computer more intelligent, where intelligence is a trait that enables an entity to appropriately perform a variety of functions (Chassignol et al., 2018). Another school of thought defines AI as a branch of computer science that assists in resolving cognitive difficulties often associated with human intelligence, such as problem-solving, learning, and pattern recognition (Chen et al., 2016; Jordan, 2019; Lu et al., 2018). AI profoundly impacts the educational industry. In the current setting, it is considered that instructors and students frequently see AI applications.

Moreover, vocational high school is a form of education that attempts to develop students' intelligence, knowledge, personality, character, and independent living abilities. According to Mirzajani et al. (2016), the fundamental concepts of Indonesian vocational K13 schools are adaptable to the demands of the communities, teachers, and students; hence, these schools have an emergent curriculum. Moreover, implementing the curriculum has improved the students' learning environment. The curriculum sets infrastructure so that students may apply skills and competencies, and graduates can meet the dynamic demands of the workplace (Camelo et al., 2018; Fonseca Ferreira et al., 2018; Tob-Ogu et al., 2018). Therefore, the K13 curriculum is aligned with learning competencies and imparts the necessary skills and knowledge for excellent performance in the workplace (Lawrence et al., 2018; Fadila et al., 2019; Idris et al., 2018). Lessons on essential abilities aim to cultivate workplace-relevant knowledge, skills, creativity, and attitudes. State vocational high schools, including State Vocational High School 10 Medan, are obligated to teach several disciplines because of their local significance (SMKN 10 Medan). Each 90-minute class on crafting skills focuses on work that is supported by students' knowledge, attitudes, abilities, and creativity. One of these sessions focuses on ribbon embroidery material; mastering this subject enables students to decorate objects imaginatively using ribbon embroidery techniques.

Improving students' proficiency in crafting requires an understanding of the interdependence of all the components that support the learning process in the classroom: teacher readiness, instructional styles, and instructional media, which are intended to convey material in a well-received way (Babalola, 2018; Zlatarov et al.,

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2018). The function of learning media in the classroom is to improve the teacher-student interaction process and the learning environment. There is enormous potential for interactive multimedia-based learning media to enhance student engagement with course material (Falessi et al., 2018; Setiawan et al., 2018; Wu et al., 2019). Learning media should be regarded as a tool for achieving learning objectives.

While all learning resources provide subject-relevant information, not all media are appropriate for kids. Indeed, effective educational media must accommodate regional factors (Hakim & Solechan, 2018). This is because students see, practice, and exhibit in addition to hearing a lecture on the subject. Multimedia-based interactive learning resources have the potential to be engaging. Using computers as learning media at SMK 10, particularly in craft skills acquisition, is not optimal since teachers are unfamiliar with the interactive multimedia-based computer media that can be used. Therefore, they typically utilize module and picture media instead (Semerci et al., 2018;Otieno et al., 2018; Kumar, 2019). The usage of computers is highly contingent on a teacher's desire to design and implement interactive multimedia-based learning media. Some skill concepts, such as ribbon embroidery, can be easily seen and presented moreengagingly if applied well.

This article aims to investigate the impact of AI on the learning techniques of Indonesian students and the production of vocational skill lessons using multimedia software. In this study, the students were aware of the development of an interactive, multimedia-based learning program for craft skills at SMK 10, in addition to their desire to boostmotivation and interest in the classes. This study's aims are: (1) to build interactive multimedia-based skills learning media on craft skills subjects at SMKN 10 Medan and
(2) to determine the effectiveness of interactive multimedia-based learning skills utilizing multimedia software in craft skills lessons at SMKN 10 Medan.

2. LITERATURE REVIEW

Audiovisual media is an intermediary medium that can simplify and streamline the learning process by using pictures and sound to create conditions that make students more satisfied with their learning (Fadila et al., 2019; Idris et al., 2018; Nasution et al., 2019). Using the software, it is possible to develop computer-based interactive learning media. Appropriate and creative learning media significantly impact the quality of instruction because they make it simpler for students to absorb the information being communicated. Media usage in the learning process should be tailored to the conditions and requirements of the pupils.

The teaching and learning process in a classroom environment stands to gain considerably from a comprehensive acceptance, and use of information and communication technology as its use expands across multiple industries (ICT). Despite the enormous costs associated with adopting, implementing, and deploying ICT

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infrastructure in educational institutions, the long-term advantages surpass the initial financial constraints that institutions must bear (Setiawan et al., 2018; Shu et al., 2018; Regan et al., 2019). Idris et al. (2018) conducted a quantitative investigation into the development of computer-aided instruction multimedia for education courses in coastal institutions. Their findings indicate that a comprehensive strategy to accept, adopt, and deploy interactive learning technologies inside vocational training institutions enhances the overall outcomes of graduating students. Giving strong practical skills is crucial for the labor market and economic expansion (Dar et al., 2018; Milic et al., 2018; Castro et al., 2018).

Beyond the core benefits of establishing computer-assisted instructional multimedia, several other research studies have focused on various aspects of ICT in training and vocational institutes as a result of its widespread adoption by a large number of institutions of higher education (Wu et al., 2019; Semerci et al., 2018; Otieno et al., 2018). Fadila et al. (2019), for instance, conducted a rigorous research study on the development of electronic multimedia workbooks for seventh graders. Mainly, Fadila et al. (2019) wanted to determine the quality of instruction and the students' response to implementing multimedia worksheets in teaching fractions. The researchers found that using an electronic worksheet was an effective and advantageous instructional method that facilitated the acquisition of skills and knowledge for overall improvement (Wiyaka & Rukmini, 2018; Willis et al., 2019; Hines, 2018).

Fadila et al. (2019) emphasize the significance of developing interactive learning media with multimedia software for vocational skill instruction. The development of interactive learning media will enhance the overall learning response of students. In addition to students, instructors at these vocational training institutions will benefit from the improved instructional process, as they will receive substantial support in creating interactive learning media using multimedia software. In addition, using discovery models to improve conceptual comprehension is an additional advantage of multimedia software in vocational training schools. Several in-depth quantitative research has indicated that low grades and poor orientation substantially affected the decline of student comprehension of essential ideas (Suárez-Rodrguez et al., 2018; Liu et al., 2017; Mueller et al., 2018).

Moreover, Idris et al. (2018) discovered that using multimedia software to enhance students' mathematical comprehension was a rational and practical strategy. By adopting this technology framework, students will get in-depth knowledge and abilities. In addition, additional research has demonstrated the progressive significance of multimedia software learning medium in promoting vocational education (Salem et al., 2018; Fernando, 2018; Margaret et al., 2018; Nikoli et al., 2019).

The degree to which teachers, particularly at vocational training institutes and advanced learning institutions, accept technology in the classroom environment impacts the

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breadth of implementation and how students might profit from such programs. Mirzajani et al. (2016) provide a detailed and in-depth description of the role of teachers in the adoption and assimilation of ICT in the classroom. Specifically, Mirzajani et al. (2016) sought to discover the specific elements that prompted tutors to utilize ICT in the classroom setting. By analyzing chosen characteristics, such as personal experiences, the propensity to embrace and apply ICT in tutoring, and the school environment about technical elements, Kim and Park (2018) determined the crucial determinants for ICT deployment in schools. Despite several research constraints, such as the small number of participants, the study indicated that school administration assistance was essential for implementing and adopting ICT in schools (Ilie, 2018; Picatoste et al., 2018; Howard et al., 2019).

Additionally, research has focused on comparable elements that motivate instructors to utilize ICT in the classroom. Inspired by the strategic importance of ICT in the education sector, Lawrence and Tar (2018) discovered that the simplicity of integration, the potential for adoption, the results, and the overall improvement in students' understanding drove teachers to embrace and implement ICT (Norton, 2018; Capurro, 2018; De Vries et al., 2018). Despite the lack of empirical research examining the factors that encourage teachers to adopt ICT in teaching and learning in the classroom, there is abundant evidence indicating that higher education institutions and vocational training centers are increasingly adopting ICT in their teaching and training processes. ICT is useful for channeling material (knowledge, skills, and attitudes) and can stimulate students' choices, emotions, attention, and willingness to learn so that the educational objectives are met (Briones, 2018; Scherer et al., 2018; Chou et al., 2019). Furthermore, multimedia can raise the material's appeal and the students' interest and concentration (Supriyadi et al., 2017; Rachmadtullah et al., 2018; Yilmaz, 2017). Multimedia makes learning presentations more engaging, giving teachers and students pleasant experiences and promoting scientific and technological knowledge in education. Finally, multimedia teaches mental models and facilitates comprehension of information. Multimedia offers the advantages of catching students' attention, introducing them to new kinds of technology and communication, providing teachers with novel experiences, and inspiring students (Pardimin et al., 2018; Dacholfany & Ninsiana, 2017; Huda et al., 2017).

