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FACTORS AFFECTING STUDENT PERFORMANCE ON ENGINEERING DRAWINGS IN THE INDUSTRIAL REVOLUTION 4.0

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Abstract :

The Industrial Revolution 4.0 has transformed education, particularly in technical drawing, requiring students to develop ICT literacy, social skills, and active engagement. However, many students face challenges in mastering ICT tools and collaborative skills, impacting their academic performance. This study uses a quantitative approach with an ex post facto design to analyze the relationships between student engagement, ICT literacy, social skills, and student performance. A Likert-scale questionnaire was distributed to 91 technical drawing students at Yogyakarta State University, and the data were analyzed using the SEM-PLS method. The results show that student engagement is the most influential factor in improving academic performance, followed by ICT literacy and social skills. Active student engagement enhances ICT literacy, which supports collaboration and boosts learning outcomes. Social skills, while less directly impactful, facilitate teamwork, which is crucial for technical drawing projects. This study emphasizes the need for integrated learning approaches combining engagement strategies, ICT literacy development, and social skill enhancement through digital tools and collaborative projects. These findings contribute to curriculum development, ensuring students are equipped to meet Industry 4.0 demands.

Keywords : *Student Performance, Social Skills, ICT Literacy, Student Engagement.*

INTRODUCTION

The Industrial Revolution 4.0 provides massive changes that occur in the field of technology (Ngatiman, Sulaiman, & Wong, 2023; Surjandari et al., 2022). The World Economic Forum (2023) states that this revolution is rapidly adopting technologies that are changing the role of humans and machines in various sectors and regions, resulting in changes in the way of working and affecting the content of work and the skills required. Rapid technological advances impact the functioning of industrial sectors, especially the demand for skilled and competitive labour (Spöttl & Windelband, 2021). This poses a threat to low-skilled workers (Nurmawiya & Kurniawan, 2021). Chang and Huynh (2016) stated that 56% of jobs in Indonesia are at high risk of automation, 35% are at medium risk, and 9% are at low risk. In addition, 23% of jobs are expected to change in the next 5 years through a growth of 10.2% and a decline of 12.3%, with 69 million new jobs to be created and 83 million jobs to be lost (World Economic Forum, 2023). This condition is a serious challenge for university graduates who have an unemployment rate of 5.25% in 2024 (Yulianti, 2024).

This challenge requires students to have competencies to be able to enter

the world of work, one of which is ICT literacy. The ICT Literacy Panel (2002) defines ICT literacy as a person's ability to practice digital technology to access, integrate, manage and create information. This ability to practise is important when using technology. Students must be able to use software such as Autocad, SketchUp and others to produce engineering drawings (Ali et al., 2024; Zhao & Wang, 2024). Mastering technical drawings is crucial because technical drawings are the basic language of an engineer (Rica, Moreno-García, Álvarez, & Serratosa, 2020). Mastering engineering drawings allows students to understand various aspects of building design and construction comprehensively (Kadam, Mishra, Deep, & Iyer, 2021; Zorn & Gericke, 2020). This mastery requires students to be able to use and master Computer-Aided Design (Marji, Musta'amal, Chidozie, & Hassan, 2023; Shreeshail, Suresh, Hiremath, Halemani, & Kottursheттar, 2021). Effective use of integrated technology can increase student engagement (Gunuc, 2023; Pandita & Kiran, 2023). In completing engineering drawing assignments, student engagement in learning is required. Student engagement has an impact on the learning environment (Muir et al., 2019). Students who are engaged in learning facilitate themselves to achieve success (Dunn & Kennedy, 2019; Pham & Chen, 2019). With this engagement, students can build their knowledge (Xie, Heddy, & Vongkulluksn, 2019).

In addition, social skills influence emotional intelligence (Imjai, Aujirapongpan, Jutidharabongse, & Usman, 2024), which allows one to interact positively with others (Erdoğan & Çargıt, 2018). This makes it easy for students to interact with lecturers in learning. In lectures, competent lecturers play a role in developing students' social skills and emotional intelligence. Through effective approaches and interactions in learning, lecturers can create an environment that supports students' interpersonal growth, builds empathy, and encourages them to become individuals who are able to communicate well. Lecturers have a role as teachers and facilitators, instilling knowledge, professional values, and 21st-century skills such as critical thinking and problem-solving. The success of education depends on lecturer competence, which requires continuous evaluation and development as the foundation of an educational process (Valantinaite & Navickiene, 2024).

However, while these four variables have been widely studied individually, the integration of ICT skills, social skills, lecturer competence, and student engagement in a single research framework is still rare. Previous studies focused on one factor without considering the interaction between these variables in a hierarchical manner. Therefore, this study aims to thoroughly analyse the influence of ICT skills, social skills, lecturer competence, and student engagement on student performance in engineering drawing projects in the era of the Industrial Revolution 4.0.

