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CREATING MEANINGFUL LEARNING EXPERIENCES WITH ACTIVE, FUN, AND TECHNOLOGY ELEMENTS IN THE PROBLEM-BASED LEARNING APPROACH AND ITS IMPLICATIONS

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ABSTRACT

Purpose – Previous studies have documented the positive effect of problem-based learning (PBL) on learners, especially in the medical discipline. However, such effect on learners in a specific course of Systems Analysis and Design (SAD) and how the PBL implementation in this course could contribute to meaningful learning are still under-researched. Therefore, this study aims to investigate how a PBL approach could be used in creating meaningful learning among the students of SAD and its effect on their skills. The focus is on how meaningful learning could be achieved through the integration of active learning with fun activities along with the use of technology (Active Fun Technology (AFT) elements) to nurture the students' knowledge and enhance their soft skills.

Methodology – The qualitative approach was adopted as a means to understand how PBL integrated with AFT elements could create meaningful learning experiences and its impacts on skills development. 108 self-reflections were received from the students. A thematic analysis was used to analyse data from the students' self-reflection.

Findings – Meaningful learning criteria and AFT elements were embedded during the process to create meaningful learning experiences. The finding of this study highlighted that PBL activities with the integration of AFT elements could be used to create meaningful learning. The study showed that the PBL implementation successfully created a meaningful learning experience and developed related skills during the learning process. In this regard, two major themes emerged from the thematic analysis, namely soft skills (social skills [with subthemes of friendship and sharing, accept others' ideas], teamwork, communication, critical thinking, and problem-solving), and technical skills.

Significance – The significance of the study was its suggestion of integrating AFT elements during the design and implementation of PBL activities. This is particularly important for educators who teach highly theoretical subjects and use PBL as their teaching approach and strategy to ensure engagement in stimulating students' interests to learn the subject.

Keywords: Problem-based learning, active, fun, technology, systems analysis and design, skills, meaningful learning.

INTRODUCTION

Problem-based learning (PBL) is a teaching approach that focuses on students (i.e., student-centred) (dos Santos et al., 2018) through the experience of solving a real-life problem in facilitated sessions (Jabarullah & Hussain, 2019). As informed by the constructivist theory, PBL is a self-directed learning process (Kwan, 2019) that can be achieved through collaborative (Borhan, 2012; dos Santos et al., 2018) and active (Alt, 2015) learning. Therefore, a teacher becomes a facilitator to ensure the visibility of the learning process (Man et al., 2020; Mohd. Yusof et al., 2005; Okolie et al., 2020; Savery, 2006).

The introduction of PBL as a way to develop the skills and abilities of students can be traced back to the late 1960s. It began with McMaster University Medical School's attempt to incorporate the actual practice in medical teaching and learning (Nilson, 2016). PBL was then widely adopted in other disciplines, including engineering, social sciences, business, and law. In the context of higher learning education, PBL has been broadly accepted as one of the teaching approaches to improve students' skills and, thus, enhancing graduates' employability (Jabarullah & Hussain, 2019; Okolie et al., 2020). Among others, previous research found that PBL could improve students' learning motivation (Moskovsky et al., 2013), lateral thinking abilities (Mustofa & Hidayah, 2020), critical thinking abilities (Gholami et al., 2016; Oja, 2011; Tiwari et al., 2006), teamwork (Adnan et al., 2009), team-based problem-solving skills (Helmi, Mohd-Yusof, & Phang, 2016), problem-solving skills (Kadir et al., 2016; Kurniawan & Sofyan, 2020; Simamora et al., 2017), and critical thinking skills (Asyari et al., 2016; Gholami, et al., 2016).

System Analysis and Design (SAD) is a course designed to describe the process of developing high-quality enterprise information systems (Tilley & Rosenblatt, 2017). In this context, SAD is regarded as the core course for graduate degree programmes in Information System (IS) (Gorgone et al., 2006). Previous literature, however, highlighted that teaching SAD is both difficult and challenging (Barefah & McKay, 2016; Chen, 2006; Garfield, 2017; Rob, 2006) due to the topics in the course that are theoretical in nature (Barefah & McKay, 2016). Hattingh and Weilbach (2020) identified the lack of instructional materials for theoretical and practical content as the challenge in teaching SAD at higher learning institutions. According to the authors, an appropriate textbook that remains up-to-date and covers the IS curriculum is tedious and almost impossible to find. In the same vein, Fatima and Abdullah (2013) and Pretorius and Hattingh (2017) agreed that teaching the SAD course is challenging due to the rapid development of technology, changing industry demands, and new market trends. Rob (2006) further encapsulated that students did not value the importance of the SAD subject. As a result, it is difficult to practise the SAD course in a classroom setting (Chen, 2006).

Motivated by a positive improvement in students' skills and employability opportunities, literature suggested the implementation of the PBL approach in teaching the SAD course (Darus et al., 2016; Fatima & Abdullah, 2013; Luce, 2000). Many researchers have

documented the positive effect of learners using the PBL approach, especially in the medical discipline (Borhan, 2012), yet its effect on SAD students (i.e., IS discipline) is still under-researched. In addition, how PBL in the SAD course could contribute to meaningful learning is not widely discussed in the literature. Therefore, this study aims to investigate how the PBL approach can be used in creating meaningful learning among SAD students and its effect on the students' skills. This paper specifically focuses on how meaningful learning is achieved through active learning with fun activities along with the use of technology to nurture the students' knowledge and enhance their soft skills. It is in line with Ashburn's (2006) definition of meaningful learning, which is systematic and intentionally created opportunities to achieve the understanding of complex ideas, and skills in working with complex problems relevant to students' lives (Ashburn, 2006). This paper presents the idea of how PBL is implemented to generate meaningful learning by integrating the Active + Fun + Technology (AFT) concepts. In this context, the knowledge and skills obtained through PBL activities are of value to the learners and can be used and incorporated into their lives. This study is significant in such a way that it captures the experience of PBL implementation from the students' perspectives and how meaningful learning is created.

