Lean Management: Project Unit, Department Of Mechanical Engineering, Politeknik Mukah

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Abstract

The management of teaching and learning systems (T&L) can benefit from adopting lean management principles to reduce waste, improve system efficiency and leverage opportunities in the era of IR4.0 for educators and students. For the Project 1 (DJJ40182) and Project 2 (DJJ50193) courses, the delivery of T&L and document dissemination is currently conducted through face-to-face meetings, email, Sistem Pengurusan Maklumat Pelajar (SPMP), Curriculum Information Document On-Line System (CIDOS) and WhatsApp, potentially leading to non-achievement and information discrepancies among coordinators, supervisors, and students. The study applies the lean management communication cycle method to identify process waste in the course information delivery. It utilizes the Plan Do Check Act cycle method to improve processes and eliminate waste. The study employs qualitative research with a sample of project supervisors, fourth-semester students (Project 1), and fifth-semester students (Project 2). Formative assessment (observation) is used to evaluate the implementation of T&L delivery and identify areas for improvement using unstructured observation methods. An Android-based application and Google Sites (G-sites) portal have been developed to enhance teaching and learning systems (T&L) management for Project courses at Politeknik Mukah.

Keywords: Lean Management; IR4.0; PDCA

1.0 Introduction

The discussion on efficiency and effectiveness in lean management is an important topic in the Fourth Industrial Revolution (IR4.0) world because both concepts are often seen as competing priorities (Morard et al., 2020). One initiative organisations take to achieve optimal management systems is implementing lean management practices (Khalid & Ab Hamid, 2020). Lean management principles emphasize the importance of delivering services with minimal waste. The convergence of IR4.0 and lean management is closely related to the widespread use of smartphones (Hamidi et al., 2020).

In managing teaching and learning systems (T&L), apart from reducing waste, improving efficiency, and system effectiveness, adopting lean management principles in T&L can also help educators and students capitalize on opportunities presented in the IR4.0 era (Singh, 2019). Lean implementation in the Department of Polytechnic and Community College Education (JPPKK) is based on three main elements: purpose, process, and people. Based on

these main elements, there are seven clusters of lean implementations in JPPKK (JPPKK, 2019) within the existing practices. Lean management methods such as 5S (Sort, Set in Order, Shine, Standardize, and Sustain) are used to manage space and equipment in the teaching and learning management system (Jamiana et al., 2013), kanban is utilized to manage workflow (Lanza-León et al., 2021), and the Communication Cycle serves as a tool to examine the communication process that occurs between departments.

2.0 Problem Statement

The traditional process of distributing documents and information about the Project courses (DJJ40182 and DJJ50193) is typically done through face-to-face meetings during the initial semester briefings. However, if there are format changes or alignment improvements, the Project Unit of the Mechanical Engineering Department (JKM) will make announcements via the preferred social media platform, WhatsApp. The working procedure for course coordinators is documented in the Course Coordinator File (FPK), which lecturers can only access. Therefore, information sharing with students occurs through two other sources, namely the course coordinator and project supervisors. There is a possibility of information discrepancies between what is communicated by the course coordinator and the project supervisors, even though a briefing session with the project supervisors has been conducted beforehand. It can lead to misunderstandings among students, assessment panels, and coordinators during presentation sessions. It also might affect the assessment and auditing processes due to inefficient information delivery methods.

3.0 Objective

The study has two objectives to achieve the goals as mentioned earlier:

i. Application of the Communication Cycle method in Lean management to identify process waste in delivering information about the Project courses.

ii. Application of the PDCA (Plan-Do-Check-Act) cycle method to improve processes and eliminate waste identified from the Communication Cycle method.

4.0 Literature Review

One of the lean management principles that can be adapted to optimize digital information delivery in teaching and learning is the use of interactive digital content (Cano et al., 2022; Gómez-Molina & Moyano-Fuentes, 2022; Krajčovič et al., 2021). Lean management principles can be utilized to create and continuously improve interactive digital content tailored to each student's needs.