The instructional materials for this study's lesson must build proficiency in ribbon embroidery and present numerous product creation options. Therefore, learning media must capture students' interest to motivate them to realize their ideas and creativity in order to generate innovation (Zaranis, 2019; Schreglmann & Kazanci, 2018; Hrmo et al., 2018). The curriculum for craft skill courses comprises various study resources that provide information on the skills and their scope, materials and tools, products, display, and entrepreneurship. The objective of the classes is to help students develop personal, social, pre-vocational, and academic skills following their interests and abilities, as well

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as the local culture, economics, and regional needs. Academic skills are advantageous for individuals pursuing further education, whereas pre-vocational abilities are advantageous for those entering the workforce (Prasasti et al., 2018; Agrawal & Mittal, 2018; Voogt et al., 2018). Thus, it is anticipated that the skills taught in vocational schools will equip students to pursue higher education or enter the workforce based on the community's requirements while preserving traditional culture.

3. RESEARCH METHODOLOGY

This study examines the use of artificial intelligence in educational institutions, its effect on learning processes, and the use of multimedia software in vocational skills instruction. In the initial part of this study, a questionnaire was used to collect data from faculty members at various institutions to examine the role of AI usage and its impact on learning methodologies. In the second step, 10th graders in their first semester at SMK 10 Medan were interviewed during the 2015–2016 school year. Using multimedia software, the project aimed to develop instructional resources for teaching ribbon embroidery techniques. The content of the learning media consists of four subcategories, including knowledge of ribbon embroidery tools, an introduction to the primary language and supporting materials used in ribbon embroidery, ribbon embroidery techniques, and ribbon embroidered product packaging methods. It also included evaluation activities at the end. Four stages of testing were conducted, including media and material validation, small group trials, medium group trials, and large group trials.

This study begins with a needs analysis conducted by analyzing the curriculum, determining the necessary material, and reviewing the relevant literature. The needs analysis aimed to collect information on the learning process, student learning characteristics, and the development of media required during the learning and teaching process. At SMK 10, the needs analysis activities were conducted by distributing questionnaires to one skills teacher and thirty-five 10th-grade students. Specifically, this group consisted of children whose performance was below average and who, as a result, required help.

The initial product was developed by identifying the new media to be designed and enhancing the already designed media. Designing the home menu, instructions menu, profile, motivation menu, description menu, destination menu, ribbon embroidery material menu, video menu, and test menu was required to create the ribbon embroidery application. Expert validation is a process by which specialists in learning media thoroughly review and assess the tools and media products about their objectives. To establish the study's breadth and the likelihood of success, learning media experts specialized in ICT, particularly in its application within the education sector, extensively examined and analyzed the potential success of the research instruments. Ten learning media specialists participated in the process validation.

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To study the influence of multimedia on the learning process, questionnaires were used to collect data to assess whether media development could be acknowledged as part of the learning process. The analysis centered on the effectiveness of the designed items. There were 35 participants in total, all students at the institution. The questionnaire contained the same set of questions for all participants. The reliability and credibility of the responses were determined using inclusion and exclusion criteria in conjunction with an in-person interview. During the process of doing the research, a variety of ethical principles were considered.

First, it was essential to preserve the identity and confidentiality of the research study participants. For instance, individuals' identities were masked using smart coding (Kumar, 2019; Norton, 2018). As a result, the actual names and other information about the participants are omitted from the findings. Following the core principles of ethical research, an effort was also made to prevent fraudulent data collection procedures during the research project (Capurro, 2018; De Vries et al., 2018). Because all participants in the research study are of legal age, participation was entirely voluntary. The participants were permitted to withdraw from the research project at any moment, and the researchers collected their signed agreement. The institution's ethical review board allowed the research investigation.

4. ANALYSIS AND FINDINGS OF THE STUDY

4.1 Impact of AI usage on Learning Strategies

The practice of AI in educational institutions is represented by the structural model depicted in Figure 1 (Model 1), which encompasses the latent variables of institutional usage, student support, and instructional techniques. Institutionally, three variables are considered: the use of AI in marketing and recurrent activities, admission and enrollment, and curriculum and resource planning. Similarly, the use of AI in student support is shown via guidance, timely assistance, and career counseling. Last, instructional approaches reflect AI's consideration of self-paced progress, tailored learning, pedagogical enhancements, etc. Figure 1(Model 2) depicts the results of the CFA, which include the values of standard factor loadings for each of the study's latent variables. Observed factor loadings for three institutional AI utilization items are 0.73, 0.81, and 0.88, respectively.

Similarly, the factor loadings for three student assistance items reveal scores of 0.63, 0.73, and 0.62. Self-paced progress, individualized learning, and pedagogical learning have factor loadings of 0.71, 0.76, and 0.80 in the context of instructional techniques.

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Table 1. Variable Descriptions AI Usage and Learning Strategies

Variables	Description of Titles	Description of Items	Measuring scale (1-5)
Artificial Intelligence (AI) usage	**Institutional Use**		Strongly disagree=1 Strongly agree=5
	Marketing and recruiting	My institution is focusing on the usage of AI in the marketing and recruiting process	
	Admission and enrollment	My institution is considering the significance of AI in Admission and Enrollment	
	Curricula and resource planning	AI plays its role in curricula and resource planning	
	Student Backing/Support		
	Guidance	AI helps to promote student support by guiding them	
	Timely help	AI helps to promote student support through timely help	
	Carrier counseling	AI helps to promote student support through carrier counseling	
	Instructional Practices		
	Self-paced progress	AI works with self-paced progress in my institute	
	Personalized learning	Personalized learning is a significant tool of instructional practices for AI usage	
	Pedagogical improvement	AI can provide pedagogical improvement to my institute	
	Learning Strategies		
Learning Strategies	Planning	P1-Start by setting goals and P2-planning for the steps regarding learning; P3-need to be interested in what I am doing; p-4 goal is to understand what I have to do thoroughly. P5-planning to deliver good to my students	Never=1 Always=5
	Doing	D1- give all my attention to the task I am doing, D2-turning the task into smaller steps, D3-keeping a record of how well I am doing, D4-carry on using the same strategies, D5-give all my attention to what I am doing, D6-. I carry on using the same strategy even if I have problems	
	Reflection	RS1-I check my work to see if I have done it well once I am finished; RS2-I do it poorly because of my ability; RS3-I do it well because of how much effort I used; RS4-I feel happy about my performance, RS5-. I give up if I cannot do the task easily	

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These loadings have elucidated the significance of selected components in the structural equation modeling approach, as observed in the following discussion. Table 2 presents the output standardization for the CFA model stated previously.