LITERATURE REVIEW

Even though the PBL approach is found to be crucial in enhancing students' soft skills, such literature on PBL and SAD course are limited. This statement is based on the searching of literature under the keywords of "problem-based learning" AND "system analysis and design" in the Scopus database on 26th November 2020. The findings resulted in only nine documents from 2005 to 2017. The Scopus database was selected as it indexes content from 24,600 active serial titles and has 1.4 billion cited references from 1970 (Scopus, 2020).

Based on the search result, it can be inferred that a limited number of Scopus papers have been published on the experience of learners in implementing PBL. Out of nine published articles, five were conference papers (Ahmad et al., 2011; Bishop-Clark, 2006; Ibrahim & Abd Halim, 2014; Morien, 2017; Udomsilp, 2013), three articles (Ahmad et al., 2015; Bentley, 2005; Hauser et al., 2007), and one book chapter (Quade, 2009). Bentley's (2005) study was the first of these nine articles to be published. The author applied the PBL approach

to an introductory first-year undergraduate course in SAD. Using the phenomenological research approach, Bentley (2005) found that the PBL approach could empower active learners in the SAD course, leading to better graduate outcomes. The study also revealed that PBL was challenging to weaker students as they might be left behind and most likely to achieve surface learning. Therefore, support and encouragement were needed to be provided by the teacher.

On the other hand, both articles published by Bishop-Clark (2006) and Hauser et al. (2007) highlighted the best approach for implementing PBL in the SAD course. Claiming the PBL project using WebQuest as successful, Bishop-Clark (2006) confirmed that real-life practical experiences using the PBL approach were crucial to nurture students' learning. In a similar vein, Hauser et al. (2007) conducted PBL via the bug hunt project. During the system testing phase of the project, the SAD students were required to locate and remove bugs. Hauser et al. (2007) concluded that the project was successful due to its ability to activate students' prior knowledge of the information system and stimulate higher-order thinking. Likewise, Udomsilp (2013) shared the findings of a case study on the PBL implementation at Mae Fah Luang University. The authors confirmed that the PBL approach could expose the students to learn in a real-life environment and help them solve particular problems. In a different perspective, Quade (2009) shared a journey to transform teaching the SAD course from a teacher-centred to a student-centred approach using a hybrid approach. The author introduced the concept of a problem-based hybrid approach in the SAD course. The hybrid approach allowed the students to analyse, design, and implement a prototype solution for a real client. The study concluded that the students could experience real-world problem-solving projects with real clients regardless of the physical distances. According to Morien (2017), IS education, including the SAD course, should incorporate a practical, hands-on project to build students' deep learning. The author also suggested that a project-based (including problem-based) approach with continuous assessment is the best strategy for teaching IS-related subjects.

All the studies reviewed so far were extracted from the Scopus database focusing on PBL implementation and SAD course. Nevertheless, these studies did not provide information on the impact of PBL implementation in the SAD course on the students' skills development. In addition, even though some research has been carried out on the impact of PBL implementation on the students' soft skills development in other courses, there remains a paucity of evidence

on the SAD course. Therefore, identifying the impact of PBL on students' skills development is crucial as it helps to realise the benefits of implementing PBL and encourages more application in the SAD course classroom.

Two studies from Ahmad et al. (2015; 2011) focused on how lecturers could transfer tacit knowledge to their students via the PBL teaching method. Using the SAD students as respondents, the study evaluated how the socialisation, externalisation, combination, and internalisation (SECI) model could support knowledge transfer from lecturer to students. The authors then concluded that the model was suitable for the PBL teaching method in software engineering education. Meanwhile, Ibrahim and Abd Halim (2014) examined the use of project-oriented problem-based learning (POPBL) approach with students undertaking Programming Technique 1 and SAD courses for software engineering students. The study emphasised the development of a generic POPBL design framework that could be mapped to the cognitive, collaborative, and content perspective principles. The authors claimed that teaching outcomes revealed using POPBL could improve both students' soft and technical skills. However, the authors did not explain how POPBL could improve soft and technical skills; they only shared several significant positive/negative responses and feedback due to the space constraint of the paper for the Scopus conference proceeding (Ibrahim & Abd Halim, 2014). While these studies focused on the approach that could be taken to enhance the PBL implementation, none of the studies highlighted the need to integrate the elements of fun, active, and technology for creating meaningful learning through PBL. Therefore, this study offers valuable insights to enhance the limited PBL and SAD literature by integrating the need to understand how PBL could be designed with the AFT elements to create a meaningful learning experience and incorporating evidence of how such implementation could affect students' skills development.

Theoretical Framework

The present study explores how students construct new knowledge by connecting it with their existing knowledge through PBL activities by drawing upon the constructivist perspective of meaningful learning as the theoretical foundation. The constructivist learning theory suggests that humans construct knowledge and meaning from their experiences. Hereof, learning via PBL is an active and constructive process, which

requires the students to participate actively in knowledge construction rather than passively receiving the information from teachers. It is in line with Mintzes et al.'s (1997, p. 419) view, who postulated meaningful learning as "the non-arbitrary, nonverbatim, substantive incorporation of new knowledge into long-term memory". Ausubel's meaningful learning highlighted the conditions of how meaningful learning could occur, namely (1) relevant students' prior knowledge, (2) meaningful materials that are conceptually related to the students' prior knowledge, and (3) incorporation of meaningful material into the students' existing knowledge. As these three conditions are fulfilled, the students are able to understand the entire concept that fits together to experience meaningful learning.

