

## Using motivation to improve learning achievement with a chatbot in blended learning

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### Abstract

Chatbots have the potential to be used as motivational learning tools, particularly for boosting academic performance. The purpose of this study is to construct a Facebook Messenger chatbot to promote accomplishment through the use of blended learning, guided by the ARCS (attention, relevance, confidence, satisfaction) motivation model that compares how engagement works, and explores the chatbot in terms of its usability. Integrated with Facebook Messenger, chatbot software was designed to answer inquiries based on the chatbot's communication framework. This included course alerts, a gradebook for each student, attendance statistics, and assignment feedback. Using a quasi-experimental research approach, the influence of the chatbot on student motivation and academic achievement was empirically investigated. The trial covered 18 weeks, and the sample comprised 48 students enrolled in a course on Information Technology for Learning. The results suggest that the chatbot increased the learning accomplishment of the students to a considerable extent, and that a motivational setting may lead to a better outcome than a blended learning environment. Overall, our approach produced reliable findings which validated the chatbot's capacity to communicate with students. The students agreed that the chatbot facilitated their learning, but that a few modifications were required in terms of ongoing development.

Keywords: Motivation; Learning Achievement; Chatbot; Blended Learning;

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## 1. Introduction

A chatbot is a computer program that can converse with humans to benefit and facilitate efficient working. Chatbots have become an integral part of this rapidly changing technological era, from mobile personal assistants to tech support and telephone answering assistants, and they are even used for answering health questions (Serban et al., 2017). Chatbots are becoming increasingly popular in a variety of fields, including commerce, the service industries, and education. Several studies have shown that chatbots have the potential to change the way students learn and access information (e.g. Chen, Vicki & Sutrisno, 2020; Pérez, Daradoumis & Puig, 2020; Rapp, Curti, & Boldi, 2021; Smutny & Schreiberova. 2020) especially in a learning context where there is a high student-to-teacher ratio, with more than 100 students per teacher. Chatbots can help to solve the problem this creates in that teachers are unable to provide comprehensive care to so many individual students, thus preventing students from participating in effective learning situations (Brinton et al., 2015).

In the current educational setting, there are two distinct types of chatbots: service-oriented chatbots and teaching-oriented chatbots. The latter are classified as educational tools and are used to generate knowledge. In contrast, the former are designed with an indicator of user intent and are trained to respond to frequently-requested questions. There is a trend toward utilizing teaching-oriented chatbots as an aid for teachers, The success of service-oriented chatbots is determined by the users' assessment of the queries answered by the chatbots, whereas teaching-oriented chatbots are evaluated on the basis of the learners' self-perception (Pérez, Daradoumis & Puig, 2020).

Several studies have shown that a lack of individualized student support leads to low student satisfaction with learning and subsequent weak learning and a high student dropout rate (Gray and Diloreto, 2016). The quality and efficacy of any learning form affect a student's motivation. To succeed, students need to be inspired. Having contact or interacting with instructors on a regular basis improves students' motivation. Education researchers have devised successful instructional design treatments that might help students retain or re-invigorate their motivation, which has an impact on their performance and achievement. The need of interaction to ensure good learning and knowledge transmission in all forms of education was also determined by Seo and Gibbons (2021). In research to date, interaction has been found to boost motivation and interest.

According to recent theoretical developments, chatbots have the potential to change the way students discover information and learn (e.g., Brinton et al., 2015; Hone & El Said, 2016). They can also increase student engagement and interaction in learning, which has a positive effect on academic achievement (Tangkittipon et al., 2020). This gives chatbots the potential to address individual student support issues. Previous studies have shown the potential of chatbots to improve learning processes. However, research on learning achievement using chatbots based on student motivation is in its infancy. To fill the gap in the research, this paper shows how to design and develop a chatbot communication framework based on a motivation model to improve learning achievement through Facebook Messenger as part of blended learning.

## 2. Review of Related Studies

Motivation can influence what and how people learn, as well as how they perform. Students who are actively engaged and motivated are more likely to achieve academic success (Wu, 2019). Implementing instructional motivation in online learning settings through the use of communication tools and electronic resources is important in learning and interaction. Students need to be given opportunities to collaborate with one another through cooperative activities, and they need ongoing support in their academic endeavours if they are to be inspired to study. An instructional motivation

approach known as Keller's Attention, Relevance, Confidence, Satisfaction (ARCS) model, has been extensively adopted. Various learning and design contexts, such as the conventional classroom, computer-assisted instruction (CAI), blended learning, and online distance learning (ODL) have all been used to test the validity of this approach (e.g., Chaiprasurt and Esichaikul, 2013; Chang et al., 2020; Ma and Lee, 2021).

As a problem-solving approach, the ARCS model was designed as a motivational tool. Learning settings that influence student motivation are at the heart of this paradigm, with students' motivation to learn being a key component. Motivating students in the classroom may be accomplished through four primary approach components, each of which has sub-categories (Keller, 2010):

1. Attention: The ability to pay attention is a pre-requisite for being motivated to study. The following are some of the methods teachers use to keep their students' attention and interest: perception arousal, inquiry arousal, and variation.