Mobile-Based Learning (MBL) aims to assist students in understanding learning materials interactively (Suarez et al., 2018). The teaching and learning approaches implemented today should be adapted to technological advancements and the educational needs of the 21st century, in line with the

seventh shift of the Malaysia Education Development Plan, which emphasizes the utilization of Information and Communication Technology (ICT) to enhance the quality of teaching and learning in Malaysia (Ismail et al., 2021). As stated in the Development of Basic 2D Animation E-Module by a group of educators (Lip et al., 2018), this teaching aid facilitates interactive and dynamic learning and serves as a student reference.

Researchers (Ab Rahman et al., 2020; Selamat et al., 2020) have developed a quality model for MOOC web content based on the 7C Conole model and PDCA (Plan-Do-Check-Act) cycle for continuous improvement. The model has been proposed and validated by content providers and experts. A tool known as the MOOC Content Quality Assessment Tool (MOCQAT) has been developed and tested among content providers and MOOC users, demonstrating high acceptance and the potential for improving MOOC content quality through assessment and quality control efforts. Additionally, researchers (Alexieva & Tomov, 2021) have also analysed the current state of work processes in examining websites and mobile applications using the principles of comprehensive quality management, specifically the PDCA cycle. An improvement process model is proposed to provide quality, reliable, and easily accessible information when examining websites and mobile applications to meet standard requirements.

5.0 Methodology

A qualitative research approach was employed as the methodology for this study. It allows the researcher to examine selected issues in more detail and depth. This method enables the achievement of the main objectives through more specific information outcomes. The research methodology consists of two phases. The first phase involves identifying waste using the Communication Cycle method. Four stages of the communication cycle model (Heath & Bryant, 2013) are followed to identify waste in the information delivery process: Preparation, Delivery, Receipt, and Evaluation. The second phase focuses on eliminating waste using the PDCA (Plan, Do, Check, Act) cycle method (Noura et al., 2019). The study specifically focuses on the delivery of teaching and learning (T&L) for Project 1 (DJJ40182) and Project 2 (DD50193) courses in the Diploma in Mechanical Engineering program at Politeknik Mukah, Sarawak.

Through the conducted qualitative study, the sample size was not predetermined at the beginning of the study, as the sampling was done continuously until no new information was obtained (Glesne, 2016). The sample consists of project supervisors, fourth-semester students (Project 1), and fifth-semester students (Project 2) in Sesi 2 2022/2023. Formative assessment (observation) (Kumar et al., 2017) was used to evaluate the implementation of T&L and identify areas for improvement. The observation method employed was unstructured, which involves observing situations without a specific plan or agenda (Rogers et al., 2023). The researcher used this method to understand the overall situation of project course delivery and

to gather qualitative data. The collected data was used to make adjustments, refine teaching strategies, and make changes accordingly.

6.0 Results and Discussion.

6.1 Communication cycle - Identifying wastage

Stage 1: Preparation

Tables 1 and 2 illustrate the document requirements for both Project 1 and Project 2 courses and the communication objectives and target recipients.

Table 1: Course Documents for Project 1 (DJJ40182)

Documents	Communication Objectives	Targets
Course Overview (CO)	Providing an overview of the course	Lecturers and students
Schedule	Setting project activity schedules	Lecturers and students
Flowchart	Defining project activities	Lecturers and students
Guidelines	Outlines necessary actions or tasks	Lecturers and students
Project briefing notes	Notification	Lecturers
	Providing learning materials	Students
Report alignment	Notification	Lecturers
	Establishing project assessment criteria and processes	Students
Pre-presentation feedback form	Notification	Lecturers
	Sharing project progress and achievements	Students
Assessment rubric	Establishing project assessment criteria and processes	Lecturers
	Action	Students
Report Template	Establishing project assessment criteria and processes	Lecturers
	Action	Students
Inventory of previous projects	Communicating research findings and project outcomes	Coordinator

Table 1 displays all the information and documents that the Course Coordinator of Project 1 needs to communicate to all lecturers and students for their awareness and necessary actions at the beginning of each semester.