Sailin and Mahmor (2018) used the five dimensions of meaningful learning as proposed by Howland et al. (2012) to understand how student-teachers' digital pedagogy could be improved through meaningful learning activities. In this context, Howland et al. (2012) elucidated the five dimensions of meaningful learning as intentional (goal directed/regulatory), active (manipulative/observant), constructive (articulative/reflective), authentic (complex/contextual), and cooperative (collaborative/conversational). The present study employed these five dimensions to combine PBL with AFT concepts to create meaningful learning. In that circumstance, through PBL practices involving three concepts of AFT, students could build their own learning (i.e., constructivist perspective) to experience meaningful learning.

Bisson and Luckner (1996) discussed four characteristics possibly inherent in the fun concept, which were relative, situational, voluntary experience, and desire to have fun. The authors concluded that fun is both a process and an outcome. As an outcome, fun is associated with enjoyment and excitement. Meanwhile, fun as a process is something that needs to be planned and integrated into the learning process. In terms of understanding the effects of fun and enjoyment on adults' learning, Lucardie (2014) concluded that fun and enjoyment could be a motivator for students to attend classes and learning. In this context, the authors further posited that fun and enjoyment could be used as a mechanism to promote concentration and absorption of learning and to build a socially connected learning environment. Tews and Noe (2019) viewed fun as an essential component of a high-quality learning experience. According to them, embedding fun in training leads to the individuals' engagement, motivation to learn

more, and favourable reaction about the experience. Viewed from the perspective of instructional activities related to critical thinking skills acquisition in the classroom environment, Boso et al. (2019) found that teachers' good sense of humour and open attitude could inspire students' participation towards in-class activities and make learning fun. Therefore, in summary, fun in learning is crucial as it offers positive effects on learning.

IT applications and Web 2.0 used as tools to help create meaningful learning. The use of both tools in teaching and learning could improve students' IT skills and encourage them to interact and collaborate with other students to share knowledge and establish social connections. Livingstone (2015) elucidated that the nature of Web 2.0 is in accordance with the social constructivist theory of Vygotsky. In this regard, learning is perceived as a collaborative process, where knowledge development is built during the teaching and learning phase through the social and cultural experiences of students. Olea (2019) highlighted that using technology in a constructivist classroom enables the students to be responsible for and actively participate in the learning process and foster meaningful learning experiences. The interactive features of Web 2.0 play a crucial role in stimulating class discussion, providing interactive learning, and encouraging success for low achievers (Olea, 2019). In a similar vein, Hursen (2021) found that the implementation of PBL supported by Web 2.0 was effective in developing students' critical thinking skills. The above discussion highlights the notion that technology in teaching and learning can be used as a tool to support knowledge construction. In this context, technology does not replace the teacher but rather acts as a tool to support learning and foster a meaningful learning experience.

The mapping of how AFT concepts are in line with Howland et al. (2012) is presented in Table 1.

Table 1

Mapping of AFT Concepts with Howland et al. (2012)

Howland et al. (2012)	PBL Activity Explanation	AFT Concept in PBL
Active	Students are actively engaged in the meaningful PBL activity, and the results from the PBL activity are observed.	Students work together/collaboratively to solve the PBL problem. The PBL question is authentic and developed to help the students achieve the learning goal. The knowledge is then constructed. The teacher acts as a group facilitator, which allows for more self-directed learning and helps stimulate discussions, particularly for groups with problems to initiate the activity. This is achieved through AFT by: i. connected content. The PBL question is related to real-life experiences. Therefore, it allows students to search for information on the Internet; ii. embedded various IT applications and Web 2.0 tools to spark the interests of students. In this PBL setting, the students were exposed and trained to use Microsoft Project and several online collaboration tools to conduct brainstorming and prepare the Ishikawa diagram. An Ishikawa diagram, also known as a fishbone diagram, is a tool to assist students in identifying possible causes of a problem (i.e., in the PBL questions) (Cieśla et al., 2017). Consequently, the students can suggest appropriate solutions based on the identified problem. The teachers, on the other hand, from time to time would experiment and introduce new digital tools to make learning through PBL more engaging (for instance, Padlet, Wheelofnames, and Kahoot);
Cooperative	Students must collaborate, communicate, and complement each other's knowledge and skills to solve the PBL problems.	
Constructive	Through solving the PBL problem, students construct their knowledge and articulate their understanding by doing reflection. Reflection can be done impromptu – during class or written.	
Authentic	The PBL question is designed to reflect real-life problems. In this context, students experience the learning process to obtain knowledge on what they learn, rather than memorising the abstract concept without understanding. This real-life problem allows the students to explore and meaningfully construct the concept that they have learnt during the PBL session.	

(continued)

Howland et al. (2012)	PBL Activity Explanation	AFT Concept in PBL
Intentional	The PBL activity is designed to achieve related learning goals. When students are actively involved in a series of discussion, their intentions to solve the problem is clear, and they execute their actions accordingly.	iii. a series of emails and memorandum to highlight the requirement of the activity that students need to perform; iv. active group discussions – "let's get their feet wet!" In this context, students become system analysts and involve in active discussions to complete the PBL tasks; and v. microteaching and fun activities – e.g., using multimedia to engage learners, classroom setting, free food, and gamification. A positive learning environment is particularly important to create an authentic experience for meaningful learning.