2. Relevance: A person's attraction to desired results and other people's ideas is characterised as relevance by their own objectives, reasons, and values. This may be emphasised by linking the lesson or the topic to their own interests. Relevance-based strategies include goal orientation, motive matching, and familiarity.

3. Confidence: Confidence may be defined as a person's belief that they are capable of accomplishing their goals or coping with adversity. Students put in more effort and are more driven to succeed when they feel they can influence their own behaviour. Confidence-based strategies include learning requirements, success opportunities, and personal control.

4. Satisfaction: A sense of contentment with one's progress as a student is referred to as satisfaction. Students' motivation is boosted when they feel satisfied with the results of their work, and this is how satisfaction is defined, consisting of intrinsic reinforcement, extrinsic rewards, and equity.

### **3. Chatbot Communication Framework**

In this study, the design and development of a chatbot is proposed as an extension of Google Classroom to Facebook Messenger. The proposed chatbot's communication framework is used to encourage students to participate. The personal motivation of the students in a blended learning context is based on the ARCS characteristics outlined above. The framework includes all of these factors, which are explored in detail below (see Table 1).

#### *3.1 Attention*

Attracting and retaining a student's attention creates a vibrant learning environment and arouses their interest. Frequently, attracting students' attention is recommended as the first step in any educational endeavour. Throughout the lesson, attention should be engaged. This is predicated on the attention element of motivational analysis and on the chatbot's features for fostering and enhancing human interactions. The chatbot is incorporated into Facebook Messenger to include course alerts and announcements, as well as material pertaining to the subject being taught, news, and forums.

- Asking questions

The chatbot is utilised to pose questions, assisting professors and students in gathering information, evaluating current ideas, and developing new ones. Frequently-asked questions (FAQs) based on lessons learned are designed to arouse students' curiosity and create possibilities for problem-solving that organically stretch a student's thinking.

- Staying up-to-date with course announcements and notifications

Chatbot course notifications and announcements may pique the attention of students and encourage them to participate in educational activities. Since students get chatbot course reminders or alerts such as assignment submission deadlines, this seems to be a good tool to keep students focused on their studies.

- Information related to the topic being taught, discussion forums, and news

With the use of this information, teachers can keep students engaged and motivated, which in turn leads to frequent, challenging, and unexpected communications. To keep the student engaged, it is necessary to accommodate a range of the student’s specific demands and learning preferences, and to encourage attention variables that contribute to enhancing their motivation in the blended learning context.

Table 1. Chatbot Communication Framework

Motivational factors	Instructional design	Chatbot Communication Framework
<b>Attention:</b> arousing and sustaining student curiosity and interest in the instruction or learning activities	<ul style="list-style-type: none"> <li>• The use of images</li> <li>• Question and answer boards</li> <li>• Different appearance of the same characters</li> <li>• Multimedia message</li> </ul>	<ul style="list-style-type: none"> <li>• Asking questions and receiving course notifications and announcements</li> <li>• Information related to the topic being taught, forums, news</li> </ul>
<b>Relevance:</b> relating the instruction to student needs, interests, and motives	<ul style="list-style-type: none"> <li>• Web search</li> <li>• Peer-to-Peer discussion</li> </ul>	<ul style="list-style-type: none"> <li>• URL-related instruction and course information</li> </ul>
<b>Confidence:</b> student expectations of a successful learning experience	<ul style="list-style-type: none"> <li>• Presenting the numbers of books learners have read</li> <li>• Selection of the starting point with optional button</li> <li>• Encouragement by recommendation</li> </ul>	<ul style="list-style-type: none"> <li>• Assignment feedback</li> <li>• Gradebook</li> <li>• Attendance reporting</li> <li>• Reinforcing feedback</li> </ul>
<b>Satisfaction:</b> student sense of achievement regarding learning activities or experiences	<ul style="list-style-type: none"> <li>• Making a graded list</li> <li>• Rewarding offline</li> <li>• Simulated gaming</li> <li>• Posing of testimonials about positive learning outcomes</li> </ul>	<ul style="list-style-type: none"> <li>• Grading results</li> </ul>

### 3.2 Relevance

To guarantee that students are getting the most out of their education, the concept of relevance is used. Despite receiving a lot of knowledge, students often have a limited ability to digest it. Consequently, it is critical that the course materials make clear what students may anticipate from the course and what they must do to succeed in it.

- URL-related instruction and course information

It is possible for teachers to select students who have received low grades or have failed to turn in assignments. In this case, the chatbot may be connected to a URL in which students can get extensive feedback or thorough explanations of how the lesson helps solve an issue or improve performance. Students' needs and requirements are taken into account in this tool. In terms of improving student motivation, this looks to be an effective method of instruction.

### 3.3 Confidence

In general, confidence is linked to a sense of optimism with regard to one's own abilities, as well as a dread of failure. It is critical to instill in students a sense of self-determination and control over their own destiny if they are to overcome their anxiety over failing. In order to boost students' self-confidence, a chatbot incorporates information such as assignment feedback, grades, attendance reports, and reinforcement feedback. Each tool's specifications are as follows:

- Assignment feedback

With assignment feedback, teachers may quickly and easily offer students comments on a specific piece of work in the Google Classroom. The feedback is available to students at all times, so they may keep referring back to it and benefiting from it. Getting comments on assignments is an excellent approach to boosting a student's self-esteem. A person's self-esteem might soar if they use the criticism they get to hone or maintain a particular competency.