The recipients of this information include lecturers acting as project supervisors and students.

Table 2: Course Documents for Project 2 (DJJ401832).

Documents	Communication Objectives	Targets
Course Overview (CO)	Providing an overview of the course	Lecturers and students
Schedule	Setting project activity schedules	Lecturers and students
Flowchart	Defining project activities	Lecturers and students
Guidelines	Outlines necessary actions or tasks	Lecturers and students
Assessment rubric	Establishing project assessment criteria and processes	Lecturers
	Action	Students
Turnitin Link	Similarity Assessment	Students

Table 2, on the other hand, presents all the information and documents that need to be conveyed to the lecturers and students for their awareness and necessary actions at the beginning of each semester for Project 2. Overall, the information and documents for Project 2 are relatively fewer compared to Project 1. It is because Project 2 is a continuation of the course from Project 1.

Stage 2: Delivery

Below are Table 3 and Table 4, which illustrate the delivery of information and documents for Project 1 and Project 2 through official and selected social media platforms according to the designated lecture weeks.

Table 3: Project 1 Course Documents (DJJ40182)

Documents	Medium	Lecture week
Course Overview (CO)	Face-to-face / SPMP / CIDOS / Whatsapp	1
Schedule	Face-to-face/email / CIDOS / Whatsapp	
Flowchart	Face-to-face/email / CIDOS / Whatsapp	
Guidelines	Email / CIDOS / Whatsapp	
Project briefing notes	Face-to-face / CIDOS / Whatsapp	2
Report alignment	Face-to-face / CIDOS / Whatsapp	2
Pre-presentation feedback form	Hard copy/email / CIDOS / Whatsapp	6
Assessment rubric	Hard copy / CIDOS	13
Report Template	Whatsapp / CIDOS	7
Previous project abstract inventory	Google Drive	-

Table 4: Project 2 Course Documents (DJJ401832)

Documents	Medium	Lecture week
Course Overview (CO)	Face-to-face / Project Management System Portal (SPMP) / Learning Management System (CIDOS) / Whatsapp	1
Schedule	Face-to-face / Email / CIDOS / Whatsapp	
Flowchart	Face-to-face / Email / CIDOS / Whatsapp	
Guidelines	Email / Whatsapp / CIDOS	
Assessment rubric	Hard copy / CIDOS	13
Turnitin link	Whatsapp	12

Table 3 and Table 4 found two primary methods of information delivery: face-to-face meetings and online platforms (email, Project Management System Portal [SPMP], CIDOS and WhatsApp). Social media has become increasingly popular over the past decade, with platforms such as Whatsapp, Facebook, Twitter, Instagram, and TikTok attracting billions of users worldwide (Tabassum et al., 2021). The Whatsapp application has gained significant popularity due to its simple and user-friendly interface, allowing users to easily send text messages, photos, and videos (Morsidi et al., 2021).

Stage 3: Receipt

Table 5 illustrates the status of information and document delivery and reception.

Table 5: Status of information and document delivery and reception.

Medium	Delivery status	Receipt status
Hard copy	Sent	Received
e-mail	Sent	Uncertain if there is no response
SPMP / CIDOS	Sent	Uncertain if not checked
Whatsapp	Sent	Received - quick response

The receipt of information by recipients through physical copies is evident. However, the delivery of information through email and SPMP cannot be guaranteed unless the recipients provide confirmation of receipt or access the SPMP system for review and feedback later. The WhatsApp application has a messaging information system that indicates when the recipient has received a message (Yilmazsoy et al., 2020).

Stage 4: Evaluation

Based on the assessment, the researcher can conclude the weaknesses in the previous communication practices.