Instructional design

The PBL activity was initially designed using the five phases of the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) instructional design model. This ADDIE instructional design was then mapped with the System Development Life Cycle (SDLC) approach, which was used in the SAD course. The mapping of ADDIE and SDLC was based on the recommendation by Eller (2015), who claimed that both combinations would help subject matter experts and instructional designers to work in tandem with one another. In each development process, the meaningful learning criteria (i.e., active, cooperative, constructive, authentic, and intentional) are a means of generating meaningful learning experiences for the students. The mapping is presented in Table 2.

Table 2

Mapping of ADDIE with SDLC Approach for Designing PBL Activities in the SAD Course

ADDIE	Activity	Description	SDLC and Milestone
Analysis	1. Identify the learning outcome	• Pre-defined in the syllabus, focuses on learning outcomes 2	**Systems Planning (PBL 1)** *Output: Preliminary Investigation Report*
	2. Create an action plan	• Detail a list of work that must be done and outline all the resources needed • Plan for the release of materials, microteaching throughout the semester	• Understanding the problem • Preparing project scope and constraint • Preparing a fact-finding and feasibility analysis • Selecting the project selection • Scheduling and managing the project (using Microsoft Project)
	3. Analyse learners	Students' profile (semester and course)	
	4. Identify the requirement	• Identify the output of PBL and submission information • Students submit two PBL projects for assessment – PBL 1 and PBL 2	**Systems Analysis (PBL 2)** *Output: System Requirement Document* • Preparing fact-finding for the current system • Identifying the requirement checklist for the new system
	5. Identify an assessment method	• Rubrics to be used as per syllabus requirement	• Preparing data and process modelling (data flow diagram) using tools, such as draw.io (https://app.diagrams.net) and LucidChart (https://www.lucidchart.com)
	6. Identify the tools that will be used	• Tools to prepare Ishikawa diagrams, data flow diagrams •Other relevant online tools for collaboration	

(continued)

ADDIE	Activity	Description	SDLC and Milestone
Design	1. Create the real problem – the question	The problem must be something that the students can search (e.g., through interviewing relevant parties or web search)	**Systems Design (PBL 2)** *Output: System Design Specifications* • Preparing user interface design (including input and output designs)
Development	2. Create the accompanying materials, such as emails and memoranda, microteaching activities	• The idea is to guide the students on what they need to do during the PBL session	• Preparing entity relationship diagram • Preparing relational database
Implementation	3. Implement PBL	• Use the identified tool to enhance self-directed learning • Students need to prepare a PBL diary (in a group) • Microteaching to explain a specific concept • Evaluate and revise (lecturer) • Students need to prepare reflection for PBL	**Systems Implementation, Support, and Security** • No PBL activities • Managing systems implementation from coding and testing to documentation and conversion • Managing maintenance tasks
Evaluation	4. Evaluate and gather feedback	• Classroom general assessment • Formative and summative assessment	

METHODOLOGY

Context and Setting of Study

The PBL approach has been introduced in the SAD course, and it is offered to students in the Bachelor of Accounting and Bachelor of Accounting (Information Systems) programmes at Universiti Utara Malaysia (UUM). For this study, three classes of the SAD course (i.e., class enrolment from September to December 2019) under the responsibility of the researcher were selected. Each of the classes was divided into eight groups of five members. The PBL method was implemented for 11 academic weeks (the total number of weeks in the selected semester was 14 weeks).

As for assessment purposes, students were required to submit two PBL reports (i.e., PBL 1 and PBL 2) following the SDLC approach. The PBL 1 report covered the preparation of a preliminary investigation report, while PBL 2 focused on the documentation of system requirements and system design specifications. This study primarily aimed on the PBL activity for the preparation of the PBL 1 report in which the students submitted at the end of Week 4. The presentation of the PBL report was conducted in Week 5. The students were then required to submit their self-reflection on the experience related to the PBL 1 activities. In this context, data were collected when the students uploaded their written self-reflection document on the UUM Online Learning platform.

Self-reflection approach was chosen to allow the students to reflect on the situation after the PBL 1 activities was resolved. This approach was based on Zimmerman (1998), who explained self-reflection as "processes that occur after learning efforts and influence a learner's reactions to that experience" (p. 2). The self-reflection approach could influence the students' forethought for the subsequent learning effort (i.e., PBL 2 activities). In this study, 108 self-reflections were received from 108 students who enrolled in the SAD course. It is important to highlight that 85 percent, i.e., 95 students, were in their third semester, and the SAD course was their first experience using the PBL approach. As they did not have much experience in doing self-reflection, the researcher provided the students with a reflection sheet that consisted of the reflection questions. The reflection questions were formulated using Gibbs's reflective cycle (Gibbs, 1988) that focused on the students' experience, such as students' brief description of the activity, their feelings (e.g., what did you like about the experience in PBL 1),

their analysis and thoughts on what they learnt in the PBL 1 activities (e.g., what did you learn), and their recommendation for future action.

This study adopted the qualitative approach as a method to understand how PBL with AFT elements could create a meaningful learning experience and its impacts on skills development. In this context, students' reflections were analysed to understand how the students learnt through their reflective writings of what they did and their experience in learning the PBL approach with AFT elements.

PBL Implementation Approach

The PBL questions were developed using a guideline suggested by Duch et al. (2001) on the characteristics of good PBL problems. The researcher acted as a facilitator to facilitate the PBL session in each class. The students worked collaboratively in a group to produce the output of the PBL activities.

