Assessing the Quality of Learning Materials in a Learning Management System (LMS): Its Impact on Learning Outcomes

Donatus Wea (romodonwea@stkyakobus.ac.id)[1)]; **Emiliana Sri Pudjiarti** (emiliana-sripujiarti@untagsmg.ac.id)[2)]; **Rikardus Kristian Sarang (**rikardkristians@stkyakobus.ac.id)[3)]
[1+3)] STK Santo Yakobus Merauke – South Papua; [2)] Universitas 17 Agustus 1945 Semarang – Central Java

Abstract

This research investigates the influence of project team interaction, guidance, feedback, and material quality within the Learning Management System (LMS) on the development of critical thinking skills and the ability to engage in lifelong learning. Partial least squares analysis was employed to test hypotheses using data from participants in the Catholic Religious Teacher Professional Education program at the Educational Institution for Education Personnel Santo Yakobus Merauke-South Papua through simple random sampling. The research results indicate that project team interaction, guidance, feedback, and material quality within the Learning Management System (LMS) significantly and positively contribute to developing critical thinking skills and lifelong self-directed learning. The managerial implications of this study underscore the importance of creating high-quality learning materials in the LMS and providing practical guidance and feedback to students to support the development of both skills. The theoretical implications of this research strengthen the understanding of the relationship between project team interaction, guidance, feedback, material quality in the LMS, critical thinking skills, and self-directed learning. Theories in education and psychology can be utilized as a foundation for designing more effective interventions to enhance both skills.

Keywords: Lifelong independent learning, Development of critical thinking skills, Project team interaction, Guidance and feedback, Quality of learning materials in LMS

Introduction

Education has undergone significant changes with the development of information technology. Implementing learning management systems (LMS) becomes crucial in information and communication technology to support project-based learning effectiveness (Picciano, 2017). LMS is a technological platform that manages, delivers, and facilitates online learning, including text, video, audio, assignments, and more (Keengwe & Georgina, 2013). As educator and philosopher John Dewey stated, "We do not learn from experience, but from reflecting on experience." In this context, reflection refers to the critical ability and profound understanding resulting from interaction with learning materials. Research by Wang (2017) indicates that well-designed learning materials meeting specific quality standards can significantly impact learning outcomes. (Quansah et al., 2021) investigated the relationship between the quality of learning materials in LMS, student attendance, and academic achievement, finding that well-designed and relevant content positively contributes to learning outcomes.

According to (Tham et al., 2017), the calibre of the learning resources in an LMS also impacts the development of critical thinking abilities. (Anderson et al., 2021) Emphasise the importance of effective instructional design in enhancing student understanding and engagement. The quality of learning materials in LMS refers to the assessment and improvement of online educational content that impacts the learning experience and outcomes. (Moore et al., 2018) highlight the importance of engaging materials to maintain student attention and participation. Easy navigation is crucial for a practical learning experience (Keengwe & Georgina, 2013).

(Anderson et al., 2021) found that the quality of materials in LMS also influences the development of students' critical thinking skills, which is crucial for lifelong learning. Materials encouraging critical thinking stimulate students to question and evaluate information, enhancing independent learning. Therefore, access to quality materials in LMS is vital in motivating students and

developing critical skills for lifelong learning. However, there are challenges and limitations in implementing LMS in project-based learning, such as difficulties in technology adaptation, the need for training for students and educators, and the availability of adequate resources.

In the educational context, the role of teachers as educators and guides is crucial in designing a learning environment that supports effective interaction, collaboration, and guidance. According to (Paul & Elder, 2019), through interaction, teachers can exchange diverse ideas, insights, and perspectives, enriching critical thinking processes. Collaboration within project teams allows teachers to work together to solve problems, identify alternative solutions, and make decisions based on careful consideration. Therefore, the role of teachers as educators and guides is essential in designing a learning environment that supports effective interaction, collaboration, and guidance.

The importance of guidance and feedback in developing critical thinking skills is also revealed in Clutterbuck's (2014) findings. Guidance helps students understand the importance of critical thinking and guides them in critically solving problems. Relevant and constructive feedback also helps students reflect and improve critical thinking skills. Thus, learners will have optimal opportunities to sharpen critical thinking skills, become independent learners, and be ready to face challenges with strong analytical abilities. Based on the above description, using project-based learning strategies through LMS can promote interaction and collaboration within teams and develop independence in lifelong learning skills for students. Therefore, it is important to explore project-based learning through LMS further to provide authentic experiences for students to integrate religious knowledge and pedagogical skills.