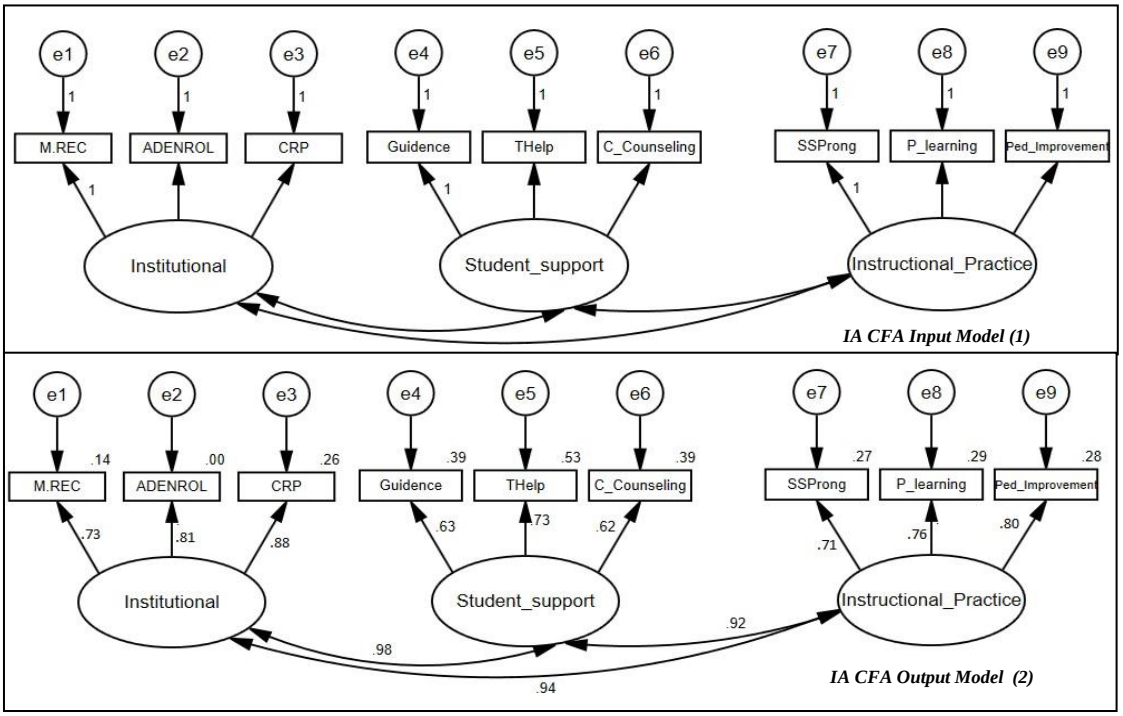

Figure 1. IA CFA Input Model (1) and CFA Output Model (2)

Table 2. Standardized Factor Loadings: (IA CFA Output Model 2)

Items	Direction	Latent Variables	Estimate
M.REC	<---	Institutional	.730
ADENROL	<---	Institutional	.812
CRP	<---	Institutional	.880
Guidance	<---	Student_support	.631
THelp	<---	Student_support	.732
C_Counseling	<---	Student_support	.622
SSProng	<---	Instructional_Practice	.713
P_learning	<---	Instructional_Practice	.760
Ped_Improvement	<---	Instructional_Practice	.802

Figure 2 illustrates the CFA input (Model I) for the learning strategies and the CFA output (Model II) correspondingly. It is noted that three latent variables with the titles planning, reflection, and doing have corresponding items, namely P1 to P5 for planning, RS1 to RS5 for reflection, and D1 to D6 for the latent variable "Doing." All three

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elements provide information about the observed endogenous variables of the study, which are learning techniques. The factor loadings for the selected planning elements range between.71(P2) and.84 (P3). RS5 has the highest factor loading for reflection at 0.81, followed by RS1 and RS2. RS4, with a loading of 0.66, has the lowest loading. In addition, each of the six actions has a factor loading value of at least 0.60 and a maximum of 0.88. To facilitate comprehension, Table 3 displays the standard weights depicted by Model II in Figure 2 accordingly.

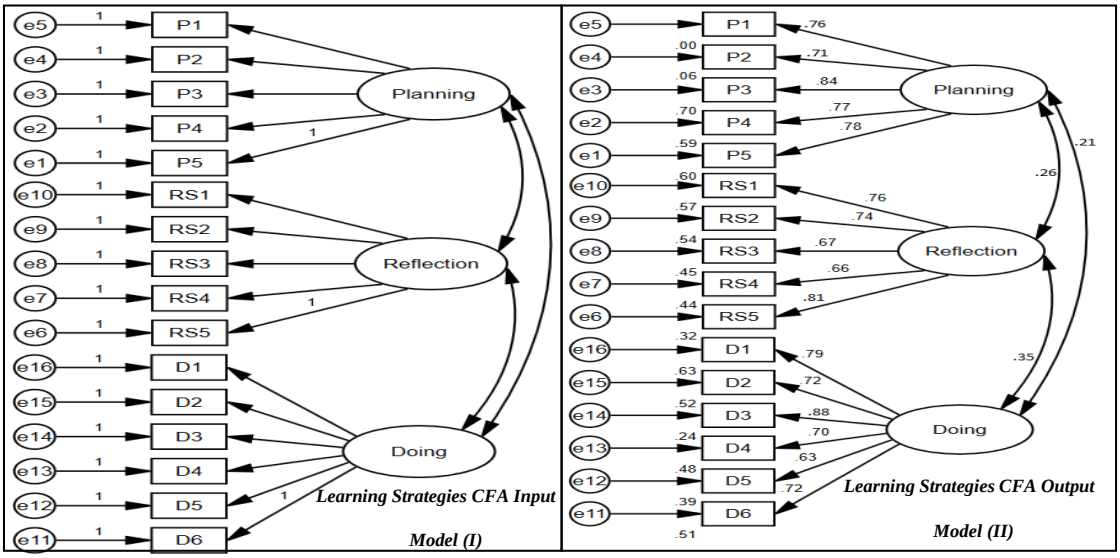

Figure 2. Learning Strategies CFA Input Model (I) and CFA Output Model (II) Figure

3 displays, after the CFA result, the three path models titled Input Path Model (A) for analyzing the effects of IA influence on learning strategies in terms of planning, AI impact on learning strategies in terms of "doing," and AI impact on reflections. All three endogenous factors are observed to be quantified by additional items, withplanning measured by P1-P5, doing by D1-D6, and reflection by RS1-RS5. The resultsof these models are shown in Table 4–6.

Table 4 details the findings regarding the influence of all three AI usage aspects on learning strategies through planning. The standardized coefficients reveal instructional practice's positive and significant effect on planning. It means that as a measure of AI utilization, the instructional methods in targeted schools positively influence learning strategy planning components and vice versa. This effect is extremely significant at 1 percent, indicating that "the greater the use of AI in instructional practice, the more effective the learning strategies in terms of planning."

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Table 3. Table 1: Standardized Factor Loadings: (Learning strategies CFA Output Model II

Items	Direction	Latent Variables	Estimate
P5	<---	Planning	.777
P4	<---	Planning	.766
P3	<---	Planning	.836
P2	<---	Planning	.712
P1	<---	Planning	.762
RS5	<---	Reflection	.810
RS4	<---	Reflection	.667
RS3	<---	Reflection	.672
RS2	<---	Reflection	.738
RS1	<---	Reflection	.758
D6	<---	Doing	.720
D5	<---	Doing	.630
D4	<---	Doing	.702
D3	<---	Doing	.883
D2	<---	Doing	.720
D1	<---	Doing	.794

In addition, the influence of the second measure of AI usage (student support) on planning is positively significant (coefficient =.548***). There is a direct effect on the planning aspect of learning strategies due to the rising use of artificial intelligence (AI) for student advice, timely assistance, and career guidance. This implies that educational institutions should focus on growing the use of artificial intelligence since it substantially impacts learners' planning capabilities. This link demonstrates that "the greater the AI usage through student support, the greater the positive impact on planning factor" is adequately validated in the current study.