- Gradebook

The gradebook is a record of each student's academic progress. When it comes to retrieving their grades, students seem more comfortable using a chatbot rather than a web-enabled mobile device. Measuring, grading, and informing students of their progress are all important steps in encouraging them to make the effort necessary to succeed.

- Attendance reporting

Engaging in a traditional classroom on a regular basis is one of the most critical aspects of a student's academic performance. Even more important than a student's grades may be his or her ability to show up to class regularly. Students who frequently attend a conventional class are more inclined to follow the course's daily activities. Teaching students that they are totally accountable for their own success is critical. One way to do this is to stress the necessity of showing up to class on time. This might give students a sense of agency over the course of their education.

- Reinforcing feedback

This motivational tool varies from common feedback information in that it provides positive reinforcement in the form of words of affirmation, support, praise, or acknowledgment. Maintaining

desired performance is made easier by providing timely and sufficient encouragement, as well as encouraging feedback.

### 3.4 Satisfaction

Students' intrinsic or extrinsic motivation is boosted when they are satisfied with their educational experience. Keller (2010) maintained that satisfaction and confidence go hand in hand. Providing students with clear goals and tough issues to tackle can help them feel more confident in their abilities. Chatbot communication may be used as a grading tool by using these principles.

- Grading results

Students are given grades based on their strengths and weaknesses so that they might be motivated to work hard and achieve their full potential. When the semester ends, students excitedly anticipate their marks. For students who want to develop and are in need of more guidance, the rapid delivery of grades is critical. In order to get the most out of chatbots, it is important to use them in a timely manner. Using this technology, it seems that students are encouraged and supported in their pleasure with regard to the learning process.

## 4. Methods

This paper aimed to develop a chatbot based on a motivation communication framework to improve learning achievement through Facebook Messenger in blended learning. The objective measurement of motivation in this study utilized engagement and academic success as its indicators. Table 2 provides a summary of the assessment methodologies, the motivating variables, and the items or instruments used to evaluate the motivation and performance associated with using chatbot among learners. The time series design method, which is a kind of quasi-experimental design, was used to determine the usability of chatbots in the real world (see

Table 3).

This study design can be divided into three distinct phases: the pre-treatment phase (first to fourth weeks when no treatment is applied), the treatment phase (fifth to sixteenth weeks), and the post-treatment phase (seventeenth to eighteenth weeks). On the basis of their participation in regular online courses utilizing Google Classroom, objective assessment data (engagement) was obtained. This pre-treatment data was obtained and compared to information gathered during the fifth and eighth weeks of treatment. During the treatment period, students had access to a Facebook Messenger and Google Classroom-integrated chatbot. To evaluate the academic development and performance of the learners, scores on assignments and the midterm exam were added to the treatment period. After the treatment ended, students utilized Google Classroom without assistance from the chatbots. During this post-treatment phase, no online course exercises were assigned by the instructor. The objective markers of their academic accomplishment were their final exam results. Before the final exam, they were also required to submit an online survey regarding chatbot usability.

The study's population consisted of university students enrolled in an Information Technology (IT) for Learning course. A total of 48 students were sampled over the course of the second semester of the 2020 academic year.

Table 2. Instruments for assessing motivation and efficiency associated with using the chatbot

Method of assessment		Variables
Objective assessment	Motivational	• Engagement (The number of submitted

Method of assessment		Variables
(learner's action)	variables	assignments)
		<ul style="list-style-type: none"> <li>• Academic performance (Average scores on assignments and tests)</li> </ul>
Subjective assessment (self-assessment)	Chatbot usability	Perceived values of 6 measurements: <ol style="list-style-type: none"> <li>1. Effectiveness</li> <li>2. Efficiency and stability</li> <li>3. Conversation coverage</li> <li>4. Completeness</li> <li>5. Learnability</li> <li>6. Satisfaction</li> </ol>

Table 3. Evaluation results for efficiency and satisfaction with the chatbot

Experiment	Pre-treatment	Treatment		Post-Treatment
	Weeks 1 - 4	Weeks 5 - 8	Weeks 9 - 16	Weeks 17 - 18
Instruction	Online course and classroom	Online course supported by the chatbot and classroom		Online course
Experimental procedure	Comparison engagement (The number of submitted assignments)		-	-
Objective assessment	Academic performance (Average scores on assignments and tests)			
Subjective assessment	-	-	-	Chatbot usability questionnaire