This research focuses on participants in the Catholic Religious Education Professional Education (PPG) at the Educational Institution of Educational Personnel Saint Jacobus Merauke-South Papua, using a mixed approach to benefit from both quantitative and qualitative approaches, allowing for data triangulation for higher validity. This approach offers a more profound insight by combining statistical analysis with qualitative context. Additionally, this method addresses the limitations of every single approach and provides a more comprehensive understanding of the studied phenomenon.

The educational goal is to develop the pedagogical competence of participants (Catholic Religious Education teachers). The research questions are: Can developing critical thinking skills mediate the relationship between the LMS learning materials quality, project team interaction, and guidance and feedback towards lifelong independent learning? Why is developing critical thinking skills essential for learning in the 21st century? What factors can encourage the development of critical thinking skills and lifelong independent learning?

Literature Review

Fundamental Theory

The foundational theory of interaction in learning emphasises the importance of learners' interaction with their environment, including teachers, classmates, and learning materials. This theory recognises that the learning process does not occur in isolation but is influenced by social and collaborative relationships. Bandura's Social Learning Theory (1977), which emphasizes the value of social interaction, imitation, and observation in the learning process, is pertinent in this context. According to Bandura, humans pick up knowledge by watching other people behave and the results they get. Practical knowledge and understanding transfer is facilitated by interaction with others.

Because learning management systems (LMS) allow for independent access to various learning resources, including learning materials, integrating interaction theory into the classroom can improve students' autonomy and critical thinking skills (Clark & Mayer, 2016). Students can schedule their study time and participate in educational activities by their needs and preferences. Within this framework, learning management systems (LMS) function as an instrument to facilitate students' independent learning and offer chances for interaction with teachers and fellow students via online discussion boards or group projects. Students can share ideas, trade viewpoints, and have in-depth discussions about concepts through this interaction. Through the exchange of ideas and considerations from different

perspectives, these discussions and collaborations foster critical thinking in students (Crawford et al., 2018).

An LMS is an electronic platform used for online learning management, distribution, and assessment. Resource-based knowledge and learning management systems (LMS) work together to promote critical thinking and lifelong, self-directed learning. According to Cooper et al. (2023), acquiring resource-based knowledge entails accessing various materials, such as books, films, websites, and other references. When paired with learning management systems (LMS), resource-based knowledge can improve critical thinking and foster lifelong, self-directed learning. LMS enables students to access various resources swiftly, locate information, and hone their analytical and problem-solving abilities (Nelson & Kotcherlakota, 2019). An LMS serves as a "portal" that links students with knowledge based on resources, assisting them in becoming active, self-directed learners and strengthening their critical thinking skills.

Conceptual Research Framework and Hypotheses Development

Lifelong Independent Learning

The ability of a person to take the initiative on their own during the lifelong learning process is called lifelong independent learning (Mckendry & Boyd, 2012). This skill includes the ability to schedule, coordinate, and oversee independent learning without assistance from teachers or official educational establishments. It is essential in the modern knowledge era when people must constantly learn and adapt throughout their lives due to the swift changes in information and technology (Power & Maclean, 2013).

Several crucial elements are involved in independent learning throughout life (Kaplan, 2016): a) Autonomy: the capacity to organize one's education, recognize educational resources, and assess one's learning development. b) Intrinsic motivation: the desire to learn that comes from inside the person and is not prompted by outside forces. A person's intrinsic motivation propels them to keep learning even in the absence of outside pressure. c) Capacity to Learn from Experience: the ability to take advantage of common occurrences as chances for development and learning. d) Adaptability: the capacity to apply newly acquired knowledge and skills while adjusting to modifications in the learning environment and emerging technologies. All of these elements work together to enhance a person's capacity for autonomous learning throughout their life, which is essential for overcoming the obstacles of the modern knowledge environment. People with strong, independent learning skills for life are better positioned to prosper and thrive as the rate of technological and informational change quickens.

Development of critical thinking skills

One of the most important aspects of education is the development of critical thinking abilities, which help people comprehend, analyze, and critically assess information. According to (Paul & Elder, 2019), critical thinking entails the capacity to carefully identify, investigate, and assess arguments, identify and evaluate underlying assumptions, and weigh the implications of a position or course of action. This process allows people to avoid prejudiced thinking and make more logical decisions. A person can improve their ability to solve problems, make wise decisions, and handle difficult situations in various settings by honing their critical thinking abilities (Heard et al., 2020).