Table 6: Formative Assessment Results for Lecturers and Students in Project-based T&L Course

Review/medium	
Hardcopy	
i.	The cost of making paper copies.
ii.	Weak documentation practices lead to document loss.
iii.	Documents cannot be carried anywhere.
iv.	Risk of damage: Paper copies can tear, get lost, or become soiled, making the information difficult or impossible to read.
v.	Space constraints: Paper copies require storage space; if there are many copies, they can take up unnecessary space.
e-mail	
i.	Irregular email checking.
ii.	Emails with other information cause important information to be overlooked or accidentally deleted.
Sistem Pengurusan Maklumat Pelajar (SPMP) & CIDOS	
i.	Layered interface: The CO can be uploaded into *Fail Rekod Pensyarah atas talian* (iFRP) (for lecturers) and Student Oriented Learning Management System (ISOLM) (for students) for reference, but it needs to go through multiple interfaces before reaching the required document folder.

ii.	Space constraint: Not all information and documents can be uploaded to SPMP due to limited functionality and storage space.
iii.	Time constraint: Document storage in SPMP is limited to two semesters only. The coordinator must repeat the process of uploading all information and documents each semester.
Aplikasi Whatsapp	
i.	Lack of attention, forgetfulness, and indifference towards the conveyed information.
ii.	Difficulty in retrieving the conveyed information and overlapping with various other information.
iii.	Information or documents can be hidden within WhatsApp groups due to settings such as automatic message deletion, changing phones or numbers, and intentionally or unintentionally leaving the group.
iv.	Issues with the format or content of the information altered in the display: If the disseminated information has a complex format or unclear content, the recipient may not understand the information.
v.	Time constraint: Recipients may not have sufficient time to read or process the received information.

Table 6 presents the findings of formative assessment feedback on lecturers and students based on observations. The distribution of hard copies, which has been practised for a long time, becomes ineffective if there is a weak documentation practice (Knauf, 2020). However, information sent via email is not reviewed or reviewed late, and the lack of housekeeping leads to excessive messages, making it difficult to retrieve specific information (Kalogiannidis & Papaevangelou, 2020).

The WhatsApp platform has the highest number of delivery weaknesses (Morsidi et al., 2021). However, there are also several potential drawbacks to using WhatsApp groups for information sharing. Based on the feedback recorded in Table 6, the five identified reviews can be classified as human errors (unawareness, forgetfulness, disregard, and lack of time to read), system settings such as inability to access deleted information and specific display format settings that are not compatible with other device types (Yilmazsoy et al., 2020).

6.2 PDCA Cycle - Eliminating Waste

Phase 1: Plan

The next step is to create a plan to address all the issues and weaknesses identified. Table 7 outlines the planning process for the next phase.

Table 7: Outlines the planning process for the Plan phase

Planning	Items
Process of PBL for Course Project 1 and Project 2	Implementation readiness
Organizational Assessment	• Organizational capacity • Financial aspects • Time • Sustainability
Identifying Needs	• Objectives • Functions • Standards • Performance • Safety • Usability • Alternative strategies
Identifying Risks	• Quality • Finance • Organization • Integration • Process continuity

Regarding Table 7, the planning phase consists of process preparation, organizational assessment, needs identification and risk identification. Identifying issues in delivering the Project-based Learning (PBL) course has been carried out in previous Communication cycles. In teaching and learning, the Planning stage involves setting learning objectives, selecting appropriate teaching strategies and methods, and designing a plan to achieve the objectives based on the needs outlined in the syllabus, SLT, and course learning outcomes (CLO) for the Project course. Subsequently, organizational assessment, needs identification and risk assessment take place. It is crucial to be thorough during the "Plan" stage to ensure the success of the subsequent "Do" stage.

Phase 2: Do

The next phase is the "Do" phase. The third step involves evaluating the effects of the actions that have been implemented.

Table 8: Outlines the planning process for the Do phase

Implementation	Items
Determining the type of Cloud Computing services	• Public cloud/Private cloud • Defining security features • Determining methods for data archiving
Implementing data integration and platform migration	• Google Drive • Google Sheet • Apps Geyser
Developing a portal and mobile application based on Cloud Computing	• Google Site • Google Play Store • iPhone Home Screen

Table 8 succinctly represents the "Do" phase of the PDCA cycle, which involves implementing the identified cloud computing services from the "Plan" phase. Figure 1 shows the display output of the portal through Google Sites. The development of the website portal and mobile applications for the Mechanical Engineering Department (JKM) Unit Project at Politeknik Mukah utilizes existing applications such as Google Site (G-Sites) and the Android App Bundle (AAB) file. According to Picciano (2015), adapting technologies can enhance achieving goals and objectives. The scope of portal accessibility is expanded through smartphone technology by constructing a mobile application.