#### 4.1 Participants and Setting

A study to examine the chatbot communication framework was conducted among the Faculty of Information Technology at a particular university in Thailand. In this study, online learning, traditional course, and IT for Learning, were the targeted instructional programs. Approximately 65% of the course materials and activities are offered online. Google Classroom was used to include chatbots in classes. Participants were randomly selected and requested to participate in the research via a simple random sampling approach. There were 48 undergraduate students in the original participation pool. A first training session about how to utilise Facebook Messenger and Google Classroom chatbots was held. The conventional and online course was divided into weekly modules, with the teacher posting information to support the articles and readings from textbooks. For a total of 16 weeks of teaching, the curriculum was divided into five sections, including (1) introduction to IT, (2) database and data storage, (3) data communications, internet, social networking, (4) crimes and threats in the use of IT, and (5) intellectual property. Asynchronous online discussion boards served as the primary medium for student-to-teacher and student-to-student communication. The focus of the lesson plans was on building on students' prior knowledge, encouraging collaboration, including real-world examples, and incorporating manipulative, reflective, and conflict-based teaching strategies. Student participation in online class activities was required by the course's lesson plans, according to the syllabus. For



instance, they would read the offered online content, publish a brief essay, argue in discussion forums, develop glossaries and blogs, and participate in social activities.

#### *4.2 Research Instruments*

The course was conducted as a blended learning program that includes both traditional classroom and online learning components. Throughout the academic semester, students participated in e-learning using the Google Classroom system. By integrating a chatbot with the Facebook Messenger application, students' questions may be answered by the chatbot using the framework provided, including receiving course notifications and announcements by subscribing to the course; receiving news and information pertaining to the subject matter under discussion; receiving instructions and course details that are linked to the URLs; viewing gradebook, attendance reporting, and reinforcing feedback; and viewing grading results. Both in-person meetings and online discussions were used. Certain elements of classroom education were substituted in some cases by online learning. The majority of the course (about 65 percent) was delivered online. For enrichment, assignment tasks, and remedial instruction, the students were required to enrol in an e-learning programme.

Quantitative data were collected from academic achievement scores for attendance, midterm and final exam scores, as well as assignment submitted in class and on Google Classroom. An online survey, in the form of a questionnaire, was used to assess the chatbot's usability to interact with students via Facebook Messenger. Using the Likert scale, which provides five options, (1) least, (2) low, (3) moderate, (4) very and (5) most, six components related to usability features were assessed by modifying the questionnaire of Santiratanaphakdi (2018) and Holmes et al. (2019) The specific areas examined were as follows: 1) effectiveness (evaluating the correctness of the results), 2) efficiency and stability (speed of question-answer interaction), 3) conversation coverage (completeness and coverage of the conversation, as well as a variety of responses), 4) completeness (completeness of the response), 5) ease of use (difficulty in use that interferes with learning to use the system), and 6) user satisfaction (to evaluate the conversational nature and appropriateness of language use). Moreover, qualitative data were collected from observations and interviews on knowledge, concepts, and attitudes that affect user satisfaction.

##### *4.2.1 Chatbot Usability Questionnaire Validation*

The judgment-quantification stage begins with the instrument's content validation. The IOC is a quantitative method that gives evidence of the instrument's content validity by measuring the content representativeness of each item's unique aims. Specifically, the panel of experts assigns each item a score of "1" if it clearly meets the objective, "-1" if it obviously does not do so, and "0" if the expert is unsure if the item meets the objective. Items with an IOC < 0.75 were reviewed and modified. Revisions, additions, or deletions of items were considered in light of panel recommendations. A panel of simulation specialists (n = 5) provided evidence to support the content validity, resulting in a content validity index of 0.88.

##### *4.2.2 Reliability Analyses of Chatbot Usability Questionnaire*

The instrument's reliability can be evaluated via test/retest or the internal consistency of the results across items within each construct. Cronbach's alpha statistical analysis, as determined by multi-item measures, is used to determine the internal consistency of the scale's reliability, ranging from "0" (no reliability) to "1" (perfect reliability). A high Cronbach's alpha shows that the construct is internally consistent and that its components measure the same underlying objective. The alpha value of the instrument as a whole is determined over all of its components, but the value of each construct is



calculated over only those components. As shown in Table 4, Cronbach's alpha was used to analyse the reliability of all of the constructs generated in this study: effectiveness (evaluating accuracy of responses), efficiency and stability (speed of response time), comprehensiveness (completeness and comprehensive scope of conversation including variation of responses), completeness (completeness of the responses), ease of use (usability that affects the way of learning to use the chatbot), and satisfaction. The reliability of the 21-item instrument was 0.94, and the reliability of each construct was between 0.70 and 0.91.

Table 4. Results from reliability analysis

Constructs	Number of items	Cronbach's alpha
Effectiveness	2	0.80
Efficiency and stability	4	0.80
Comprehensiveness	2	0.70
Completeness	2	0.75
Ease of use	6	0.91
Satisfaction	5	0.85
Overall	21	0.93

#### 4.2.3 Reliability Analyses of Test

In this study, the Hambleton and Novick approach was utilized to determine the dependability of the criterion-based test. This method examines the consistency of the decision-making process by testing the same set of students twice. The values collected from both tests are then utilized to establish the test's reliability (Hambleton & Novick, 1973). The midterm and final exam had a reliability of 0.88 and 0.94, respectively.

#### 4.3 Methodology

The research process consists of two important phases: 1) development of a chatbot program in conjunction with Facebook Messenger and 2) trial operation of the chatbot program. The details are as follows.