The study by Heard et al. (2020), which claims that people with the required strong thinking skills typically excel in problem-solving, conducting in-depth analyses of information, and making better decisions, also reflects the development of critical thinking abilities. According to a study by Ku (2009), cultivating critical thinking abilities can have long-term advantages such as enhanced emotional intelligence, adaptability in dynamic work environments, and problem-solving skills. Gaining these abilities increases a person's capacity for information processing and interpretation, which substantially impacts their capacity for lifelong learning and their level of autonomy during the learning process (Deveci & Ayish, 2017).

Critical thinking skills also enable individuals to recognise and overcome various challenges in the learning process. In the context of lifelong learning, critical thinking becomes crucial in facing

changes and adapting to advancements in science and technology. Individuals with the necessary thinking skills are more open to new ideas and perspectives, better able to sift through relevant information, and more motivated to continue learning and self-development (Fraser et al., 2015).

H1: The development of critical thinking skills significantly influences lifelong independent learning.

Project Team Interaction

The concept of project team interaction emphasises the importance of communication and interaction among team members. It encompasses various elements crucial for project success, such as exchanging ideas, collaboration, joint decision-making, and effective communication among team members. In this context, project team interaction focuses on how team members work together as an integrated unit, sharing knowledge, experiences, and expertise to achieve project goals collectively. Effective interaction in this context helps enhance team productivity, optimise resource utilisation, and ensure high-quality project outcomes.

Interaction and collaboration within project teams play a sign. Conversely, collaboration thinking skills. Both are interrelated and mutually influential in creating a conducive learning environment for developing critical thinking skills (Paul & Elder, 2019). Project team interaction involves various forms of communication and relationships among team members. When teachers interact within a project team, they can exchange ideas, perspectives, and information relevant to a specific topic. Through this interaction, teachers can gain new insights, deeper understanding, and diverse perspectives, enriching the critical thinking process (Fisher & Scriven, 2017). In contrast, collaboration entails team members working together to accomplish shared objectives (Jackson & McManus, 2016).

According to Wang & Woo (2017), collaboration within project teams can enhance members' ability to solve problems and think critically. (Ng et al., 2019) found that cooperation among project team members could promote idea-sharing and improve group understanding. In project teams, people frequently engage in cooperative learning processes where they exchange knowledge and provide mutual support.

This may impact self-directed learning since people can become more independent through interaction and teamwork (Gu et al., 2013). According to a 2009 study by Hrastinski, project teams' interactions and collaboration can positively affect the development of independence in lifelong learners. Collaborating as a project team can improve one's capacity for self-directed learning and drive to acquire new information. Project team interaction has also enhanced students' independence and capacity for lifelong learning (Zainuddin et al., 2016).

H2: Project team interaction significantly influences the development of critical thinking skills.

H3: Project team interaction significantly influences lifelong independent learning.

Guidance and Feedback

Giving students direction, support, and guidance as they work toward their learning goals is known as guidance. This entails providing teaching resources, outlining ideas, and giving instructions. Through guidance, learners can receive assistance in tackling challenging learning problems or tasks (Zainuddin et al., 2016) (Clutterbuck, 2014). Advice can help students identify issues, formulate critical questions, develop problem-solving strategies, and apply appropriate thinking methods. (Hounsell et al., 2008), in their research on the power of feedback, illustrate how effective feedback can influence student learning outcomes. Effective feedback aids students in reflecting on their thoughts, evaluating arguments or ideas, and enhancing their understanding and critical thinking skills. Teachers or mentors providing guidance can guide students in formulating critical questions, analysing information, and developing logical reasoning. Constructive feedback provides insights into strengths and weaknesses in critical thinking (Norcini, 2010). Learners can use this feedback to identify areas for improvement and strengthen necessary thinking abilities.

A study by (Mandouit Hattie, 2023) emphasizes that effective feedback is one of the most potent factors in enhancing student learning outcomes. When feedback is combined with good guidance, both

can improve critical thinking skills. Similarly, according to King (2019), intensive guidance can impact students' academic progress and assist them in developing necessary thinking skills. Advice and feedback support lifelong independent learning (Norcini, 2010). Through guidance, individuals can plan and achieve learning goals, and feedback provides valuable information about student progress and allows for improvements. Practical advice, such as mentoring and career planning, motivates individuals to learn independently, while quality feedback helps track performance and identify areas for improvement. In combination, guidance and feedback help individuals become more successful, lifelong independent learners.

H4: Guidance and feedback significantly influence the development of critical thinking skills.

H5: Guidance and feedback significantly influence lifelong independent learning.