Figure 2 illustrates the transition of content development from the portal to the mobile application (Google Play Store and iPhone Home Screen) using Responsive Web Design (RWD) (Baturay & Birtane, 2013). With this portal's creation, the ease of use through mobile applications has a significant relationship in facilitating students and lecturers in accessing up-to-date information, reference materials, and student project statuses (Hashim et al., 2022).

Figure 1: Main Web Portal Display

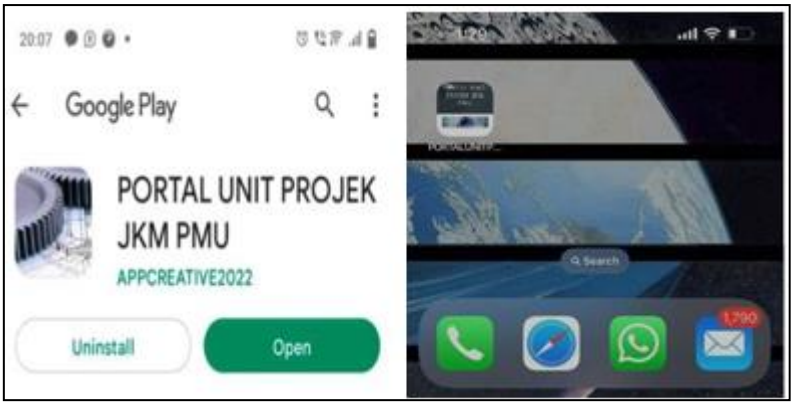

Figure 2: Application in Google Play Store and Equivalent Application in iPhone Home Screen

Phase 3: Check

Table 9 shows initial feedback with comments and suggestions from lecturers and students.

Table 9: Initial feedback

	Item
Review / Monitor	• Conduct a thorough review of all information and document requirements in Project 1 and Project 2 T&L. • The record received feedback through reviews. • Enhance the sustainability of the service plan. • Implement acknowledgement for every change in information and documents. • Establish a monitoring system for the web portal and mobile application platform.

Table 11: Feedback from users.

No	Comment/suggestion
1	This portal is very beneficial for all students.
2	It uses a user-friendly website that is easy to access.
3	It is highly effective and beneficial.
4	It is very easy to understand.
5	The JKM portal is very helpful for students.
6	The portal is excellent to use as it helps students search for project information.
7	It enhances the availability of information by utilising the JKM Politeknik Mukah Project Unit's web portal and mobile application.
8	This portal has been very helpful for me in Project 1.
9	It is easy and quick to find information.
10	The portal is hoped to be updated with the latest technological advancements.

Based on the feedback and comments in Table 10, both students and lecturers have provided highly positive feedback on the development of this portal. Researchers such as Knauf (2020) and Aina Zainudin et al. (2021) have previously validated this strategy in the context of digital platform documentation practices. Additionally, comments state that the information search process is easy and fast. This finding aligns with the time-saving factor highlighted in one of the highlights of the Fourth Industrial Revolution, Industry 4.0 (Halili, 2019). Meanwhile, Figure 3 provides an overview of the platform lecturers and students use.