The implementation of PBL in this study followed the Illinois Mathematics and Science Academy's (IMSA) PBL Teaching and Learning Template. The IMSA academy prepared the template to guide the implementation of PBL in a classroom. It highlights the important approach for a successful PBL implementation, which focuses on three core techniques of (1) understanding the problem, (2) exploring the curriculum, and (3) solving the problem. The central idea of the PBL question is about a story of a company that faced several difficulties in managing their business, such as repetitive mistakes in booking and taking a great deal of time to approve booking, which led customers to walk away as they were tired of waiting for confirmation. The business owner hired the students, who acted as systems analysts, to suggest the potential for automation. In line with the concept of SAD, the students were expected to prepare a preliminary investigation report (PBL 1) highlighting the systems proposal. As systems analysts, once the students had identified the best-proposed system, the students were then expected to design a new system for the business (PBL2). In these two series of PBL 1 and 2, the students experienced how an information system is developed to support business needs. The process started from analysing the business situation, identifying opportunities for improvement, and designing an information system through SDLC (i.e., planning, analysis, design, implementation, maintenance, and support). These techniques and the PBL activities are summarised in Table 3.

Table 3

PBL Implementation Approach

Week	Technique for PBL 1	Activity
Week 1	1. Understand the problem (Topic: System planning)	• Meet the problem! • Brainstorming sessions to identify: (1) what the students know, (2) what they need to know, and (3) what they need to do based on the PBL question. • Share their findings with other groups (students shared their answers on the Padlet website (www.padlet.com) and whiteboard).
Week 2	2. Explore the curriculum (Topic: System Planning)	• Search for the information needed. • Assess and discuss the information gathered from the previous activity (i.e., problem identification). • Microteaching on preparing the fishbone (Ishikawa) diagram. • Analyse the problem and examine the possible causes of the problem.
Week 3-4	3. Resolve the problem (Topic: System Planning)	• Students determine the best system that can be designed and developed to solve the problem based on the fishbone diagram (i.e., generate possible solutions). • Prepare a preliminary investigation report by defining project scope and constraint, performing fact-findings, evaluating feasibility, scheduling, and project management.
Week 5	Students Presentation	• Debrief the problem, potential solutions, and the best solution (by learners) during the preliminary investigation report presentation. • Debrief the PBL by the teacher and obtain feedback.

DATA ANALYSIS

Data were gathered from the students' reflections that were submitted after the submission of the PBL 1 report. Following Braun and Clarke (2006), this study employed a thematic analysis that focused on six steps, which were (1) familiarising with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing a report. In this context, repeated patterns of meaning were constructed to establish the main themes.

FINDINGS

PBL and Meaningful Learning

As mentioned earlier, meaningful learning could occur when the content is relevant to students' prior knowledge, the materials are conceptually related to the students' prior knowledge, and the meaningful materials are incorporated into the students' existing knowledge. Therefore, learning through problem-solving turned students who acted as systems analysts into problem solvers. The students defined the problems and search for the solution by working in groups. Then, the students created meaningful learning experiences by actively engaging in the PBL discussion, starting from understanding the problem, gathering related information to propose potential solutions, and determining the best solution to address the identified problem. Students needed to exchange information during the process, agree to disagree, and choose the best solution after considering all options. The themes that emerged from the students' reflection that focused on how PBL could create a meaningful learning experience were as follows: (1) the question used real-life problems, (2) it should include challenging questions to spark interests and the opportunities to experience satisfaction once they completed the PBL, and (3) the PBL implementation was integrated with AFT elements. In this regard, the students experienced a learning process where they had to solve the real-life problem, which required them to think critically, listen to the opinion of team members, collect information via various sources, and consider various possibilities to solve the problem. Therefore, the implementation of PBL integrated with AFT elements offered the students the opportunity to practise what they have learnt as a meaningful and enjoyable experience and they could apply it to solve real-life problems.

In the reflection, after the students were introduced to PBL activities with AFT elements, most of them described the PBL problem as representing real-world problems and treasured these experiences. For example, Student #1 explained that:

> "This is my first experience of thinking about possible solutions to problems that arise that might occur in real life" [Student #1]

In a similar vein, Student #2 wrote that:

> "The process of completing the PBL activity gave me a lot of new experiences. Students were exposed to conduct or create a new system where it feels like a real task, where we received memos and details of the system request. This enhanced the students' ability to think critically in order to create something new with the steps provided as a guideline" [Student #2]

PBL with a challenging question attracted the students to stay focus and spark their interest. The following students explained that:

> "It was a good experience for me to do this project together with my groupmates. It was also challenging for me to get some new ideas during the brainstorming session in my group" [Student #3]

> "The most interesting discovery of this PBL1 is that I know how system analysts work and how they uncover a system. I also realised that I love doing something that enables my brain to squeeze out all the ideas. PBL1 helped me boost my critical thinking and learning experience, especially to think of something that I had never experienced, such as think about the system prediction cost and how to use Microsoft Project to organise the tasks" [Student #4]

> "I never expected this project to be quite challenging because it requires a lot of thinking and reading. It was actually hard for me and my team to do this project because sometimes we have different ideas, and

> at times, none of us has any idea about what to do, but we managed to overcome this problem. I could say that this project teaches me that I need to work hard to achieve something because there is no easy way to obtain something" [Student #5]

The impact of the PBL implementation with AFT elements is clear when Student #6 described her PBL experience as something that is meaningful:

> "It was my first time planning a system. It was a great experience for me to learn these things because before this, I only focused on accounting. With this knowledge, I believe it really helps me in my career soon. While doing PBL 1, I learnt to plan a system as if it was real. You are not just creating and writing reports, but it feels like developing a real system" [Student #6]

This student further explained how her knowledge is constructed:

> "At first, I really don't understand why we need to do the entire task in the class, but now I realise it really helps me to comprehend how the procurers work before we plan the new system. I had tried to read the book but could not understand why we need to learn such things, but while doing PBL, it helps me to understand the process that basically will be used in real life" [Student #6]

In her reflection, the student described how new knowledge is incorporated into her existing knowledge.