Quality of Learning Materials in LMS

The quality of learning materials in LMS refers to evaluating and enhancing the quality of learning materials presented in learning management systems within online education. It encompasses several vital factors, such as relevance, student engagement, ease of navigation, and progress measurement. The quality of learning materials in LMS is crucial as it influences students' online learning experiences and can impact learning outcomes. Understanding the essence of the quality of learning materials in LMS enables the design of more effective approaches in the increasingly dominant field of online education. Research (Picciano, 2017) contributes uniquely to understanding and developing quality online education.

Learning in LMS should be designed to captivate and engage students. (Moore et al., 2018) reveal that the ability to maintain student attention and encourage active participation indicates the quality of learning materials in LMS. This can be achieved through multimedia elements, interactive tasks, and challenging pedagogical approaches. Ease of navigation is a crucial factor. According to (Keengwe Georgina, 2013), intuitive and efficient navigation in LMS can enhance students' learning experiences.

Learning materials that provide opportunities for participating in discussions or collaborations with fellow students can help develop critical thinking skills. In such situations, students can ask questions, debate ideas, and view topics from various perspectives, enriching the process of critical thinking. A study by (Crawford et al., 2018) on using LMS in education found that the quality of learning materials in LMS significantly influences students' critical thinking skills.

Research (Johnson & Brown, 2020) highlights that LMS providing diverse and well-presented learning materials positively impacts students' participation levels and self-directed learning. The results of this study indicate that the quality of materials in LMS not only affects the understanding of content but also motivates students to take initiative in self-directed learning. In other words, access to quality learning materials in the LMS can stimulate students' interest in lifelong independent learning. Research by (Anderson et al., 2021) found that the quality of learning materials in LMS also influences the development of students' critical skills, a crucial aspect of effective independent learning. Learning materials that promote critical and analytical thinking can encourage students to be more active in self-directed learning as they become accustomed to questioning, reflecting, and evaluating information more critically.

H6: The quality of learning materials in LMS significantly influences the development of critical thinking skills.

H7: Quality of learning materials in LMS significantly influences lifelong independent learning.

Research Methods

This study employs a mixed-methods approach. According to (Creswell, 2018), mixed methods combine two research methodologies, quantitative and qualitative, into a unified research activity, resulting in more comprehensive, valid, reliable, and objective data. The mixed-methods approach aims to benefit from both quantitative and qualitative perspectives, allowing for data triangulation to enhance

validity. This approach provides deeper insights by integrating statistical analysis with qualitative context.

The research population consists of participants in the Catholic Religion Teacher Professional Education Program at St. Yakobus Teacher Training and Education College in Merauke, South Papua, in Batches 1 and 2, totalling 620 participants. Sample determination utilises probability sampling techniques. With a minimum sample size of 242 respondents, this study gathers data from a larger sample, totalling 274. Data collection techniques include questionnaires, interviews, and literature reviews. The questionnaire comes in two forms: structured or closed-ended questionnaires and unstructured or open-ended questionnaires. After determining the sample, oral interviews are conducted with selected respondents. The analytical tool used to test hypotheses is the structural equation model (SEM), implemented through SmartPLS 3.23 software.

Result

Table 1: Demographic Respondent

Description	Amount	%	Description	Amount	%
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Age			Gender		
a) 31 – 35	6	2,48%	**a)** Male	100	41,32%
b) 36 – 40	135	55,79%	**b)** Female	142	58,68%
c) 41 – 45	80	33,06%	**Etnis Origin**		
d) 46 – 50	17	7,02%	a) NTT	130	53,72%
e) >50	4	1,65%	b) Maluku	48	19,83%
Years of service			c) Central Papua	25	10,33%
a) < 5	4	1,65%	d) West Papua	5	2,07%
b) 6 – 10	135	57,79%	e) South Papua	14	5,79%
c) 11 – 15	70	28,93%	f) South Sulawesi	10	4,13%
d) 16 – 20	28	11,57%	g) North Sulawesi	5	2.07%
e) > 20	5	2.07%	h) Another Etnis	5	2,07%

Most samples are female (58.68%), with the highest distribution in the NTT region. This is because the NTT province is predominantly Catholic, leading many to choose the profession of Catholic Religious Education teachers in schools. The majority are female because women are generally more patient, skilled, and loyal in accompanying students (at the elementary and secondary education levels) in teaching faith and Christian morality. Their age is highly productive and mature, evident from the majority falling within the average age range of 36 to 40 years (55.79%). Teaching experience (work tenure) mostly ranges from 6 to 10 years (57.79%), meaning that this cohort is young, energetic, entirely romantic, and open to changes in improving themselves as professional teachers by legal requirements and the changing times (demands of modern-century educators).