H_1: Student engagement has a significant effect on social skills
H_2: Student engagement has a significant effect on student performance
H_3: Student engagement has a significant effect on ICT literacy
H_4: ICT literacy has a significant effect on social skills
H_5 : Social skills have a significant effect on student performance

H_6 : ICT literacy has a significant effect on student performance

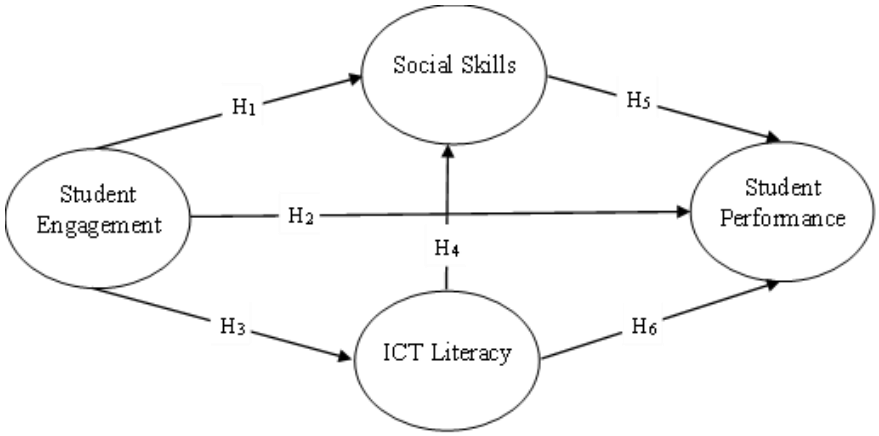

Figure 1. Frame of Mind

This research is expected to make an important contribution to theory development, as well as a practical reference for educational institutions in designing learning strategies that are relevant to the needs of modern industry.

RESEARCH METHOD

This study uses a quantitative approach with an ex post facto design, where researchers will identify and measure the relationship between variables. The variables are ICT literacy, social skills, lecturer competence and student involvement in student performance on engineering drawing projects that experts have validated. The instrument used was a Likert scale questionnaire distributed online with a sample study of 91 students who took technical drawing subjects at Yogyakarta State University. The sample was selected using stratified random sampling to ensure the representation of various characteristics of student performance, which was developed to measure the intensity of the influence of variables using SEM PLS data analysis.

FINDINGS AND DISCUSSION

Measurement Model

This study used the PLS-SEM method with two stages of analysis: the outer model to assess indicator validity and reliability and the inner model to analyze the structural model and variable relationships. Table 1 shows that the outer model achieved high reliability and validity.

Table 1. Construct Validity and Reliability

Constructs/item	Loading Factor	α	CR	AVE
Student Engagement		0.928	0.941	0.695
Listening to learning	0.821			
Conscientious about learning and assignments	0.827			
Study hard in class	0.753			
Learning new things	0.834			

Have high curiosity	0.879			
Interested in doing new tasks	0.853			
Happy to learn new things in class	0.861			
Social Skills		0.914	0.933	0.701
Adaptable	0.844			
Able to collaborate	0.865			
Responsible for team tasks	0.828			
Understanding other people's opinions	0.831			
Able to give explanation to the team	0.847			
Propose ideas to the team	0.807			
ICT Literacy		0.928	0.941	0.666
Able to gather information	0.786			
Able to sort out information	0.852			
Presenting arguments	0.864			
Completing tasks with ICT	0.785			
Able to use ICT	0.831			
Learning efficiency with ICT	0.845			
Utilise ICT to design	0.799			
Realise the impact of using ICT	0.763			
Student Performance		0.881	0.912	0.676
Using a laptop in designing	0.736			
Knowing the application of technical drawings	0.833			
Using technical drawing applications	0.874			
Able to use technical drawing applications in designing	0.874			
Understand calculations on engineering drawings	0.787			

Based on the results of construct validity and reliability, all loading scores are above 0.5, so no indicators need to be removed from the research model. Discriminant validity is assessed through the AVE value, which must be more than 0.5. Table 1 shows that all AVE values meet the required criteria, so discriminant validity can be considered good.

Structure Model

After completing the outer model testing, the next step is to analyze the direct and indirect effects between variables, as presented in Table 3. The results of the model analysis show that the fit value (SRMR = 0.086, NFI = 0.702) and the Adjusted R Square value (IL = 0.128, SS = 0.678, SP = 0.409). Meanwhile, the results of the influence analysis between variables presented in Table 3 show that student engagement has a significant influence on social skills ($\beta = 0.191$, $p < 0.05$), student performance ($\beta = 0.584$, $p < 0.01$), and ICT literacy ($\beta = 0.371$, $p < 0.05$). In addition, ICT literacy has a significant effect on social skills ($\beta = 0.737$, $p < 0.01$), and student performance ($\beta = 0.363$, $p < 0.05$). These findings indicate that H1 to H6 have a significant effect on student engagement, social skills, and ICT literacy, which influence improving student performance in engineering drawing.