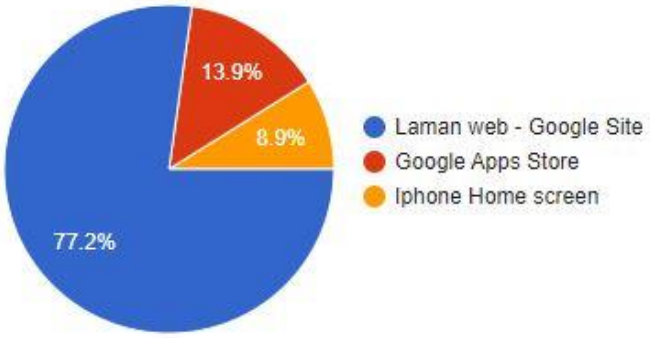

Figure 3: Access Platform

The provision of multiple platforms for accessing the portal has provided higher access opportunities for lecturers and students. The efficiency of information and document delivery services through the development of the portal has also been endorsed by Tumin & Mohamed (2009) and Nawi et al. (2016). The portal has become the primary reference source for the final project course for lecturers and students and should be maintained. The findings of this study also indicate that users exhibit greater interest when the display within the application is engaging and interactive, as it can provide satisfaction and motivation to users, as agreed by previous researchers (Nor et al., 2022).

Phase 4: Act

Researchers have agreed on involving several crucial activities, such as ensuring implementation, managing changes, assessing risks, implementing configuration changes, and improving services comprehensively, as outlined in Table 11.

Table 11: Act phase.

	Items
Maintenance / Enhancement	• Ensuring implementation and conducting campaigns and promotions for the portal and mobile application. • Managing changes according to the curriculum requirements (JPPKK). • Analyzing and assessing risks and service safety. • Implementing configuration changes as needed. • Enhancing services based on current requirements to ensure the effectiveness of cloud service quality.

Among the items contained in Table 11, extensive implementation communication has been carried out at all levels, including department level (briefings), polytechnic level (meetings), and at the JPPKK level through "Best Practice" presentations. Activities such as managing changes, analyzing and assessing risks, and implementing configuration changes are conducted continuously as needed. Service enhancements align with Lean management objectives, which aim to achieve zero waste (Awasthi et al., 2021). This finding also aligns with developing the portal to address the shortcomings in delivering T&L for Projects 1 and 2 of the Mechanical Engineering Diploma program.

7.0 Conclusion.

Based on the conducted study, applying lean management principles in the teaching and learning system (T&L) management can help improve the efficiency and effectiveness of the system and leverage opportunities in the era of IR4.0. This study employed the communication cycle and PDCA method to identify waste in delivering information regarding the Project course and to improve the process. The results of the communication cycle indicated that electronic and social media were more effective in identifying delivery weaknesses. The results of the PDCA cycle demonstrated that the developed portal functioned well and could help address the shortcomings in delivering the Project course T&L. Lean management principles can be utilized to foster a culture of collaboration and continuous improvement, where students and educators work together to optimize the digital delivery of information.

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Author Contributions

Mohd Ghafran M.: Conceptualisation, Methodology, Software, Writing-Original Draft Preparation;
Nur Adilla K.: Data Curation, Validation, Supervision, Writing-Reviewing and Editing;
W.K. Chen: Software, Validation.

Conflicts Of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

References

Ab Rahman, W. N. W., Zulzalil, H., Ishak, I., & Selamat, A. W. (2020). Quality model for massive open online course (MOOC) web content. *International Journal on Advanced Science, Engineering and Information Technology*, 10(1), 24–33.

Aina Zainudin, A., Sarpin, N., Mohamed, S., Ta Wee, S., Pengurusan Pembinaan, J., & Pengurusan Teknologi dan Perniagaan, F. (2021). Penggunaan Sistem Proses Pengurusan Keselamatan (Process Safety Management System) di Tapak Pembinaan. *Penerbit.Uthm.Edu.My*, 2(2), 555–570. https://doi.org/10.30880/rmtb.2021.02.02.040

Alexieva, J., & Tomov, P. (2021). Improving the Work Process for Checking Websites and Mobile Applications. *2021 IV International Conference on High Technology for Sustainable Development (HiTech)*, 1–4. https://doi.org/10.1109/HiTech53072.2021.9614217

Awasthi, A. K., Cheela, V. R. S., D'Adamo, I., Iacovidou, E., Islam, M. R., Johnson, M., Miller, T. R., Parajuly, K., Parchomenko, A., Radhakrishan, L., Zhao, M., Zhang, C., & Li, J. (2021). Zero waste approach towards a sustainable waste management. *Resources, Environment and Sustainability*, 3, 100014. https://doi.org/10.1016/J.RESENV.2021.100014