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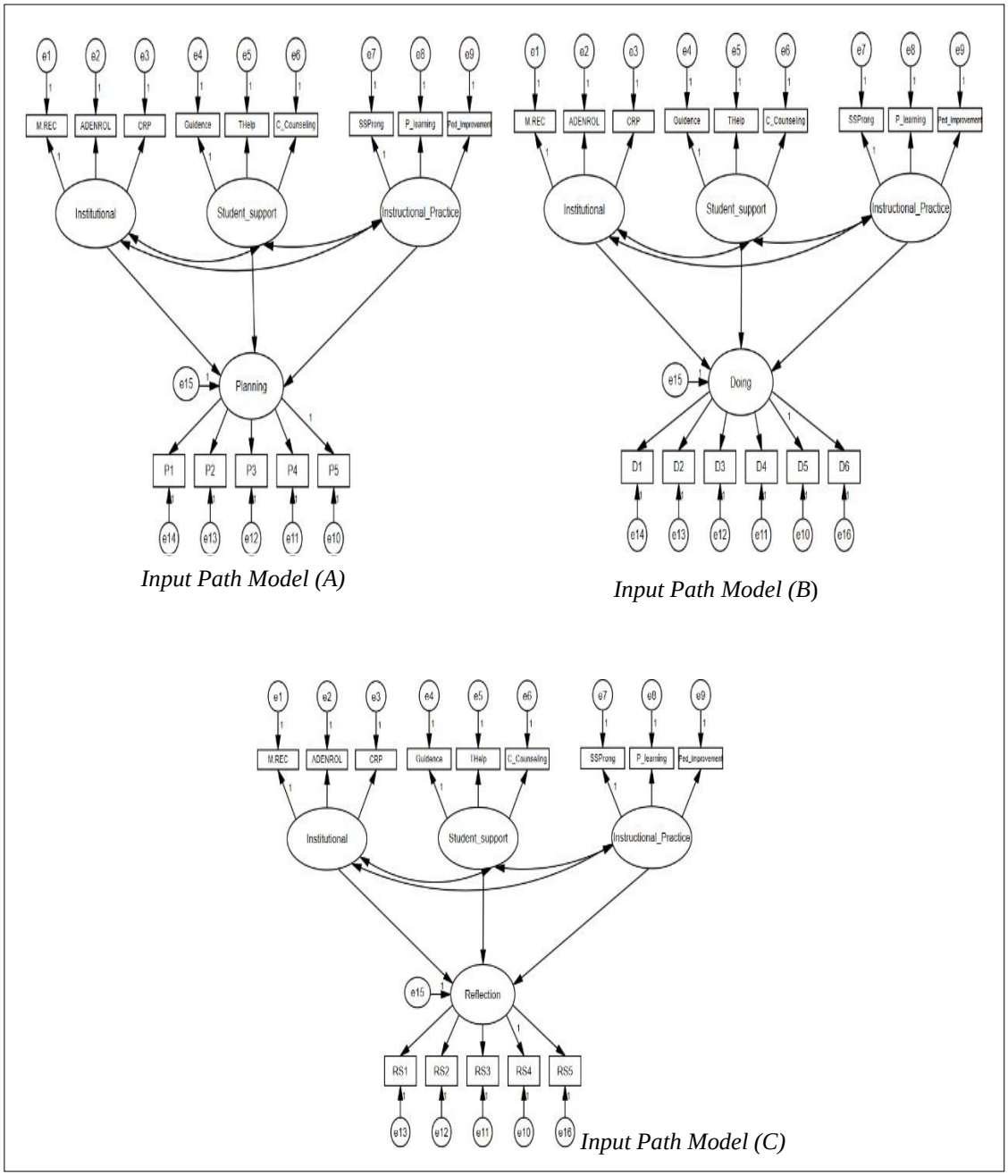

Figure 3. Input path Models: A, B, C for AI usage and its impact on Learning Strategies

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Table 4. SEM Output for AI Impact on Learning Strategies through Planning: Input Path Model (A)

Variables/Indicators	Direction	Variables	Estimate
Planning	<---	Instructional_Practice	.364***
Planning	<---	Student_support	.548**
Planning	<---	Institutional	.382***
M.REC	<---	Institutional	.730
ADENROL	<---	Institutional	.812
CRP	<---	Institutional	.880
Guidance	<---	Student_support	.631
THelp	<---	Student_support	.732
C_Counseling	<---	Student_support	.622
SSProng	<---	Instructional_Practice	.713
P_learning	<---	Instructional_Practice	.760
Ped_Improvement	<---	Instructional_Practice	.802
P5	<---	Planning	.777
P4	<---	Planning	.766
P3	<---	Planning	.836
P2	<---	Planning	.712
P1	<---	Planning	.762

Table 5 displays the results of observing the impact of AI on learning processes through practice. It reveals that instructional approaches have a considerable and beneficial influence on learning-by-doing strategies (coefficient =.364***). It implies that an increase in the use of AI in instructional techniques will directly impact learning by doing. However, the effect of AI usage on student support is considerable and unfavorable, indicating a negative causal relationship (coefficient = -0.548*). In addition, the institutional use of AI has demonstrated its highly significant and favorable impact on learning-by-doing methodologies. It means that, on average, bothinstructional practices and institutional AI deployment have a substantial and beneficialeffect on student learning. In contrast, student support has a significant and bad impact on learning techniques in terms of doing.

The input path model (C) findings are reported in Table 6, including the use of artificial intelligence in instructional practice, student support, institutional settings, etc. It is noticed that instructional practice has a strong and beneficial influence on reflection as the third measure of learning strategies. The value of 462 indicates that the greater the AI usage in instructional techniques, the greater the influence of reflection on learning processes, and vice versa. However, the influence of student support and institutional use of AI on the learning component, as measured by the reflection indicator, is favorably insignificant.

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Table 5. SEM Output for AI Impact on Learning Strategies through Doing: Input Path Model (B)

Variables/Indicators	Direction	Variable	Estimate
Doing	<---	Instructional_Practice	.364***
Doing	<---	Student_support	-.548*
Doing	<---	Institutional	.382***
M.REC	<---	Institutional	.730
ADENROL	<---	Institutional	.812
CRP	<---	Institutional	.880
Guidance	<---	Student_support	.631
THelp	<---	Student_support	.732
C_Counseling	<---	Student_support	.622
SSProng	<---	Instructional_Practice	.713
P_learning	<---	Instructional_Practice	.760
Ped_Improvement	<---	Instructional_Practice	.802
D6	<---	Doing	.720
D5	<---	Doing	.630
D4	<---	Doing	.702
D3	<---	Doing	.883
D2	<---	Doing	.720
D1	<---	Doing	.794

Table 6. SEM Output for AI Impact on Learning Strategies through Reflection: Input Path Model (C)

Variables/Indicators	Direction	Variable	Estimate
Reflection	<---	Instructional_Practice	.462***
Reflection	<---	Student_support	1.624
Reflection	<---	Institutional	2.385
M.REC	<---	Institutional	.730
ADENROL	<---	Institutional	.812
CRP	<---	Institutional	.880
Guidance	<---	Student_support	.631
THelp	<---	Student_support	.732
C_Counseling	<---	Student_support	.622
SSProng	<---	Instructional_Practice	.713
P_learning	<---	Instructional_Practice	.760
Ped_Improvement	<---	Instructional_Practice	.802
RS4	<---	Reflection	.672
RS3	<---	Reflection	.667
RS2	<---	Reflection	.738
RS1	<---	Reflection	.758
RS5	<---	Reflection	.810

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4.2 Implementation of Interactive Multimedia-Based Learning Media

Using multimedia software, the deployment of interactive multimedia-based learning material for craft skills was carried out in stages. Animation, graphics, and video-based learning materials had never been utilized in class previously. 92% of the class reported never encountering animated media, photos, or videos in skills learning. This highlighted the breadth of students' requirements, indicating that the interventional method was crucial in the vocational school. After conducting a needs study, the initial product development phase followed. The media specialists validated the items based on the following criteria: guidance, indicators, content/material, individuals, student interests, feedback, learning environment, and computer component principles. The maximum score possible was 100. The purpose of the evaluation was to determine the viability of creating interactive multimedia-based learning materials utilizing multimedia software. The evaluation form reveals that the content obtained a score of 93% based on the set criteria, while the display quality received a score of 95%.

4.2.1 Small-Group Field Test Data

The test evaluated attractiveness, difficulty level, appearance, and beneficial aspects. As Figure 4 illustrates, media experts highly rated all elements.