Result of Quantitative Analysis

SmartPLS requires that the data must be valid and reliable. Therefore, each construct's validity and reliability are evaluated in the initial stage. This measurement is reflected in Table 2, which summarizes the criteria for loading factors, AVE (Average Variance Extracted), and CR (Composite Reliability) for each construct.

Table 2: Validity and reliability criteria for each construct

Concept	Indicator	Item	Loading factors*)	AVE**)	Composite reliability***)	Cronbach Alpha****)
Project team interaction (Holen &	Communication frequency	PTI1	0,821	0,893	0,911	0,934
	Open communication	PTI2	0,881			
	Openness and trust	PTI3	0,870			

Concept	Indicator	Item	Loading factors*)	AVE**)	Composite reliability***)	Cronbach Alpha****)
Sortland, 2022)	Division of tasks	PTI4	0,793			
	Synergy	PTI5	0,816			
Guidance and feedback (Hattie & Timperley, 2017)	Availability of time and support	GF1	0,833	0,894	0,912	0,880
	Listening and empathy skills	GF2	0,795			
	Development of trusting relationships	GF3	0,719			
	Specific and targeted	GF4	0,727			
	Objective and constructive	GF5	0,809			
	Focused on development	GF6	0,793			
	It involves a two-way interaction.	GF7	0,796			
Quality of learning materials in LMS (Gupta. M, 2019)	Clarity of information	QLM1	0,853	0,855	0,931	0,914
	Content relevance	QLM2	0,808			
	Interactivity	QLM3	0,902			
	Student engagement	QLM4	0,844			
	Ease of accessibility	QLM5	0,811			
Development of critical thinking skills (Moon, 2007)	Logical analysis	DCTS1	0,903	0,907	0,943	0,919
	Evaluate arguments	DCTS2	0,784			
	Informed decision making	DCTS3	0,902			
	Reflective thinking ability	DCTS4	0,901			
	Openness to alternative points of view	DCTS5	0,889			
Lifelong independent learning (Brookfield, 2013)	Self-regulation	LIL1	0,872	0,899	0,939	0,939
	Ability to search for information	LIL2	0,846			
	Reflection ability	LIL3	0,912			
	Adaptability	LIL4	0,872			
	Personal study plan	LIL5	0,839			

The results of the concurrent validity analysis are assessed through the average variance extracted (AVE) for each construct. It should be above 0.70, while AVE should exceed 0.50 because the sum of squared loadings from external factors should account for 50% of the variable's variance. Additionally, Cronbach's alpha should exceed 0.70. Based on the analysis in Table 1, all items meet the criteria generated using SmartPLS version 3.2.8 (Ringle et al., 2015). Furthermore, discriminant validity is tested by assessing the heterotrait-monotrait ratio of correlations (HTMT). One method to evaluate this is the heterotrait-monotrait correlation ratio (HTMT ratio), as Henseler et al. (2015) suggested. The values produced should be at most 0.85, as shown in Table 3. Table

Table 3: Heterotrait-monotrait Results

Variable	Development of critical thinking skills	Guidance and feedback	Lifelong independent learning	Project team interaction
Guidance and feedback	0,578			

Lifelong independent learning	0,627	0,574		
Project team interaction	0,529	0,362	0,517	
Quality of learning materials in LMS	0,659	0,633	0,609	0,514

Assessment of Model and Hypothesis Testing

The assessment of the structural model explores the hypothesized relationships through the bootstrapping process from 274 samples with a 95% confidence interval (Figure 1). The model is presented in Table 4, including path coefficients, standard errors, t-values, and p-values (Hair et al., 2006). The basis used to test the hypotheses is the values found in the output path coefficients.

Tabel 4: Path beta, t-value, and P-value

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values	Result
Project team interaction → Development of critical thinking skills	0,203	0,205	0,075	2,724	0,007	Accepted
Project team interaction → Lifelong independent learning	0,166	0,166	0,077	2,174	0,030	Accepted
Guidance and feedback → Development of critical thinking skills	0,352	0,351	0,070	5,043	0,000	Accepted
Guidance and feedback → Lifelong independent learning	0,197	0,193	0,089	2,219	0,027	Accepted
Quality of learning materials in LMS → Development of critical thinking skills	0,197	0,200	0,068	2,883	0,004	Accepted
Quality of learning materials in LMS → Lifelong independent learning	0,187	0,195	0,089	2,097	0,036	Accepted
Development of critical thinking skills → Lifelong independent learning	0,219	0,225	0,082	2,657	0,008	Accepted

*) t-value should be more than 1.99; **) P-value should be less than 0.5 **).

