Adaptive Mobile Learning in the Nearby Wisdom App

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Abstract— **Adaptive mobile learning is necessary platform in supporting students to understand the lesson because the system can adapt to the different learning skills and characteristics of learners. This paper focuses on the application of adaptive learning in nearby wisdom app that are being developed; nearby wisdom is a mobile learning platform that provides a variety of learning features that support self-directed learning, collaborative learning, gamification and adaptive learning. Implementation of adaptive learning in the app divided into three types, 1) adaptive content, 2) adaptive assessment, and 3) adaptive sequence. The paper tries to illustrate and compare these types of adaptive learning, the workflow and differences in input and output generated. In the end, the paper provides some recommendations on the common factors in building adaptive mobile learning that is 1) user, 2) content, 3) skill or difficulty level and 4) performance. However, developing adaptive mobile learning that implement all types of adaptive learning requires systematic thinking skills and sophisticated algorithms, especially for adaptive sequences.**

Keywords- *adaptive learning; adaptive mobile learning; mobile learning*;

I. INTRODUCTION

According to smartphone user penetration in China, data show that regarding smartphone users in China from 2014-2020 an average increase of about 4% per year is expected and in 2018 this will reach 62.8% of the population. The age groups of 12-17 and 18-24 years are those with the most users accounting for 76.5% and 88.3% [1]. This phenomenon is an excellent opportunity for mobile learning platforms to grow their business in China. The statement of Steven Case in the book The Third Wave explains that the current world of technology is facing a wave of the third stage that will greatly affect the health sector, education, and energy [2].

Furthermore, technological innovation in mobile-based education is the right step in supporting the optimization of the learning process and the wise use of smartphones. Technological innovation in education has also been proven to help overcome the problems of students in learning, support of learning constructivism, self-directed learning, collaborative learning and helping students learn according to their learning style [3, 4, 5]. The Oxford Royale Academy reveals seven common problems faced by students in their learning, including 1) low motivation, 2) many distractions, 3) trouble concentrating, 4) distress in remembering information, 5) disliking the subjects, 6) lack of the right resources, and 7) problems with time management [6]. The mobile learning platform is one of the solutions to overcome the problems.

However, the development of mobile learning should also consider the right characteristics of learning that can be achieved. Kemp and Dayton assert that learning media must have eight essential points: the delivery of learning messages should be more standardized, more exciting learning, interactive learning, implementation time should be shortened, the quality of learning should be improved, the learning process should run anytime and anywhere, the positive attitude of learners to the learning process should increase, and the teacher's role should change to being positive [7].

Mobile learning is learning packaged with mobile devices that can make it easier for students to learn whenever and wherever [8]. Now, many mobile learning tools have been developed and are interactive [9, 10, 11, 12], but the developed applications do not fulfil the principle of personalized learning, in the sense of adjusting to the character of the students as revealed by Tortorella and Graf [13]. The right type of mobile learning to fulfil the principle is adaptive mobile learning that can adapt to the different learning styles and characteristics of learners. Adaptive learning is one type of learning technology that can respond to the learning needs of students which can automatically provide material according to their needs [14].
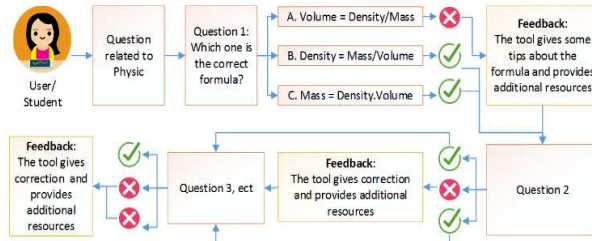
Figure 1. Interface Nearby Wisdom app
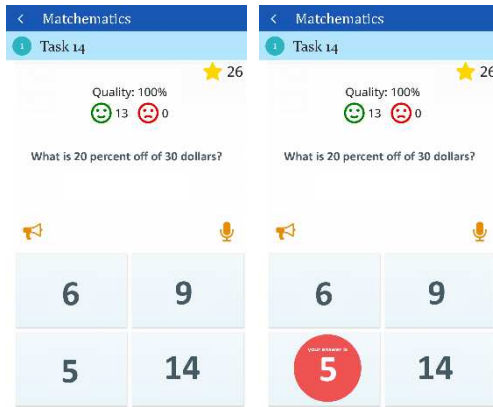