> "In PBL 1, I learnt so much, and it helped me to recall what I have learnt previously. I like this type of activity where the lecturer relates the syllabus with our project. When implementing this project, it helped me to think out of the box, like what I want to build or what system I want to manage in my company. During my seventh semester, I never did a task in which we had to reflect or do critical thinking as if it is in real life. That's why I think PBL 1 gives me a new learning experience" (Student #7)

Apart from the above reflections, it was also found that the students enjoyed the PBL session that was integrated with the AFT concepts, such as:

> "I really enjoyed the moment we discussed during the class, we solved problems together and made jokes, which made me feel relaxed" [Student #8]

> "My experience in carrying out this task was enjoyable because this activity helped to enhance my knowledge while performing it. In addition, I received help from my team members in finding ideas and listening to ideas from other members to complete this project" [Student #9].

The Impact of the PBL Implementation with AFT Elements on the Students' Skills Development

The data gathered from the self-reflection contained six themes, which highlighted issues related to the impact of PBL. These themes were teamwork, friendship, sharing/accepting others' ideas, communication, technical skills, critical thinking, and problem-solving skills. After further refinement, the themes were divided into the following two primary themes and subthemes:

1. Soft skills (social skills [subtheme: friendship, sharing/accepting others' ideas], teamwork, communication, critical thinking, and problem-solving)
2. Technical skills

Soft skills – social skills – subtheme: friendship

The students expressed their happiness by making new friends as a result of conducting PBL activities. It is one of the benefits of PBL activities where students worked in groups and became closer at the end of the semester. One of the students wrote that:

> "I made new friends in this activity. When the lecturer assigned us to work as a team, we did not know each other, and there was an awkward moment be-

> tween us. But now, the ice melted, and the awkward moment is no more" [Student #10]

Likewise, Student #11 explicated that:

> "I didn't expect that I will get closer to my groupmates when I meet them in our first class. Now, I really consider them as my friends who can understand and tolerate me" [Student #11]

Active involvement during the PBL activity helped this student to build a positive relationship with her groupmates. In her written reflection, the student described that:

> "I always had a great time in the class with them. We were always having fun by exchanging opinions and ideas that are sometimes related to the project and sometimes not. But even if it is not related, I believe not everything that we shared was just nonsense, it is also a way to improve our bonding and chemistry for us to perform better for this project" [Student #12]

Soft skills – social skills - subtheme: sharing/accepting others' ideas

Through the PBL activities, the students learnt how they could improve their ability to listen, give, and accept the ideas of other group members. In the reflection written by Student #13, she explained that:

> "I learnt how to improve myself in expressing ideas because my group is not the type that rejects a given idea. Every time I give an idea, they will accept it, or they will try to improvise the idea to make it better to add to the project. This circumstance makes me feel comfortable and confident to continue giving ideas and think harder to produce better ideas. I also learnt to accept other people's ideas and provide an alternative idea if those ideas do not fit. I say this because, in other subjects, my ideas are always rejected by my group, which makes me give up thinking of ideas. I usually say nothing and just let my groupmates decide on any task given" [Student #13]

Similarly, Students #14 and #15 expressed their opinions as:

> "In the course of this assignment, the team members can actively put forward their own opinions for the system design and can listen to other people's opinions very well. I think this is an excellent collaborative experience. Through the exchanges, the team members can get something they have neglected" [Student #14]

> "During the discussion, we sometimes quarrelled over ideas because each of us had our own understanding of the project. But then, we clarified the things by reviewing together and looked from the same perspectives" [Student #15].

Student # 16 shared his experience in the reflections about how he wanted to be more open with the idea of others during the process of completing the PBL activity:

> "I found that I was quite impatient. When we clash on our ideas, I tend to back up my point as it is true. It's like that I can't accept others' ideas. But then, I tried to be more open about everyone's ideas as we can try to interpret them together" [Student #16]

Soft skills - subtheme: teamwork

The PBL activities successfully helped the students to cultivate teamwork, whereby they worked together to solve the problem given. The students expressed their feelings on how the PBL allowed them to collaborate with their team members. For example:

> "I can say that the project that I have completed, namely PBL 1, is a fruitful project. It was a very tough project, but in completing the project, we learnt how to cooperate with group members to complete the project in the given time frame" [Student #17]

> "I enjoyed every moment while discussing with them in class on the journey of completing the task. They were fully committed to completing the assigned task. It makes it easier for me to face all the challenges regarding the task since all of my group members are very supportive. We discussed everything together and communicated well with each other. The thing that I like about PBL 1 is I can make new friends because the group was created randomly by the lecturer. I love working with all my team members because they give full commitment to completing the task given. Every one of us is aware of our task, thus, it simplifies our work and we can complete it successfully. The most enjoyable moment is when all of my team members truly enjoyed doing this project in the class, where we discussed every single thing together" [Student #18]