Baturay, M. H., & Birtane, M. (2013). Responsive web design: a new type of design for web-based instructional content. *Procedia-Social and Behavioral Sciences*, 106, 2275–2279. https://doi.org/10.1016/j.sbspro.2013.12.259

Cano, M., Murray, R., & Kourouklis, A. (2022). Can lean management change the managerial culture in higher education? *Studies in Higher Education*, 47(4), 915–927. https://doi.org/10.1080/03075079.2020.1817892

Glesne, C. (2016). Becoming qualitative researchers: An introduction. ERIC.

Gómez-Molina, D. L., & Moyano-Fuentes, J. (2022). Lean management in universities: a systematic literature review. *International Journal of Lean Six Sigma*, 13(1), 156–177. https://doi.org/10.1108/IJLSS-12-2020-0224/FULL/HTML

Halili, S. H. (2019). Technological advancements in education 4.0. *The Online Journal of Distance Education and E-Learning*, 7(1), 63–69. https://tojdel.net/journals/tojdel/volumes/tojdel-volume07-i01.pdf#page=70

Hamidi, S. R., Yusof, M. A. M., Shuhidan, S. M., & Kadir, S. (2020). IR4. 0: unmanned store apps. *Indonesian Journal of Electrical Engineering and Computer Science*, 17(3), 1540-1547.https://doi.org/10.11591/ijeecs.v17.i3.pp1540-1547

Hashim, N. H., Razak, M. R. A., & Jasa, J. (2022). Usability Test For The Long Life Learning Mobile Apps System. *Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities*, 7(1), 11–20. https://app.mypolycc.edu.my/journal/index.php/PKKJLLL/article/view/106/65

Heath, R., & Bryant, J. (2013). Human communication theory and research: Concepts, contexts, and challenges.

Ismail, S., Saad, R., Radzi, N. A. A., Idris, N. A., & Aziz, N. E. M. (2021). Tahap penggunaan inovasi teknologi maklumat dan komunikasi (ICT) dalam pengajaran dan pembelajaran (PDP) pensyarah Kolej Universiti Islam Melaka. *Jurnal'Ulwan*, 6(2), 173–194.

Jamiana, R., Rahmanb, M. A., Derosb, B., & Ismailc, N. (2013). Penggabungan Konsep 5S dan 3R untuk Menambahbaik Prestasi Alam Sekitar Syarikat Pembuatan PKS ke Arah Pembangunan Lestari. https://www.academia.edu/download/42861074/1116-8964-1-PB.pdf

JPPKK. (2019). BUKU GP PENGURUSAN LEAN. KPT.

Kalogiannidis, S., & Papaevangelou, O. (2020). Impact of business communication on the performance of adult trainees. *International Journal of Academic Research in Progressive Education and Development*, 9(3), 213–222.

Khalid, W. K. W. M., & Ab Hamid, E. (2020). Tahap Kefahaman Konsep Pengurusan Lean Menggunakan eLEAN di Politeknik Besut Terengganu. *Proceeding International Multidisciplinary Conference* (IMC 2020). https://penerbit.unimap.edu.my/images/pdf/IMC%202020/583-590.pdf

Knauf, H. (2020). Documentation strategies: Pedagogical documentation from the perspective of early childhood teachers in New Zealand and Germany. *Early Childhood Education Journal*, 48(1), 11–19. https://doi.org/10.1007/s10643-019-00979-9

Krajčovič, M., Gabajová, G., Furmannová, B., Vavrík, V., Gašo, M., & Matys, M. (2021). A case study of educational games in virtual reality as a teaching method of lean management. *Electronics*, 10(7), 838.https://doi.org/10.3390/electronics10070838

Kumar, N., Singh, N. K., Rudra, S., & Pathak, S. (2017). Effect of formative evaluation using direct observation of procedural skills in assessment of postgraduate students of obstetrics and gynecology: Prospective study. *Journal of Advances in Medical Education & Professionalism*, 5(1), 1–5.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5238490/