##### 4.3.1 Phase 1: Development of a chatbot

A chatbot program was developed that works in tandem with the Facebook Messenger application. It consists of the following steps:

1. Define the features of the students (personas) and the bot that will communicate with them (Botsona).
2. Develop a rule-based approach that will interact with users via conditions or defined rules. This focused on intent and context by using Natural Language Processing technology to help the chatbot understand what the students are asking. This study used the Chatfuel program to establish a knowledge foundation by identifying the questions and determining appropriate responses, according to the chatbot communication framework. The following details are included:

2.1 Determine the scope of work, such as always interacting with students, and the support available in the Thai language.

2.2 Define the following format for interaction, based on user experience:

- Using informal language, create human-like dialogues.
- Engage users with a variety of methods, including text, images, and animations.
- If students send images, the previous set of replies will be displayed. This is because the bot is incapable of processing imagery.
- In line with the framework supplied, the researchers constructed a collection of questions and their associated replies, such as course announcements, information linked to the subject being taught, course information, and URL-related instruction. The framework provided was aimed at ensuring that the discussions were as natural as possible. The chatbot would automatically react to the user if the user's communications matched the set of queries.

3. Create a database in Google Sheets for each student in accordance with the provided framework, which includes course notifications and announcements, URL-related instruction, assignment submissions and their feedback, a gradebook, attendance reporting, and grading results, as illustrated in Figure 1 which are linked to the grades assigned to students' assignments in Google Classroom.

4. Develop an intermediary for receiving various commands to process and automatically return data (Application Programming Interface: API). It allows Chatfuel, Intagromat and the Google Sheets programs to communicate with one another by linking to the course database.

When students use the Facebook Messenger Chatbot to check their grades, the Chatfuel program receives data from Facebook Messenger and sends the student code to the Intagromat application (as shown in Figure 2). Intagromat analyses Google Sheets for information on the student code and delivers the results to Facebook Messenger in a JSON format. The relationship between the Chatfuel and Intagromat programs is depicted in Figure 3.

#### 4.3.2 Phase 2: Trial run

Conduct a trial run of the developed program and evaluate its capability to interact with students. This involved the following steps:

1. Instructor teaches in the classroom four hours per week throughout the semester (weeks 1- 16) together with being involved in the e-Learning Google Classroom system. Instructors bring content, course activities, as well as worksheets into the Google Classroom system. However, during post-treatment (weeks 17–18), students only study online.

2. The instructor requires that students attend the Google Classroom system for at least five hours per week and submit their work through the system.

3. Instructor scores worksheets in Google Sheets.

4. The activities during the treatment period (weeks 5 – 16) are as follows:

- The instructor sends messages on Facebook Messenger to notify individual students when new content or worksheets that students have to submit are available in the Google Classroom system, and notifies students of the deadline for submitting assignments.
- Instructor sends messages on Facebook Messenger to notify individual students when they have graded each worksheet via the Google Classroom system.

- Students can check test scores, assignment scores, job descriptions, assignment submissions status, and more through inquiries via Facebook Messenger.
- In weeks 7 and 16 students took midterm and final exams, respectively.

5. From weeks 5 to the end of the semester, the lecturer assesses the students' academic achievement in terms of attendance, classroom activities, and participation in Google Classroom; submitted assignments; and midterm and final exam scores.

6. During post treatment (weeks 17-18), students take an online questionnaire at the end of the semester to evaluate the chatbot's ability to interact with them. In addition, individuals can also attend conventional online classes without a chatbot.

#### 4.4 Data Collection

The instructor taught a class, Information Technology of Learning, throughout an academic semester using both a traditional classroom setting and the e-Learning Google Classroom system. Learning materials were provided as part of the system. Additionally, the instructor required that students share their perspectives on a variety of topics with their peers via discussion forums during each week of learning. A question and answer forum was additionally used where students could ask questions about their studies or participate in various activities. Students must participate in weekly learning online activities. For each week of e-learning, the instructor prepares the following information for the students:

A weekly learning plan that includes behavioural objectives, content/teaching materials, learning activities, and assessments for each activity was used to keep students informed about the activities that will take place in the e-learning system during that week.

- Weekly content such as e-books, multimedia materials, online lessons, and links related to the learning content.
- Weekly learning activities such as discussions, exchange of ideas with classmates and instructors through the discussion forums, and submission of work as detailed in the learning plan.
- Points are awarded for participation in activities and assignments, as well as for giving feedback from activities assigned to the e-learning system.
- A Q&A board is available for students to ask about the details of the subject matter or methods of doing various learning activities that they find problematic.

Data analysis consists of two main methods (see Table 2):

##### 1. Objective assessment

This study's objective measurement of motivation utilized academic performance and involvement as indications of motivation. Students started at the pre-treatment phase (the first four weeks, in which no treatment had yet been applied). On the basis of their on-going behaviours, objective assessment data on engagement was obtained through participation in regular online courses. This pre-treatment data was obtained and compared to data collected from the fifth to eighth week of treatment. A non-parametric technique, the Wilcoxon signed rank test, was utilized to compare data between the baseline and the intervention periods. Academic performance was determined by calculating the sum, mean, and percentage of points for participation in activities, assignment submission, and academic success.