Table 2. Discriminant Validity of Variables (Fornell & Larcker criterion)

Variabel	ICT Literacy	Social Skills	Student Engagement	Student Performance
ICT Literacy	0.816	-	-	-

Social Skills	0.808	0.837	-	-
Student Engagement	0.371	0.465	0.833	-
Student Performance	0.400	0.343	0.616	0.822

Table 3. Hypothesis Testing

Hypothesis/path	Direct effect		Indirect effect		Total effect	
	β	*t*-value	*β*	*t*-value	*β*	*t*-value
H_1 : SE => SS	0.191	2.160*	0.274	3.362**	0,465	3.752**
H_2 : SE => SP	0.584	5.167**	0.031	0.410	0.616	8.645**
H_3 : SE => IL	0.371	3.105**	-	-	0.371	3.105**
H_4 : IL => SS	0.737	9.976**	-	-	0.737	9.976**
H_5 : SS => SP	-0.223	1.687*	-	-	-0.223	1.687*
H_6 : IL => SP	0.363	2.991**	-0.164	1.543	0.199	1.670*

Note : SE: student engagement; SS: social skills; SP: student performance; IL: ICT literacy; Significant at $p < 0.05$*, $p < 0.01$**.

The transformation of digital technology affects the way students develop their technical, social, and academic skills. The study's results revealed factors significantly affecting students' performance in learning engineering drawing, as shown in Figure 2.

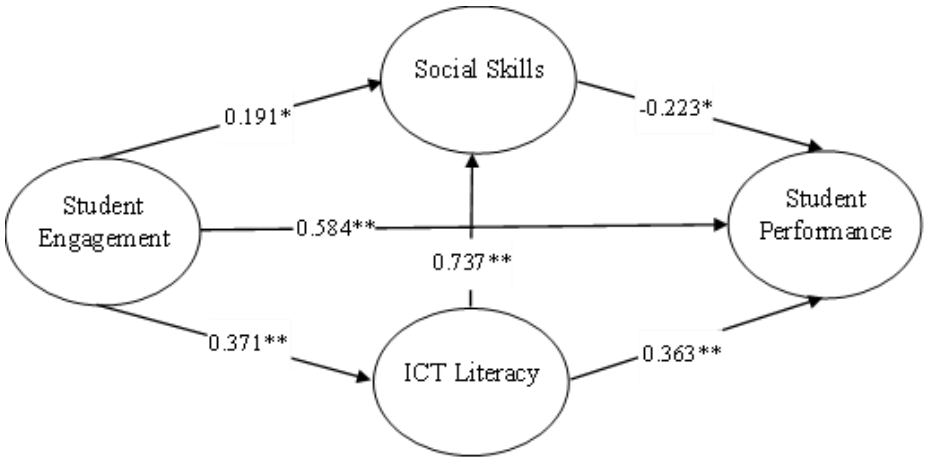

Figure 2. The Result of Testing the Direct Relationships Between the Variables

The analysis shows that Student Engagement has a significant effect on Student Performance. This confirms that students' active engagement in learning has a great impact on their academic achievement, especially in engineering drawing courses that require active interaction with materials, software, and technological tools. In Industry 4.0, technical drawing learning involves technology such as Computer-Aided Design (Gunuc, 2023; Marji et al., 2023). Technology plays an important role in learning technical drawing by enhancing visualization, linking theory and practice, and preparing students for careers. (Ali et al., 2024). Actively engaged students can better integrate theory and practice, improving their understanding and performance.

Students with high ICT literacy tend to be more capable of operating CAD software, understanding 3D models, and applying technology. In addition, ICT literacy helps students to search for information independently, solve technical problems, and adapt to new tools that are constantly evolving in the world of

technology. Based on the results of the analysis, ICT literacy also has a significant influence on social skills, which are an important element in team collaboration and communication in the digital era. Open and cohesive communication builds a strong social presence, which has a positive impact on students' cognitive presence. (Huang et al., 2019). This indicates that students' ability to use technology also supports their social interaction in team-based projects that are common in technical drawing learning.

In addition, social skills affect student performance variables. In learning technical drawing, students are often involved in group tasks that require active communication, task sharing, and conflict resolution. This factor is becoming increasingly important as the world of work demands high interpersonal and teamwork skills. The role of social skills in supporting ICT literacy also reinforces its relevance. For example, students with good social skills are more likely to share technical knowledge with their peers, facilitate collective learning, and solve technical problems collaboratively. Therefore, the development of social skills still needs to be addressed even though its direct effect on student performance tends to be smaller than student engagement and ICT literacy.

CONCLUSION

This research shows that student engagement is the main factor that influences students' performance in learning technical drawing. Students who actively engage with technology will improve their ICT literacy, subsequently improving their ability to work collaboratively (socially) and promoting better student performance. An integrative approach that combines the development of student engagement, ICT literacy and social skills can create a learning environment that is holistic and relevant to industry needs. These three factors are particularly relevant for technical drawing learning in the Industry 4.0 era, where student success depends on a combination of student engagement, strong ICT literacy and good social skills.

The findings have several important implications for technical drawing education in the Industry 4.0 era. First, educational institutions should strengthen programmes that encourage student engagement through active learning approaches, digital simulations, and the use of interactive technologies. These approaches can increase student participation while improving their ICT literacy.

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