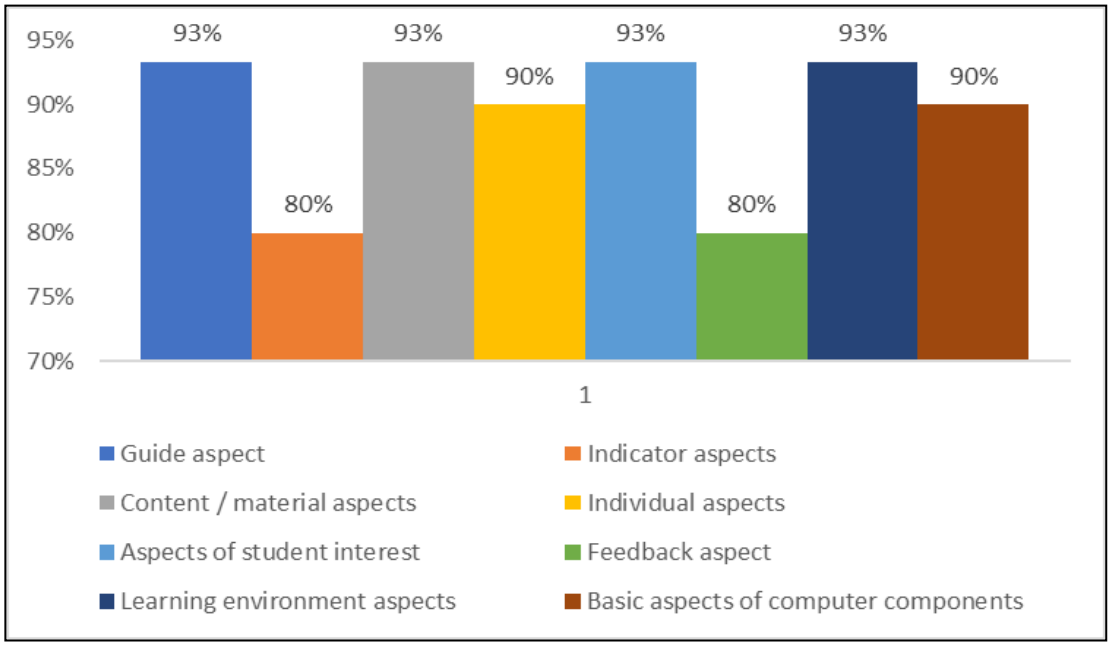

Figure 4. Media Expert Scores

The results of the material expert's assessment of the program's feasibility (93%) and display quality (95%) showed, based on the responses of material experts, that this media was feasible for field trials with revisions according to suggestions put forward and generally accepted.

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4.2.2 Analysis of Small Group Test Results

With an average score of 60.40 percent in the small group trials, students' perceptions of the developed media were moderately favorable. This outcome necessitated minimal modifications to meet issues presented by individual trials. There was no need to change the material so it could be utilized in the field trial because it did so well in small-group testing. As seen in Figure 5, students gave all elements reasonably high scores. After collecting this information, we rectified the issues that arose during individual trials so that field tests could proceed.

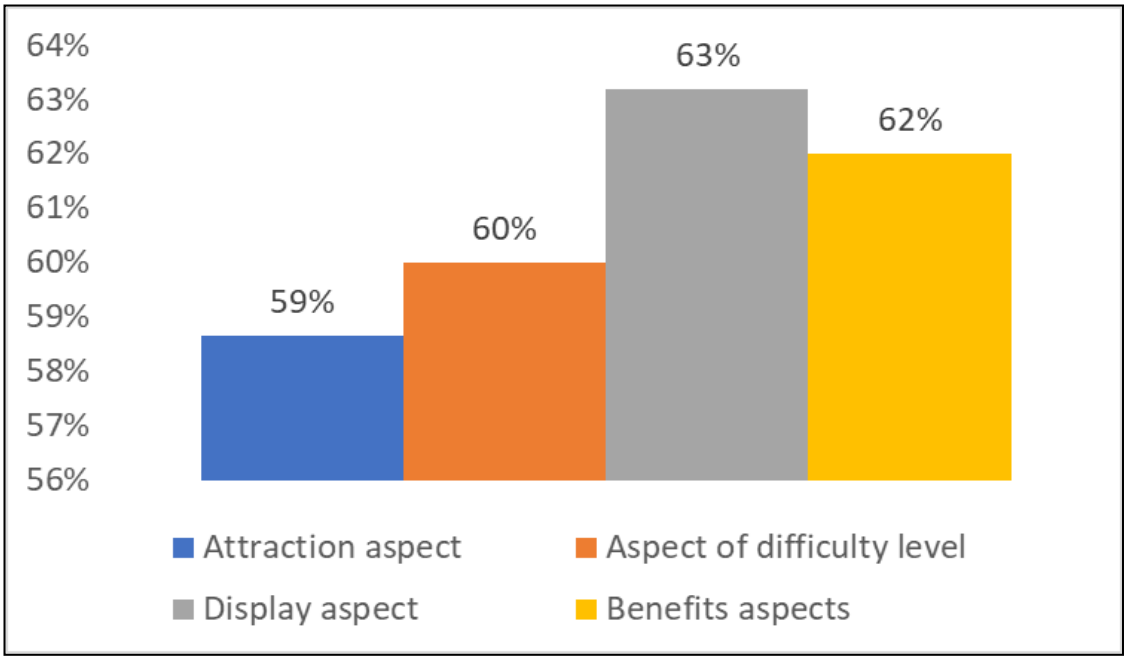

Figure 5. Small Group Trial Scores

4.2.3 Analysis of Medium Group Test Results

As seen in Figure 6, students in this group rated all aspects above 70%. Individual (small group) trials increased by 13.57 percent, as evidenced by the data presented. As a result of the media experts' recommendations, the content was altered once more so that the field trials could continue. The findings indicate discrepancies between the responses of professionals and pupils. For example, the professionals' responses were more significant than the students because the students lacked a full understanding of how the interventional approach's framework could be deployed. In addition, the discrepancy may be attributable to the limited application of the interventional method and a limited comprehension of its benefits. This is consistent with the findings of Derlina et al. (2018), Baharuddin et al. (2018), and Baharuddin and Dalle (2019) – the students have only encountered the superficial characteristics of the interventional strategy.

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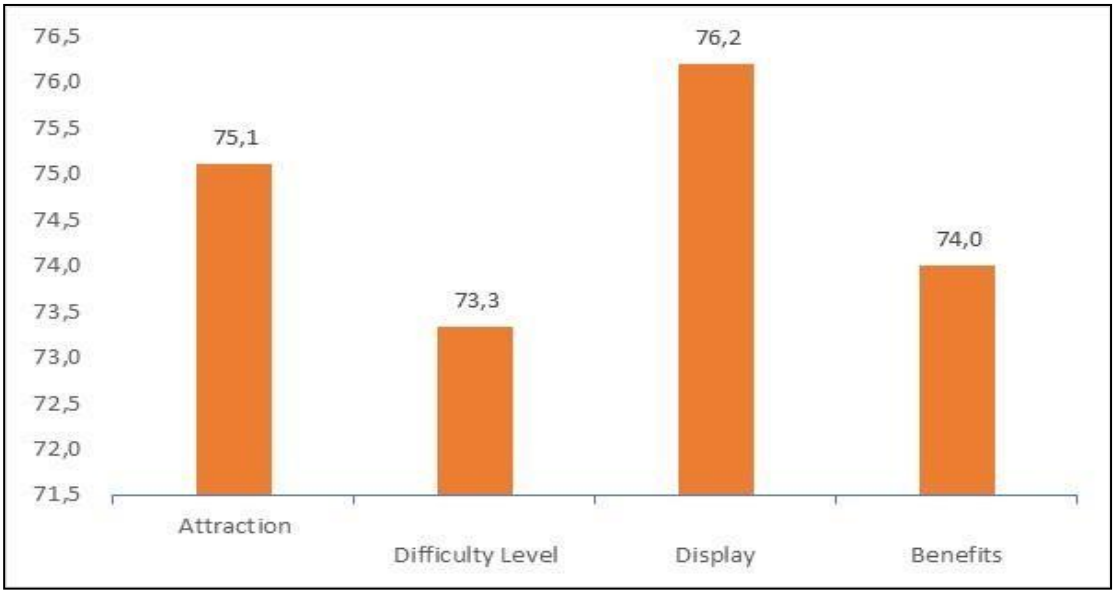

Figure 6. Obtaining Empirical Scores in Moderate Group Trials

4.2.4 Analysis of Large/Field Group Trial Results

As Figure 7 shows, students gave very high ratings to all elements.