Soft skills - subtheme: communication

The integration of AFT in PBL in the classroom successfully helped the students to improve their communication skills. This success had been highlighted in the reflection by the following students. For example:

> "I realise that I am more receptive to the idea of someone and give a positive comment about it. My communication skills have also improved through every discussion I had in class. Definitely, I have learnt a lot of things" [Student #19]

> "It is because when doing the group tasks, I tend to speak out my ideas, therefore it helps me improve my communication skills and to not be afraid of talking to people about my ideas" [Student #20]

> "To be precise, throughout this programme, I can see myself interacting more with the lecturer and all of my classmates. It is because we have our task, and to complete it, we must find some ideas. The way

> to brainstorming the idea is also by asking other friends/people besides our group members so that we can complete this task using the same understanding" [Student #21]

Soft skills – subtheme: critical thinking and problem-solving

Since the nature of the PBL question is to provide students with a real-world problem that requires them to solve it, the findings suggested that such an approach could nurture the students' ability to think critically to solve the problem. It is illustrated by the reflections written by the students. For example:

> "PBL 1 helps me to boost my critical thinking because I have to think outside of the box and need to solve the problem in different ways" [Student #22]

> "I can say that BKAS2013 (the course code for SAD) opened my mind to think outside of my comfort zone while searching for relevant solutions. Additionally, the technique used for the investigation can be applied easily in our daily life" [Student #23]

The PBL activities required the students to solve the problem collaboratively with their teams. They had to brainstorm and prepare the Ishikawa diagram to help them understand the problem and, thus, suggest the solution. While in the process of searching for the answer, the students had to read textbooks and search for more information on the Internet. The reflections written by Students #24, #25, and #26 explained that:

> "It really improved my critical thinking skills because for the first time I spent a very long time thinking about something, and also boosted my learning experience because by doing this, we cannot just rely on the textbook, but it forces us to think and use our imagination to the maximum. This project is of great assistance in my learning as it helps me understand what I have learnt because I apply and implement them" [Student #24]

> "This project gives me a new perspective, challenges my point of view, and also introduces me to new techniques, skills, and processes. In addition, PBL 1 helps me boost my critical thinking skills and learning experience. Each part of PBL 1 consists of many critical thinking problems and I need to brainstorm to provide ideas and ways of solving the problem. I will search for information from websites or Google for reference" [Student #25]

> "This project did change my perspective and challenge my point of view. This project acquires me to use my critical thinking skills to give solutions to the problem faced on the project. I think that this project really boosts my critical thinking skills and learning experience during the process of discussion with my team members. We exchange our opinions on the solutions of the project by giving justification to each of the ideas. I learnt a lot of techniques such as create proper planning to start and proceed with the project" [Student #26]

Technical skills

The PBL output in the SAD course was for the students to prepare a preliminary investigation report and for project management. They were introduced to Microsoft Project as a tool to help them prepare the planning requirement by developing schedules of tasks and tracking the system development progress. In most reflections, the students acknowledged that they learnt how to use Microsoft Project. For instance:

> "My most interesting discovery would be Microsoft Project. Actually, I have used it once, but I do not really remember about it. Furthermore, I did not understand anything about the predecessor and successor while using Microsoft Project before. Thus, when we learnt and used it during class, I felt that I finally understood what we were doing" [Student #11]

> "I only knew that there is a software called Microsoft Project after doing this PBL 1. I manually created pert and Gantt charts during my matriculation, but now I know there is a software that makes it easy to create these charts" [Student #26]

> "I discovered that Microsoft Project is thought-provoking because it helped me to build new skills. I need to think about whether the task in every phase is suitable, determine what task should come first, and the implications" [Student #27]

DISCUSSION

This study is a constituent of the Scholarship of Teaching and Learning (SOTL), where the researchers conducted a systematic inquiry into students' learning and shared the findings with the public. In this context, the objective of this inquiry is to investigate how the PBL approach could be used in creating meaningful learning among SAD students and its effect on the students' skills. This paper specifically focused on how meaningful learning could be achieved through active learning with fun activities together with the use of technology to nurture the students' knowledge and enhance their soft skills. During the development of the PBL question and activities in the classroom, this study mapped the ADDIE instructional design model with the SDLC approach utilised in the SAD course. This study concurred with Eller (2015) that mapping the ADDIE and SDLC could help design a better PBL instructional design for the SAD course. In this regard, the mapping offered a dual perspective from the instructional designers and subject matter experts (i.e., SAD teacher), reducing errors during any facet of the PBL design from the learning objectives to potential system development (Eller, 2015). Meaningful learning criteria and AFT elements were embedded during the process to create a meaningful learning experience for the students. Therefore, this study acknowledged that PBL with AFT elements positively impacted the learners, resulting in meaningful learning that could increase their satisfaction, pleasure, and motivation (Somyürek, 2015).

This study observed that the students involved in diverse PBL activities were able to process information, construct understanding, and apply

the knowledge to solve the PBL question. They were able to make judgements and propose the best solution to solve the problem. As the PBL activities required the students to involve in active discussions and use specific software, they used Microsoft Project to plan their projects accordingly. While the nature of PBL implementation in the SAD course involves technology per se (i.e., analysing and designing a system) (see, for example, Ahmad et al., 2015, 2011; Ibrahim & Abd Halim, 2014), the role of technology itself had been taken for granted. As a result, the technology integration for creating meaningful learning has been overlooked in the SAD literature. Accordingly, the findings of this study suggested that the elements of technology, in addition to fun and active elements, are crucial to support the meaningful learning experience of the students. In line with Howland et al. (2012), this study integrated technology, such as Microsoft Project and other Web 2.0 tools, as technology-as-partner in the learning process. In this context, the use of technology helped to articulate a meaningful learning experience as it linked the application of knowledge through hands-on experience via the technology.