## 2. Subjective assessment

The chatbot usability questionnaire was used to analyse subjectively the preferences and opinions of the students. 45 students rated the usefulness of the chatbot, followed by a summary and analysis of the data acquired from the evaluation. Moreover, synthesis of qualitative data was obtained by compiling information from interviews addressing the chatbot's capabilities, user satisfaction-related knowledge, concepts, and the students' attitudes.

	A	E	F	G	H	I	J
1	Order	Midterm (20)	Attention (10)	Assignment & Project (30)	Final (40)	Total	Grade
2	1	16.5	10	26	31	83.5	A
3	2	13	10	25.5	26.5	75	B+
4	3	10	10	26.5	23.5	70	B
5	4	12	10	25	24	71	B
6	5	11	10	26	26.5	73.5	B
7	6	13.5	10	30	24.5	78	B+
8	7	11.5	10	26	29	76.5	B+
9	8	13	10	30	29.5	82.5	A
10	9	11	10	26.5	27.5	75	B+
11	10	12.5	10	24.5	28	75	B+
12	11	12.5	10	25	22.5	70	B
13	12	14.5	10	29	29	82.5	A
14	13	9	10	23	28	70	B
15	14	11.5	10	25	29	75.5	B+
16	15	10	10	23	29.5	72.5	B
17	16	15	10	23	29.5	77.5	B+
18	17	12.5	3	14.5	25	55	D+
19	18	13	10	26	29.5	78.5	B+
20	19	8.5	10	26	26.5	71	B
21	20	10	10	25	30.5	75.5	B+
22	21	15	10	26	30.5	81.5	A
23	22	11.5	10	17.5	26	65	C+
24	23	10.5	10	26	28.5	75	B+

Figure 1. The details of the scores in various sections of each individual student

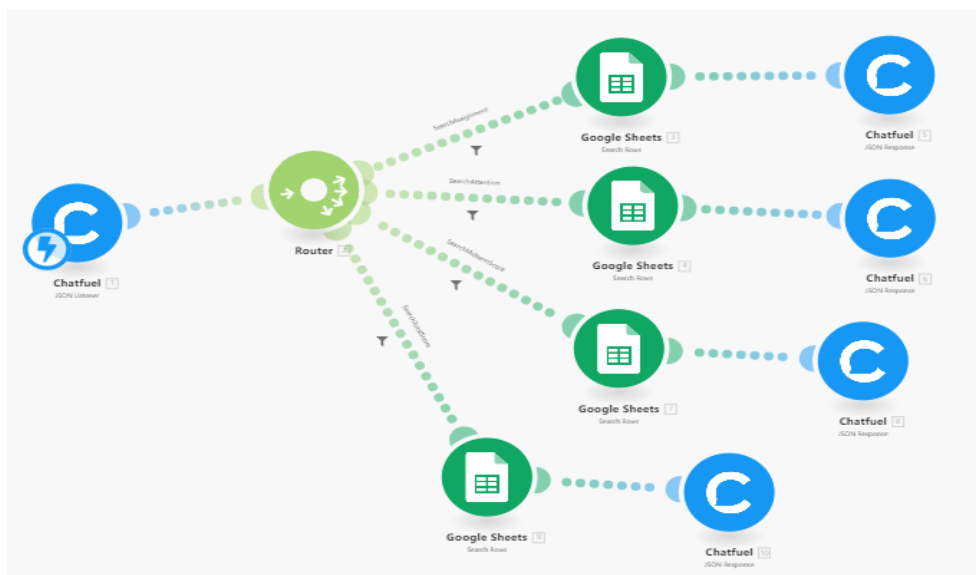


Figure 2. Working operations of the Integromat program

## 5. Research results

The study used a chatbot as part of blended learning to motivate students and enhance learning achievement. It employed a consistent data analysis process with three objectives: 1) to develop a chatbot through Facebook Messenger, 2) to assess students' motivation 3) to assess the chatbot's capability to interact with students, and 4) to assess learning achievement.

### 5.1 Results of the Chatbot Development

The primary goal of building a chatbot was to increase student motivation to engage in online learning in order to increase learning achievement. The developed chatbot was based on Google Classroom and Google Sheets. Asking questions, receiving course notifications and announcements, information about the topic being taught and current events, URL-related instruction and course information, assignment feedback, gradebook, attendance reporting, reinforcing feedback, and grading results all contributed to the Chatfuel knowledge base that the chatbot communication framework utilised. As demonstrated in Figure 3, for a student data query to check scores in various sections, Integromat was designed to connect Chatfuel and Google Sheets in terms of Service to Service.

For specific student information, the chatbot required the students to identify (id) themselves in order to retrieve the necessary personal data from Google Sheets via Facebook Messenger. Individual student information was supplied from the Google Sheets database to Chatfuel via the Integromat service on Facebook Messenger. As illustrated in Figure 4, Google Sheets sent data to Facebook Messenger.