Based on the partial least squares (PLS) analysis, it was found that project team interaction has a positive and significant influence on critical thinking skills, with a coefficient value (β1) of 0.203 and a t-value of 2.742 at a significance level of α = 0.007. Furthermore, project team interaction positively and significantly influences lifelong independent learning, with a coefficient value (β2) of 0.166 and a t-value of 2.174 at a significance level of α = 0.030. It has also been demonstrated that guidance and feedback variables positively and significantly impact the development of critical thinking skills, with a t-value of 5.043 at a significance level of α = 0.000 and a coefficient value (β3) of 0.352. With a t-value of 2.219 at a significance level of α=0.027 and a coefficient value (β4) of 0.197, this variable also positively and significantly impacts lifelong independent learning.

The Learning Management System (LMS) variable has a positive and significant impact on the development of critical thinking skills. Its coefficient value (β5) is 0.197, and at a significance level of α = 0.004, its t-value is 3.883. Additionally, at a significance level of 2.097 and a coefficient value (β6) of 0.187, this variable positively and significantly impacts lifelong independent learning.

Next, with a coefficient value (β7) of 0.219 and a t-value of 2.657 at a significance level of α = 0.008, it was discovered that critical thinking abilities positively and significantly influence lifelong independent learning. Thus, it can be concluded that project team interaction, guidance, feedback, and the quality of learning materials in the LMS significantly contribute to developing critical thinking skills and lifelong independent learning. Additionally, the development of critical thinking skills also positively influences lifelong independent learning. In conclusion, Ho is rejected and Ha is accepted, indicating an influence of independent variables on the dependent variable, as shown by the p-value less than 0.05 and the t-value greater than 1.99.