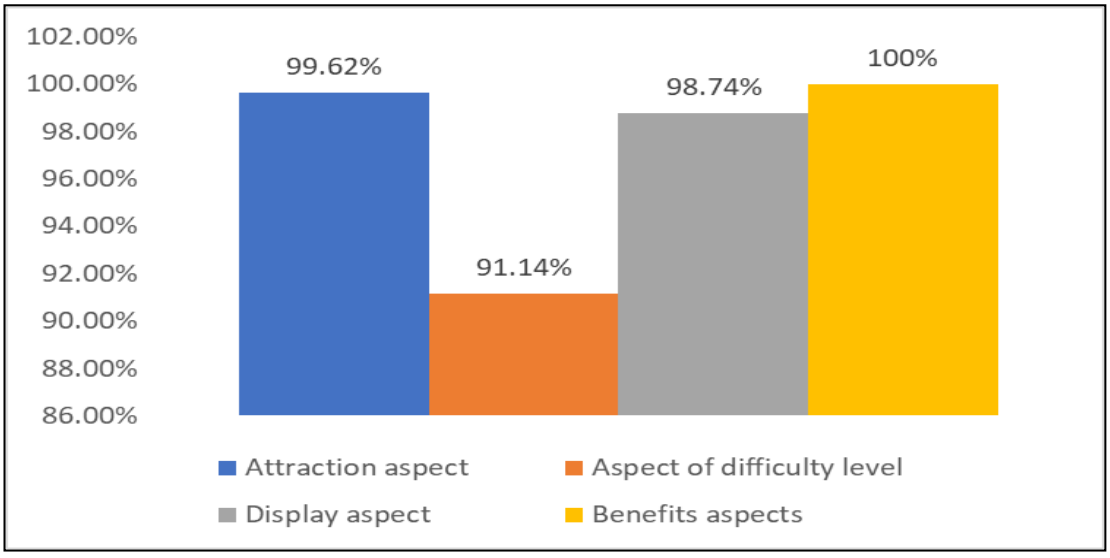

Figure 7. Significant Group Trial Scores

This data from the field trial shows that media development has been maximized; no significant revisions are needed to the multimedia software program, meaning that the media can be produced and is a feasible medium for learning skills in schools (Fig. 7).

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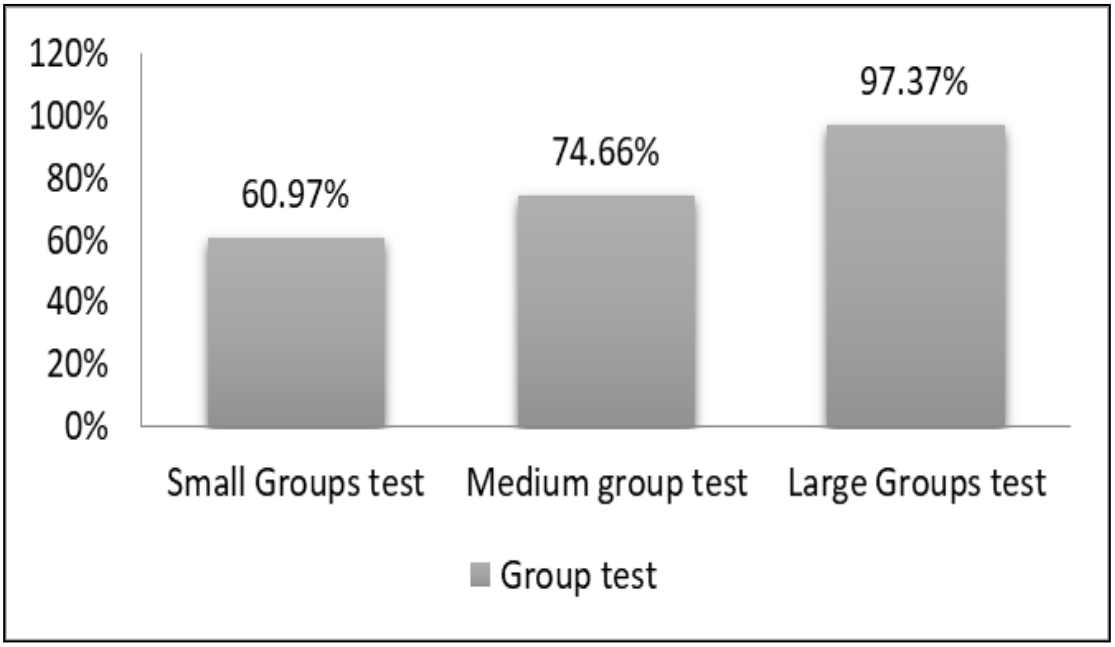

Figure 8. Small, Medium, and Large Group Test Results

According to the study, pupils found multimedia software innovative and user-friendly (Fadila et al., 2019). The benefit of multimedia software learning media is that the program provides comprehensive skills content that is visually appealing, relatively simple to use, and requires minimal effort to maximize productivity. Learning media will capture students' interest and increase their motivation to study (Hong & Shin, 2015; Baharuddin et al., 2018; Dalle & Mutalib, 2018; Derlina et al., 2018; Baharuddin & Dalle, 2019). In addition, teachers and students have identified numerous difficulties with the conventional learning process. For example, teachers reported that traditional approaches were less engaging, which played a significant influence in limiting student participation in the learning process. Similarly, the pupils highlighted the lack of appeal and the difficulty in comprehending concepts with the usual teaching method.

5. CONCLUSION

This study investigates the impact of artificial intelligence on the learning practices of Indonesian students. To facilitate comprehension, the whole analysis is separated into two key groups. The first step examines the relationship between AI usage and learning strategies observed during the planning, doing, and reflecting stages. The CFA results demonstrate that each item has a favorable factor loading. While SEM results suggest that AI usage is directly connected with the planning and doing stages of the learning process, AI usage has no meaningful effect on the reflection stage. In addition, this research proposes an interactive learning approach based on multimedia software materials for ribbon embroidery instruction in craft skills classes.

6. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Despite the exhaustive and precise findings, there were several limitations to theresearch study. First, the sample size was relatively small, the population was limited, and there were no classroom-based data. Nonetheless, this was a pilot and exploratory study, and future research may incorporate corrective methods. The material experts' evaluation based on the criteria is excellent, indicating that this program may be utilizedas a learning medium, boost students' interest in studying, stimulate them, and have an appealing appearance. These characteristics make it an ideal learning medium for students. Therefore, teachers should be willing to develop multimedia-based interactivelearning resources to pique students' interest in education.

REFERENCES

Agrawal, A. K., & Mittal, G. K. (2018). The role of ICT in higher education for the 21st century: ICT as a change agent for education. *Multidisciplinary Higher Education, Research, Dynamics & Concepts: Opportunities & Challenges for Sustainable Development (ISBN 978-93-87662-12-4)*, *1*(1), 76-83. Retrieved from https://ij360mr.com/docs/vol7/spcl/5.pdf

Babalola, S. O. (2018). Factors Influencing Behavioral Intention to the Use of Information and Communication Technology (ICT) among Students of Federal Polytechnic, Ilaro. Ogun state. Nigeria. *Library Philosophy and Practice*, 1-32. Retrieved from http://digitalcommons.unl.edu/libphilprac/2153?utm_source=digitalcommons.unl.edu%2Flibphilprac%2F2153&utm_medium=PDF&utm_campaign=PDFCoverPages

Baciu, C., Opre, D., & Riley, S. (2016). A new way of thinking in the era of virtual reality and artificial intelligence. *Educatia 21, 14*, 43-51. Retrieved from https://www.researchgate.net/profile/Ciprian-Baciu/publication/303818717

Baharuddin., & Dalle, J. (2019). Transforming learning spaces for elementary school children with special needs, *Journal of Social Studies Education Research*, 10(2), 344-365. Retrieved from https://www.learntechlib.org/p/216580/

Baharuddin., Hadi, S., Hamid, A., Mutalib, A. A., & Dalle, J. (2018). Dilemma Between Applying Coherent Principle and Signaling Principles in Interactive Learning Media. *The Open Psychology Journal*, *11*(1). doi: http://dx.doi.org/10.2174/1874350101811010235