### 5.2 Results of objective assessment

#### 5.2.1 Engagement

During the pre-treatment (weeks 1-4) and treatment (weeks 5-6) period, the numbers of student-submitted assignments were counted and compared. Table 5 demonstrates that the percentage of submitted assignments made by the experimental group students during the treatment period was greater than those in the pre-treatment period. This demonstrates that there was a change in student engagement between the pre-treatment and treatment periods. There were statistically significant differences in students' submitted assignments (engagement) between the pre-treatment (traditional blended learning) and treatment (blended learning with chatbot) period of the treatment.



Figure 3. Sending results from an Integromat search results back to Chatfuel

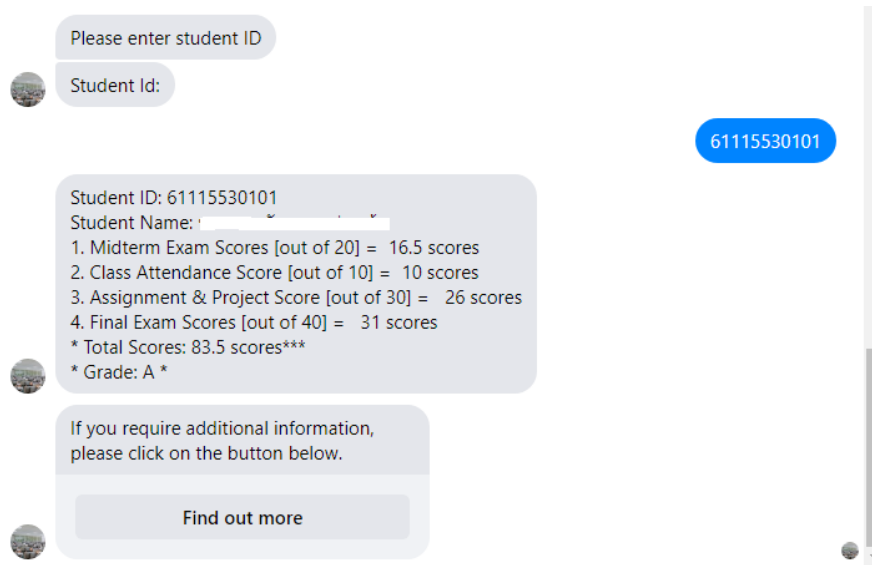


Figure 4. Facebook Messenger score query results

Table 5. Descriptive statistics and Wilcoxon signed ranks test results of the number of submitted assignments

Phase	Number of Assignments	Experimental group (n=47)			Z	p
		Summation of submitted assignments	Mean	SD		
Pre-treatment (Weeks 1–4)	4	146	3.19	1.13	3.977	.000*
Treatment (Weeks 5–8)	4	173	3.76	0.66		

\* $p < 0.05$

### 5.2.2 Learning Achievement

- The academic performance of the IT for Learning course consists of scores in the following sections: Participation in classroom and e-learning activities = 10 points
- Assignments = 30 points
- Midterm exam = 20 points
- Final exam = 40 points

Table 6 summarizes the learning accomplishment scores of 47 students only, as one student dropped out of the class. It can be seen that 46.81 percent of the students earned scores between 80 and 100. The average score was 77.81 percent. The chatbot performed well, giving good results. The results of the experiment found clear support for using a chatbot to increase motivation in order to enhance learning achievement.

Table 6. Learning Outcomes of the Information Technology for Learning Course

Range of scores	Letter grades	Number of students	Percentage
80-100	A	22	46.81
75-79.99	B+	13	27.66
70-74.99	B	8	17.02
65-69.99	C+	1	2.13
60-64.99	C	-	0
55-59.99	D+	3	6.38
50-54.99	D	-	0
Below 50	E	-	0

### 5.3 Results of subjective assessment

#### 5.3.1 Chatbot usability questionnaire

During the semester, only one student dropped out. The questionnaire was administered to the 47 remaining students of whom 45 students returned the questionnaire (9 males and 36 females) with all questions completed. These respondents ranged in age from 19 to 22 years. Over three-quarters of the respondents (78.7%) reported that their computer skill level was fair (which posed no problems in routine operations). Of the respondents, 36.2% said they accessed the Google Classroom three times or more per week, while 34.0% and 25.5.6% said they accessed it two times per week or more, and once a week, respectively.

Of the respondents, 48.89% said they had previous familiarity with chatbots, which they had used to make online purchases (63.6%), helping in transactions such as banking (31.8%), food businesses (22.7%), and tourism (13.6%). Over 50% of respondents said they had used a chatbot once a week, while 19.1% and 17.0% said they had accessed it twice per week, and three times or more per week, respectively. The IT for Learning chatbot's usability from the students' perspective indicated that 45 users, or 95.74%, reported an overall capability at a good level (4.20, S.D. = 0.32). These details are shown in

Table 7.

The results confirm that it was a good choice to develop a chatbot based on ARCS motivation factors. The primary component was identified as learnability, which was rated as excellent (4.27). This was particularly true on the ease of use aspect and the appropriateness of selecting a radio button rather than inputting a question. In terms of efficiency and stability, which were both rated as excellent, the system performed admirably (4.25). When considering the distribution of data, it was found that ease of use (S.D. = 0.34) had a higher distribution of data than other areas, which was comparable to other aspects that were at a low level.