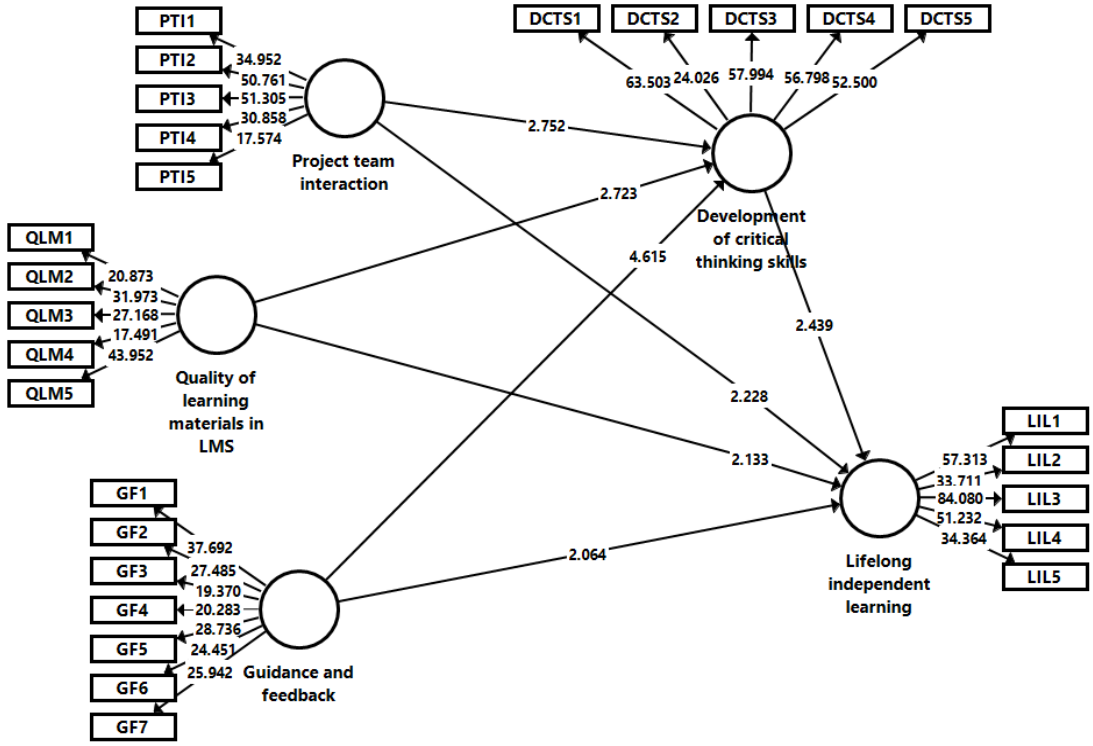

Figure 1: Full model SEM

Table 4 and Figure 1 test the determination values of effect sizes R^2, f^2, and Q^2. This study's R^2 value is 0.323 for developing critical thinking skills and 0.317 for lifelong independent learning. These R^2 coefficients have moderate predictive accuracy below 0.50 (Hair, 2007). The f^2 and Q^2 values are assessed to test the impact on the determination coefficient when the interaction effect is removed from the research model. The f^2 value, the Cohen indicator, is categorised as the median because it is above 0.15 (Sheko & Spaho, 2018). Similarly, the Q^2 value has a high contribution above 0.5. Thus, the model in this study has relatively good predictive validity based on these coefficients.

Discussion

The results of Partial Least Squares analysis indicate that project team interaction, guidance, feedback, and the quality of materials in the Learning Management System (LMS) significantly contribute to developing critical thinking skills and lifelong independent learning. These findings align with research by (Anisimova et al., 2022), emphasizing the crucial role of the quality of learning materials in the LMS in enhancing critical thinking skills. Essential thinking ability also aids in seeking feedback, self-assessment, and improving learning motivation (Jones et al., 2023). The emphasis on assessing the quality of learning materials in the LMS goes beyond administrative aspects; it influences the learning experience and goal achievement.

Critical thinking is crucial in supporting lifelong learning and enabling learners to become independent and active in knowledge development (Yilmaz Yavuz, 2020). This skill is crucial in addressing the challenges and uncertainties of the 21st century, allowing individuals to navigate complexity and find innovative solutions (Valli et al., 2017). Critical thinking helps uncover biases, stimulates curiosity, and promotes an open mind. With the necessary thinking skills, individuals can continually expand their knowledge, adapt to new information, and enhance their understanding. This ability is relevant in an educational context and aids in making informed decisions and effectively solving problems in personal life. Therefore, understanding and advancing critical thinking skills become essential in facing the dynamics of modern education and life (Yilmaz Yavuz, 2020).

Interview results with students can provide valuable insights into how the quality of materials in the Learning Management System (LMS) relates to the development of critical thinking skills and the ability to learn independently throughout life. "The quality of materials in the LMS significantly affects my understanding of the content more deeply. Well-presented, clear, and relevant materials make thinking critically about the topic easier. Conversely, unstructured or difficult-to-understand materials can hinder the development of my critical thinking skills."

> *"When the LMS materials include various resources, such as articles, videos, and interactive exercises, I feel more motivated to learn independently. I can choose resources that suit my learning style and delve deeper into topics that interest me. This helps me become a more effective independent learner."*
>
> *"The feedback included in LMS materials also plays a crucial role in developing my critical thinking skills. When I receive immediate feedback on work or tasks I complete in the LMS, I can see where I need improvement and how I can think more critically in problem-solving."*
>
> *"Regularly updated materials in the LMS also help me stay interested and motivated to learn. I feel that I continually have access to the latest and relevant information, which is an essential part of lifelong learning."*
>
> *I continually have access to the latest and most relevant information, an essential part of lifelong learning.*

Through interviews with students, it can be seen that the quality of materials in the LMS significantly impacts the development of students' critical thinking skills and their ability to learn independently throughout life. This highlights the importance of developing and presenting quality learning materials in the digital environment to support student growth. Critical thinking skills enable individuals to analyse information from various sources, evaluate different perspectives, and make sensible judgments based on evidence and logical reasoning. These skills are particularly crucial in education, where learners need to be equipped with critical thinking skills and adapt to the progress of time (Yilmaz Yavuz, 2020).

According to student interviews, positive impact has a positive impact on their development and capacity for lifelong independent learning. Well-developed critical thinking abilities help students overcome obstacles to learning, make more effective use of the resources available to them, and gain a deeper comprehension of various subjects. These skills also enable them to pinpoint areas where their learning needs to be strengthened and actively look for resources and answers to meet their learning objectives. Learning on their own throughout life makes students more effective and self-reliant, allowing them to explore more deeply into subjects they are interested in and expand their knowledge over time.

To foster the growth of critical thinking abilities, people can incorporate group activities that encourage participation in the active investigation of different subjects. Interaction within the project team has a significant impact on lifelong autonomous learning. According to research (Kaplan, 2016), learning autonomously and developing critical thinking abilities positively correlate with active engagement in project team interactions. Working together in project teams enables people to exercise critical thinking in the face of various obstacles and issues that may arise during the project. Moreover, project team interaction provides valuable experience developing independent learning skills, as individuals must seek solutions and resources independently. These findings illustrate that interaction in the context of project teams influences critical thinking skills and encourages more effective lifelong learning.