Basham, R. (2019). Artificial Intelligence in Health, Human Service Delivery, and Education: A Brief Conceptual Overview. *Journal of Health Science, 7*, 73-78. doi: http://dx.doi.org/10.17265/2328-7136/2019.02.002

Berger, S., Denner, M.-S., & Roeglinger, M. (2018). The Nature of Digital Technologies-Development of a Multi-Layer Taxonomy. *Nature, 11*, 28-2018. Retrieved from https://www.myecole.it/biblio/wp-content/uploads/2020/11/2018-Nature-of-digital-technologies.pdf

Briones, C. B. (2018). Teachers' Competency on the Use of ICT in Teaching Physics in the Junior High School. *KnE Social Sciences*, *3*(6), 177-204. doi: http://dx.doi.org/10.18502/kss.v3i6.2380

Camelo, G. E. H., Torres, J. M. T., Reche, M. P. C., & Costa, R. S. (2018). Using an integration of ICT in a diverse educational context of Santander (Colombia). *JOTSE*, *8*(4), 254-267. doi: http://dx.doi.org/10.3926/jotse.314

Capurro, R. (2018). Why Information Ethics? 1. *International Journal of Applied Research on Information Technology and Computing*, *9*(1), 50-52. doi: http://dx.doi.org/10.5958/0975-8089.2018.00005.2

Castro, W. F., & Nyvang, T. (2018). From professors' barriers to organizational conditions in ICT integration in higher education. *Tidsskriftet Læring Og Medier (LOM)*, *10*(18). doi: http://dx.doi.org/10.7146/lom.v10i18.96143

Chou, C. M., Shen, C. H., Hsiao, H. C., & Shen, T. C. (2019). Factors influencing teachers' innovative teaching behavior with information and communication technology (ICT): the mediator role of organizational innovation climate. *Educational Psychology*, *39*(1), 65-85. doi: http://dx.doi.org/10.1080/01443410.2018.1520201

Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia Computer Science*, *136*, 16-24. doi: https://doi.org/10.1016/j.procs.2018.08.233

Chen, Y., Argentinis, J. E., & Weber, G. (2016). IBM Watson: how cognitive computing can be applied to big data challenges in life sciences research. *Clinical Therapeutics*, *38*(4), 688-701. doi: https://doi.org/10.1016/j.clinthera.2015.12.001

Chen, Y., Huang, S., Fu, P., Zhou, H., & Xue, W. (2019). Exploration of Practical Teaching with Digital Technology for Industrial Engineering Education in Local Universities of China. *Creative Education*, *10*(10), 2082-2100. doi: https://doi.org/10.4236/ce.2019.1010151

Dacholfany, M.I., & Ninsiana, W. (2017). From Live Interaction to Virtual Interaction: An Exposure on the Moral Engagement in the Digital Era. *Journal of Theoretical and Applied Information Technology*, 95(19), 4964-4972. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/54813683/JATIT

Dalle, J., & Mutalib, A.M. (2018). The impact of technologies in teaching interaction design. *Journal of Advanced Research in Dynamical and Control Systems*, Special Issue (14), 1779-1783. Retrieved from http://eprints.ulm.ac.id/id/eprint/7760

Dar, M., Masood, F., Ahmed, M., Afzaal, M., Ali, A., Bibi, Z., ... & Zia, H. U. (2018, July). Information and communication technology (ICT) impact on education and achievement. In *International Conference on Applied Human Factors and Ergonomics Springer Cham*, 781,40-45. doi: https://doi.org/10.1007/978-3-319-94334-3_6

David, P. A. (2000). Understanding digital technology's evolution and the path of measured productivity growth: present and future in the mirror of the past. *Understanding the Digital Economy: Data, Tools, and Research. MIT, Cambridge, MA.* Retrieved from https://books.google.ae/books?hl

De Vries, H., Jakobs, K., Egyedi, T. M., Eto, M., Fertig, S., Kanevskaia, O., & Morone, P. (2018). Standardization: Towards an agenda for research. *International Journal of Standardization Research (IJSR), 16*(1), 52-59. doi: https://doi.org/10.4018/IJSR.2018010104

Derlina., Dalle, J., Hadi, S., Mutalib, A. A., & Sumantri, C. (2018). Signaling Principles in Interactive Learning Media through Expert's Walkthrough. *Turkish Online Journal of Distance Education (TOJDE), 19*(04), 147-162. doi: https://doi.org/10.17718/tojde.471911

Fernando, M. G. N. A. S. (2018). Teaching, Learning and Evaluation Enhancement of Information Communication Technology Education in Schools through Pedagogical and e-Learning techniques in the Sri Lankan Context. *Engineering and Technology, International Journal of Educational and Pedagogical Sciences, 12*(6). 1-7. Retrieved from https://www.researchgate.net/profile/Noel-Fernando/publication/328188616

Fadila, A., Dasari, R., Septiana, R., Sari, R. M., & Rosyid, A. (2019, February). The Development of Electronic Flash Worksheet Based on Adobe Flash Cs6 on Fraction Numbers in the Seventh Grade of Junior High School. In *Journal of Physics: Conference Series* 1155(1), 012019. IOP Publishing. doi: https://doi.org/10.1088/1742-6596/1155/1/012019

Falessi, D., Juristo, N., Wohlin, C., Turhan, B., Münch, J., Jedlitschka, A., & Oivo, M. (2018). Empirical software engineering experts on the use of students and professionals in experiments. *Empirical Software Engineering*, *23*(1), 452-489. doi: https://doi.org/10.1007/s10664-017-9523-3

Fonseca Ferreira, N. M., & Freitas, E. D. (2018). Computer applications for education on industrial robotic systems. *Computer Applications in Engineering Education, 26*(5), 1186-1194. doi: https://doi.org/10.3390/electronics8030264

Hakim, F. N., & Solechan, A. (2018). Design and Implementation Multimedia Learning Success for Vocational Schools. *International Journal of Electrical & Computer Engineering (2088-8708), 8*(2). doi: https://doi.org/10.11591/ijece.v8i2.pp1067-1073

Hines, M. G., & Lynch, R. (2019). The Relationship Of Grade 7 Students' General Ict Use And Attitudes Towards Ict Use For School Related Activities With Ict Self-Efficacy In Eleven English Program Schools Of Thailand. *Scholar: Human Sciences,* 11(2), 366. Retrieved from http://www.assumptionjournal.au.edu/index.php/Scholar/article/view/4338

Hong, S.R., & Shin, I.Y. (2015). The application of multimedia and wireless technology in education, *Indian Journal of Science and Technology*, 8(20), 1-11.doi: https://doi.org/10.17485/ijst/2015/v8i20/79291

Howard, S. K., Thompson, K., Yang, J., & Ma, J. (2019). Working the system: Development of a system model of technology integration to inform learning task design. *British Journal of Educational Technology*, *50*(1), 326-341. doi: https://doi.org/10.1111/bjet.12560

Hrmo, R., Mistina, J., Jurinova, J., & Kristofiakova, L. (2018, September). Software Platform for the Secondary Technical School E-Learning Course. In *International Conference on Interactive Collaborative Learning Springer Cham*, 916, 855-865. doi: https://doi.org/10.1007/978-3-030-11932-4_79

Huda, M., Haron, Z., Ripin, M. N., Hehsan, A., & Yaacob, A. B. C. (2017). Exploring Innovative Learning Environment (ILE): Big Data Era. *International Journal of Applied Engineering Research*, 12(17), 6678- 6685. Retrieved from https://www.ripublication.com/ijaer17/ijaerv12n17_53.pdf

Idris, H., Nurhayati, N., & Satriani, S. (2018, May). Developing Computer-Assisted Instruction Multimedia for Educational Technology Course of Coastal Area Students. In *IOP Conference Series: Earth and Environmental Science*, 156(1), 012049). IOP Publishing. https://iopscience.iop.org/article/10.1088/1755-1315/156/1/012049/meta.