PBL activities lean on its fundamental principle of constructivism, where it focuses on the learners' activities to construct knowledge through interaction with their peers (Nikitina, 2010) with the facilitation of the instructor (Kantar, 2014). The implementation of PBL facilitates the construction and transfer of knowledge and development of various skills, such as communication and problem-solving. In this context, this study presented how PBL activities were designed and implemented in the SAD course. The findings of this study were significant to emphasise that PBL activities could be used to create meaningful learning with the AFT approach. The study indicated how a well-designed PBL question with AFT elements contributed to the meaningful learning experience of students. In addition, the elements of active, fun, and technology (AFT) were crucial to adding the diversity of how PBL could create meaningful learning for students. For example, the use of authentic PBL questions that reflected real-life problems helped the students to understand the problem given and obtain knowledge during the problem-solving process. As for the cooperative and active elements, the students were actively involved in the activity to solve the PBL question collaboratively.

Throughout the PBL activities, the students were introduced to various IT applications and Web 2.0 tools to assist them in solving the PBL problem. Meaningful learning in this study as reflected through

the words "having fun", "memorable moment", and "enjoy learning through PBL". This study revealed that fun in learning PBL could be in the form of fun and hard fun, as highlighted by Barret (2005). The former focuses on fun as: (1) laughter and joking, (2) freedom and creativity, and (3) playfulness. Meanwhile, the latter emphasises fun as: (1) the hard level of difficulty associated with the problem, (2) the high level of activity demanded by the nature of the learning, and (3) the transformative nature of learning in terms of attitudinal change (Barret, 2005). The initial idea of introducing AFT was to embed the element of fun to make the learning more meaningful. The findings of this study revealed that the fun elements contributed to not only laughter and joking, and freedom and creativity, but also hard fun (i.e., it was fun because it was challenging). The hard fun emerged from the PBL implementation with AFT elements' ability to activate students' prior knowledge related to the information system and stimulate higher-order thinking among the students, as highlighted by Hauser et al. (2007). In this regard, the study's findings suggested that the PBL approach resulted in meaningful learning. The integration of active, cooperative, constructive, authentic, and intentional elements during the PBL question development and AFT elements throughout its implementation is regarded as the key to support the creation of meaningful learning in a subject defined as highly conceptual. This study also provided compelling evidence that a successful PBL implementation for meaningful learning must start with good planning and design. As such, this study illustrated the design of PBL activities, starting from the mapping of ADDIE and SDLC in the instructional design, followed by the PBL implementation approach.

In this study, the impact of PBL was manifested through the skills developed as a consequence of intense collaborative and investigative work (dos Santos et al., 2018). The analysis resulted in two key themes, namely (1) soft skills (social skills [with subthemes of friendship and sharing, accept others' ideas], teamwork, communication, critical thinking, and problem-solving), and (2) technical skills. When the teachers successfully encourage and cultivate a culture of learning through problem-solving, it fosters the development of various skills, as highlighted by this study. The findings of this study are consistent with previous studies that emphasised the important role of PBL in improving critical thinking abilities (Gholami et al., 2016; Lapuz & Fulgencio, 2020; Oja, 2011; Tiwari, Lai, So, & Yuen, 2006), teamwork (Adnan et al., 2009; Deep et al., 2019), team-based problem-solving skills (Helmi et al., 2016), problem-solving skills (Kadir et al., 2016;

Kurniawan & Sofyan, 2020; Sari, 2021; Simamora et al., 2017), and communication skills (Deep et al., 2019; Salari et al., 2021).

Considering the effect of PBL activities on meaningful learning and soft skills development, the outcomes of this study also suggested that the creation of the PBL question and activities could embed Howland et al.'s (2012) five dimensions of meaningful learning. In terms of the PBL implementation, the integration of AFT elements is crucial to help students create a meaningful learning experience and develop related skills during the learning process.

CONCLUSION

This SOTL study demonstrated how to unleash the potential of PBL with a combination of AFT elements to create meaningful learning experiences and revealed its impact on the skills development of SAD students. The first part of the findings contributed to the understanding that the implementation of PBL was more meaningful to the students with the integration of AFT elements. In this context, active participation made the students engaged in the learning process, fun elements, such as gamification, spiced up the learning, and encouraged full participation from the students, and technology, such as web 2.0, sparked the interests of the university students who are the digital natives (Prensky, 2001). The second part of the results revealed that when PBL activities were conducted with the integration of AFT elements, it affected the students' social and technical skills development. Therefore, it becomes crucial for teachers, particularly those who teach highly theoretical subjects to apply the PBL approach with AFT elements as their teaching approach and strategy. At this juncture, following this study's instructional design, the teachers could create an authentic learning experience that is meaningful to the students. In addition, the teachers must be trained to become good facilitators. According to Scialdone and Connolly (2020), good facilitators could motivate the students to engage in the learning process. At the same time, the teachers must also be trained to become technology-savvy in using technologies and Web 2.0 applications to facilitate the learning process. Teachers with excellent facilitating techniques and tech-savvy skills could create fun learning activities and produce authentic learning experiences.

This study also revealed how the SDLC approach was mapped with the ADDIE instructional design and PBL implementation approach. Both of these approaches are transferable and scalable, which can be applied to different courses or subjects in any institution. Future studies on the impact of PBL with AFT elements on academic performance should be further explored.

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