Interview results with students can provide valuable insights into how project team interaction relates to the development of critical thinking skills and the ability to learn independently throughout life. Here are some examples of student responses that can be used to link to this topic:

> "*When interacting in project teams, I feel more open to discussing various ideas and opinions with other team members. This helps me see different perspectives on the issues we face in the project. In this regard, I feel that project team interaction strongly supports the development of my critical thinking skills because I am prompted to consider various arguments before making decisions."*
>
> *"When we work in project teams, we often provide feedback to each other. This feedback helps us understand our strengths and weaknesses in project completion. This is a great opportunity to enhance my critical thinking skills because I have to consider advice and criticism wisely."*
>
> *"Working in project teams gives me more control over my learning. I can choose how to contribute and learn from other team members. I also learned to find resources independently when facing project challenges. This enhances my ability to learn on my own."*
>
> *"Project teams frequently face challenges that call for problem-solving. This compels us to exercise critical thought and come up with workable answers. My critical thinking abilities are being developed in a supportive environment through project team interaction."*

Student interviews reveal that project team interaction helps students work together, get feedback, and cultivate lifelong independent learning and critical thinking abilities. How students engage with each other shapes their learning experiences. Research on the impact of guidance and feedback on developing critical thinking abilities and lifelong independent learning has also become important in education. Significantly impacthave a significant impact on the development of these two skills, according to a study published in international journals.

This highlights the significance of high-quality feedback in enhancing critical thinking abilities. According to them, effective feedback can give students precise, understandable, and beneficial information to help them better understand problems and develop their critical thinking abilities. Furthermore, guidance is essential for developing critical thinking abilities and self-directed learning capacities. The findings of student interviews can offer critical new perspectives on the relationship between mentoring and constructive criticism and the growth of critical thinking abilities and the capacity for lifelong learning.

> *"When I get criticism on my work from instructors or fellow students, it helps me identify areas that still require work". I learned to reflect critically on my work and find ways to improve its quality. This is an essential part of my learning process."*
>
> *"Teacher guidance on how to start a specific project or task is beneficial. Sometimes, we need to know the first steps, and guidance gives us direction. However, I also learned to use guidance as a starting point and develop my ideas and knowledge over time."*

Conclusion

This research concludes that project team interaction, guidance, feedback, and the quality of materials in the Learning Management System significantly contribute to developing critical thinking skills and lifelong independent learning. These findings support previous research highlighting the crucial role of the quality of learning materials in the LMS in enhancing critical thinking skills. It also underscores that critical thinking ability aids in seeking feedback and self-assessment, subsequently enhancing learning motivation.

Critical thinking skills, as a fundamental foundation for lifelong learning, play a crucial role in facing the challenges and uncertainties of the 21st century. These skills help individuals navigate complexity, stimulate curiosity, and promote open-mindedness. With critical thinking ability, individuals can continually expand their knowledge throughout life, adapt to new information, and enhance their understanding. These skills are relevant in an educational context and assist in making informed decisions and practical problem-solving in personal life.

In educational development, assessing the quality of learning materials in the LMS goes beyond administrative aspects; it also influences the learning experience and goal achievement. Therefore, educational institutions and curriculum developers must pay special attention to presenting quality materials in the digital environment. Additionally, through interaction in project teams, individuals have the opportunity to think critically when facing various challenges and problems in projects. This interaction promotes more effective lifelong learning, as individuals must seek solutions and resources independently. Therefore, collaboration in project teams not only influences critical thinking skills but also encourages lifelong learning.

The managerial implications of this research suggest that educational institutions must develop strategies to consistently update and effectively present quality materials in the LMS. Feedback systems from students also need improvement to understand their needs and enhance learning materials. Moreover, teaching methods that encourage project team interaction and provide quality guidance and feedback can advance students' critical thinking skills and their ability to learn throughout life. The theoretical implications of this research strengthen the understanding of the relationship between project team interaction, guidance, feedback, the quality of materials in the LMS, critical thinking skills, and independent learning. Theories in education and psychology can serve as a foundation for designing more effective interventions to enhance both skills.

The limitations of this study include sample size constraints and the analysis methods used. Further research could expand the sample scope for more robust generalization and employ more complex analysis methods to understand the deeper relationships between the variables studied.
For future research, it is recommended to explore other factors that may influence the development of critical thinking skills and lifelong learning. Additionally, longitudinal studies could help understand how the story of these skills progresses over time.

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