Ilie, M. M. (2018). The Use of ICT in Integration of Freshmen Students into the Academic Environment. In *Conference proceedings of» eLearning and Software for Education «(eLSE)*, 3(14), 71-76. Editura Universităţii Naţionale de Apărare "Carol I". https://www.ceeol.com/search/article-detail?id=668974

Jordan, M. I. (2019). Artificial intelligence—The revolution hasn't happened yet. *Harvard Data Science Review*, 1-9. doi: https://doi.org/10.1162/99608f92.f06c6e61

Kellow, J.-M. (2018). Digital Technologies in the New Zealand Curriculum. *Waikato Journal of Education, 23*(2) 75-82. doi: https://doi.org/10.15663/wje.v23i2.656

Kim, B., & Park, M. J. (2018). Effect of personal factors to use ICTs on e-learning adoption: comparison between learner and instructor in developingcountries. *Information Technology for Development*, *24*(4), 706-732. doi: https://doi.org/10.1080/02681102.2017.1312244

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners*. Sage Publications Limited. Retrieved from https://books.google.ae/books?hl

Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. *Educational Media International*, *55*(1), 79-105. doi: https://doi.org/10.1080/09523987.2018.1439712

Lawrence, J. E. (2018). Factors Influencing Teachers' Integration of ICT in Teaching and Learning. *International Journal of Adult Vocational Education and Technology (IJAVET)*, *9*(2), 48-63. doi: https://doi.org/10.4018/IJAVET.2018040104

Le, D.-N., Van Le, C., Tromp, J. G., & Nguyen, G. N. (2018). *Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial*

Intelligence, Internet of Things, Robotics, Industry 4.0: John Wiley & Sons. Retrieved from https://books.google.ae/books?hl

Liu, F., Ritzhaupt, A. D., Dawson, K., & Barron, A. E. (2017). Explaining technology integration in K-12 classrooms: A multilevel path analysis model. *Educational Technology Research and Development, 65*(4), 795–813. doi: https://doi.org/10.1007/s11423-016-9487-9

Lu, H., Li, Y., Chen, M., Kim, H., & Serikawa, S. (2018). Brain intelligence: go beyond artificial intelligence. *Mobile Networks and Applications, 23*(2), 368-375. doi: https://doi.org/10.1007/s11036-017-0932-8

Margaret, R. E., Uma, B., Tejonidhi, M. R., & Neelakantappa, B. B. (2018). A Recipe for the Use of ICT Tools in an Educational Institute. *Journal of Engineering Education Transformations, 31*(3), 114-119. doi: https://doi.org/10.16920/jeet/2018/v31i3/120778

Milic, N. M., Ilic, N., Stanisavljevic, D. M., Cirkovic, A. M., Milin, J. S., Bukumiric, Z. M., ... & Trajkovic, G. Z. (2018). Bridging the gap between informatics and medicine upon medical school entry: Implementing a course on the Applicative Use of ICT. *PloS one, 13*(4), e0194194. doi: https://doi.org/10.1371/journal.pone.0194194

Mirzajani, H., Mahmud, R., Fauzi Mohd Ayub, A., & Wong, S. L. (2016). Teachers' acceptance of ICT and its integration in the classroom. *Quality Assurance in Education, 24*(1), 26-40. doi: https://doi.org/10.1108/QAE-06-2014-0025

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2018). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers & Education, 51*(4), 1523– 1537. doi: https://doi.org/10.1016/j.compedu.2008.02.003

Nasution, N., & Bornok, S. M. (2019). Developing Learning Media Assisted-flash Macromedia Software by Applying Discovery Model to Improve Students' Concept and Self-Regulated Learning on Senior High School. *American Journal of Educational Research, 7*(2), 161-165. doi: https://doi.org/10.12691/education-7-2-7

Nikolić, V., Petković, D., Denić, N., Milovančević, M., & Gavrilović, S. (2019). Appraisal and review of e-learning and ICT systems in teaching process. *Physica A: Statistical Mechanics and its Applications, 513*, 456-464. doi: https://doi.org/10.3390/electronics8030264

Norton, L. (2018). *Action research in teaching and learning: A practical guide to conducting pedagogical research in universities,* 224. Routledge. doi: https://doi.org/10.4324/9781315147581

Otieno, K. J., Ajowi, J. O., & Gudo, C. O. (2018). Influence of principals' performance in training teachers in Information Communication Technology on usage of ICT for teaching and learning in secondary schools, 6(8), 201-210. http://ir.jooust.ac.ke:8080/xmlui/handle/123456789/2792.

Picatoste, J., Pérez-Ortiz, L., & Ruesga-Benito, S. M. (2018). A new educational pattern in response to new technologies and sustainable development. Enlightening ICT skills for youth employability in the European Union. *Telematics and Informatics*, *35*(4), 1031-1038. doi: https://doi.org/10.1016/j.tele.2017.09.014

Prasasti, F. D., Situmorang, R., & Kusumawardani, D. (2018). Development of integrated audio visual module for learning animation principles at multimedia vocational school. *International Journal Of Education, Information Technology, And Others*, *1*(2), 55-69. doi: https://doi.org/10.5281/zenodo.1795345

Rachmadtullah, R., Ms, Z., & Sumantri, M. S. (2018). Development of computer-based interactive multimedia: study on learning in elementary education. *Int. J. Eng. Technol*, *7*(4), 2035-2038. doi: https://doi.org/10.14419/ijet.v7i4.16384

Pardimin, A., Ninsiana, W., Dacholfany, M. I., Kamar, K., Teh, K. S. M., Huda, M., ... & Maseleno, A. (2018). Developing multimedia application model for basic mathematics learning. *Journal of Advanced Research in Dynamical and Control Systems*. Special Issue (14), 1347-1356. Retrieved from https://elibrary.ru/item.asp?id=38678774

Regan, K., Evmenova, A. S., Sacco, D., Schwartzer, J., Chirinos, D. S., & Hughes, M. D. (2019). Teacher perceptions of integrating technology in writing. *Technology, Pedagogy and Education*, 28(1) 1-19. doi: https://doi.org/10.1080/1475939X.2018.1561507

Reinsfield, E. (2019). A future-focused approach to the technology education curriculum: the disparity between intent and practice. *International Journal of Technology and Design Education*, 30, 1-13. doi: https://doi.org/10.1007/s10798-019-09497-6

Riasanow, T., Soto Setzke, D., Hoberg, P., & Krcmar, H. (2018). Clarifying the Notion of Digital Transformation in IS Literature: A Comparison of Organizational Change Philosophies. *Available at SSRN 3072318*. 22. doi: https://dx.doi.org/10.2139/ssrn.3072318

Shu, H., & Gu, X. (2018). Determining the differences between online and face-to-face student–group interactions in a blended learning course. *The Internet and Higher Education*, *39*, 13-21. Doi: https://doi.org/10.1016/j.iheduc.2018.05.003

Setiawan, I., Hamra, A., Jabu, B., & Susilo, S. (2018). Exploring A Teacher Educator's Experiences in Modeling TPACK to Create English Language Multimedia in Technology Courses. *Journal of Language Teaching and Research*, *9*(5), 1041-1052. Retrieved from http://eprints.unm.ac.id/id/eprint/10767

Semerci, A., & Aydin, M. K. (2018). Examining High School Teachers' Attitudes towards ICT Use in Education. *International Journal of Progressive Education*, *14*(2), 93-105. Retrieved from https://files.eric.ed.gov/fulltext/EJ1177301.pdf

Salem, N., & Mohammadzadeh, B. (2018). A Study on the Integration of ICT by EFL Teachers in Libya. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 2787-2801. doi: https://doi.org/10.29333/ejmste/90594

Scherer, R., Tondeur, J., Siddiq, F., & Baran, E. (2018). The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modelingapproaches. *Computers in Human Behavior*, *80*, 67-80. doi: https://doi.org/10.1016/j.chb.2017.11.003

Schreglmann, S., & Kazanci, Z. (2018). A Lesson Plan Development Study for Higher Education Based on Needs Assessment "Graphics and Animation in Education" Course. *International Education Studies*, *11*(7), 155-165. doi: https://doi.org/10.5539/ies.v11n7p155

Suárez-Rodríguez, J., Almerich, G., Orellana, N., & Díaz-García, I. (2018). A basic model of integration of ICT by teachers: Competence and use. *Educational Technology Research and Development*, *66*(5), 1165-1187. doi: https://doi.org/10.1007/s11423-018-9591-0