Additionally, five students were randomly interviewed. They were all satisfied with the chatbot since it made communication simple and quick. There was an immediate response to inquiries at any time, particularly for work that had not yet been sent and scores in various categories. Furthermore, they suggested that the chatbot should be capable of responding to requests about the course's content, particularly the lesson summary, and of submitting questions and receiving a variety of responses.



Table 7. Evaluation results in terms of efficiency and satisfaction with the chatbot

No.	Components	$\bar{x}$	S.D.
1	Effectiveness	4.16	0.33
2	Efficiency and stability	4.25	0.34
3	Conversation coverage	4.18	0.30
4	Completeness	4.13	0.27
5	Ease of use	4.27	0.37
6	Satisfaction	4.24	0.34
Overall average		4.20	0.33

## 6. Discussion

The results demonstrate that the proposed chatbot can be utilized to encourage and motivate students in a blended learning environment. The ARCS motivation model could be used as a framework for creating Facebook Messenger chatbots. The results indicate that users appreciated the chatbot created with the proposed framework, and that the employment of the chatbot improved student learning achievement. This study highlights the requirement for both objective and subjective evaluations in order for them to complement and reinforce one another. The study's conclusions are discussed, beginning with the development of the chatbot.

In addition, chatbots can reach a large number of students through messaging apps and be more effective than humans are. This finding is consistent with other studies by Pereira (2016) and Adamopoulou & Moussiades (2020). They lead to significant cost reductions for institutions. The developer community should be encouraged to create and distribute technologies that enable any educator to integrate chatbots into their courses with ease. This conclusion is consistent with previous research by Abbasi and Kazi (2014), who discovered that the quality and quantity of students' memory retention and learning results while utilizing a chatbot system, is substantially greater than when using standard search engines.

There was a statistically significant difference between the baseline (normal online courses) and the intervention (a chatbot that worked with Facebook Messenger) with regard to the engagement variable. These results demonstrated that the use of chatbots can improve student engagement and learning. This is congruent with the findings of Tangkittipon et al.'s (2020) earlier study, in which a chatbot was implemented into a flipped classroom setting to encourage students to engage more with all types of learning objects. Others have demonstrated that, unsurprisingly, students' engagement is a predictor of their motivation (Chaiprasurt, 2019).

The experimental results suggest that adding the mobile chatbot communication framework to a blended learning course enhanced the students' learning performance. These fundamental findings are congruent with research such as that of Chang et al. (2022) and Chen et al. (2020) which demonstrate that chatbot-based learning considerably increases students' learning achievements.

There are a few limitations to the present study since true experimental research designs could not be used. The fundamental restriction of the current work relate to the research design. This is primarily due to the researchers' inability to comprehensively control the trials. Firstly, blended learning utilising a chatbot and conventional blended learning modalities should be evaluated using both objective and subjective metrics to assess two different time periods of the course. This information should be supplied before and after the chatbot usage with two different groups, one experimental group and one control group. Secondly, it does not compare motivational outcomes between students who had the support of a chatbot and those who did not. Thirdly, it is essential to explore the elements that influence the success of learners with regard to chatbots. As mentioned by Yin and Satar (2020), understanding the elements that influence the performance and perceptions of learners is essential for undertaking reflections and developing more effective learning strategies.

## 7. Conclusions

Students' academic performance is significantly influenced by their level of motivation, and this is particularly true in online learning, where effective communication methods are needed to keep students engaged. Online learning may bring about feelings of isolation and lead to a lack of cohesion among students, which can result in a lack of interest in the course material. A chatbot communication

framework is examined in this study, which makes use of the flexibility of chatbots with regard to enhancing blended learning situations and inspiring students. For the chatbot's development and deployment, the ARCS motivation model was employed. The psychological theories of motivation that underlie the ARCS elements were used to guide the creation of the instruments. Questions, course notifications and announcements, information about the subject being taught, news, URL-related teaching and course information, feedback on assignments, and gradebook attendance reporting are just a few of the features that were added to Facebook Messenger by the chatbot. The results revealed that a chatbot can be used to enhance learning achievement. Using the ARCS factors that optimize online student motivation, these findings provide researchers and practitioners with a better understanding of the design of motivation principles for a chatbot.

## 8. Recommendations

Two main areas for future work are particularly important for leveraging development insights, the enhancement of chatbot development and the evaluation of learning motivation. Future developments should make it intelligent enough to respond to a broad range of questions from students (Gonda et al., 2018). The chatbot must be capable of self-development to learn new questions and automatically respond to them (Colace et al., 2018). The quality of questions from the students, such as handling misspelling, should improve the overall learning using the chatbot system.

In addition to learning motivation, future research should focus on building a thorough longitudinal evaluation of chatbot communication frameworks. It should evaluate how student motivation changes when they use the chatbot communication framework by measuring their perceptions of their learning experiences in relation to the framework used. This paradigm will be used to determine how chatbot-based learning can be used in conjunction with traditional instruction. Regardless, future research could continue to explore chatbot usability in an online learning environment without the need for face-to-face instruction, which is crucial in the present pandemic crisis (Yin et al., 2021).

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