Lanza-León, P., Sanchez-Ruiz, L., & Cantarero-Prieto, D. (2021). Kanban system applications in healthcare services: A literature review. *The International journal of health planning and management*, 36(6), 2062-2078.https://doi.org/10.1002/hpm.3276

Lip, R., Hashim, S., & Musa, M. K. (2018). Pembangunan Dan Penilaian Tahap Kesesuaian Penggunaan E-Modul Asas Animasi 2D Berdasarkan Teori Konstruktivisme Model Needham 5 Fasa. *Politeknik & Kolej Komuniti Journal of Life Long Learning*, 2(1), 16–27. https://app.mypolycc.edu.my/journal/index.php/PKKJLLL/article/view/51/21

Morsidi, S., Samah, N. A., Rahman, K. A. A., Ashari, Z. M., Jumaat, N. F., & Abdullah, A. H. (2021). WhatsApp and Its Potential to Develop Communication Skills among University Students. International *Journal of Interactive Mobile Technologies*, 15(23). http://eprints.utm.my/id/eprint/96447/1/AbdulHalimAbdullah2021_WhatsAppandItsPotentialtoDevelopCommunicationSkills.pdf

Nawi, A., & Zakaria, G. A. N. (2016). Pembangunan dan penilaian portal IPBL di Politeknik Brunei. *Jurnal Komunikasi: Malaysian Journal of Communication Jilid*, 32(1), 261-285. https://doi.org/10.17576/JKMJC-2016-3201-20

Nor, M. A. A. M., Othman, F. W., & Ayub, N. (2022). Usability And Acceptance Of Augmented Reality (AR) Applications For SKR 3302 Vehicle Air Conditioning System Maintenance Course At Kolej Komuniti Pasir Salak. *Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities*, 7(1), 31–40. https://app.mypolycc.edu.my/journal/index.php/PKKJLLL/article/view/108/67

Noura, M., Web, M. G.-P. of the 10th A. C. on, & 2019, undefined. (2019). An automated cyclic planning framework based on plan-do-check-act for web of things composition. Dl.Acm.Org, 205–214. https://doi.org/10.1145/3292522.3326044

Picciano, A. G. (2015). Planning for online education: A systems model. Online Learning, 19(5), 142–158. https://eric.ed.gov/?id=EJ1085774

Rogers, Y., Sharp, H., & Preece, J. (2023). Interaction design: beyond human-computer interaction. John Wiley \& Sons.

Selamat, A. W., Ab Rahman, W. N. W., Zulzalil, H., & Ishak, I. (2020). Mooc Content Quality Assessment Tool (Mocqat): A Case Study. *INTED2020 Proceedings*, 2073–2082. https://doi.org/10.21125/inted.2020.0652

Singh, J. (2019). The lean prescription for non-traditional adult learners. Quality Assurance in Education.

Suarez, A., Specht, M., Prinsen, F., Kalz, M., & Ternier, S. (2018). A review of the types of mobile activities in mobile inquiry-based learning. *Computers & Education*, 118, 38–55. https://doi.org/10.1016/j.compedu.2017.11.004

Tabassum, M., Perumal, S., Mohanan, S., Suresh, P., Cheriyan, S., & Hassan, W. (2021). IoT, IR 4.0, and AI Technology Usability and Future Trend Demands: Multi-Criteria Decision-Making for Technology Evaluation. *In Design methodologies and tools for 5G network development and application* (pp. 109-144). IGI Global. https://doi.org/10.4018/978-1-7998-4610-9.ch006

Tumin, W., & Mohamed, M. (2009). Membangun Web Portal Berasaskan Moodle Bertajuk solid Geometry Matematik Tingkatan 1-3. http://merr.utm.my/12213/

Yilmazsoy, B., Kahraman, M., & Utku, K. (2020). Negative aspects of using social networks in education: A brief review on WhatsApp example. *Journal of Educational Technology and Online Learning*, 3(1), 69–90. https://dergipark.org.tr/en/pub/jetol/article/662746