Figure 2. Adaptive content

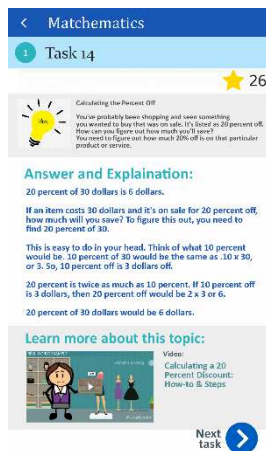Figure 3. Adaptive content interface

Figure 4. Adaptive content feedback interface

A report from Edsurge [15], an EdTech resource and community has reviewed more than 20 articles on adaptive learning and interviews of 20 educators,

product designers and professors divide adaptive learning elements into three levels: 1) adaptive content, 2) adaptive assessment and 3) adaptive sequence. In this paper, adaptive mobile learning elements that being developed utilize all types of it. The app is Nearby Wisdom that provides a variety of learning materials (video, animation and also Augmented Reality), quizzes, test, find the nearest private teacher or join a forum in a chat group containing teachers and students. This application supports various learning methods such as self-directed learning, collaborative learning, gamification and adaptive learning (fig 1) and the target market of the app is students in Mainland, China and Hong Kong. The focus on writing is adaptive learning in the Wisdom Nearby app.

II. ADAPTIVE CONTENT

Adaptive content is the ability of a learning tool to manage learning content based on the learner's learning style and their background knowledge [16]. Also, features can respond to students through feedback and hints, additional learning materials and scaffolder support [15]. Adaptive content is different from responsive design; responsive design is more about the ability of the device to adjust the content layout, while adaptive content is more than this and able to adapt based on several factors such as the device, context or user.

Figure 2 shows one of the flowcharts in the Nearby Wisdom app that depicts adaptive content in the Physics Subjects Quiz. It is based on the person's factor by the ability to answer questions, can respond and provide feedback, hints, and additional learning resources to students if students make mistakes when answering questions. Also, before the learner enters a quiz, the application asks questions about the level of education, what materials to learn and what the focus of learning is, and then the quiz will respond by setting a problem according to the learner's goal. Figure 3 and 4 show the interfaces of adaptive content on mathematics subject. If a student answers an incorrect answer, the student will get feedback and additional resources. Such as an explanation of how to solve the task and more resources about the topic with a video or link.

III. ADAPTIVE ASSESSMENT

Adaptive assessment (or adaptive testing) has been developed since the 1970s [17]. The critical thing in adaptive assessment is that tools can change the questions according to what the answer to the previous question was. If they can answer the question correctly, then the level of questions will be raised, and vice versa [15]. It is different from the traditional assessment that always generalizes the subject matter, whereas each student has different capabilities and requires different treatment. Figure 5 illustrates the adaptive assessment process in the application, where the difficulty level of

the question will change according to the student's previous answer, making it more difficult or easier.

Figure 5 also illustrates how tools can adjust student responses based on previous answers. When students can answer the first and second questions correctly, then the question level will continue to be upgraded to the next level. The third question will undoubtedly be more difficult, and when the student answers wrongly, the problem level will be lowered to the lower level. The fifth question is a question that is used to measure students to the next stage, and finally, the last five items are questions that have been standardized based on the five answers at the beginning, resulting in greater stability. Figure 6 show the interface of the level of difficulty, student can see the level of their task on this interface.

IV. ADAPTIVE SEQUENCE

Adaptive sequences are the highest and most complex form of adaptive learning, where tools can real-time collect and analyze student data and automatically change what students will see next. Adaptive sequences use algorithms and prediction analysis and can continuously collect data and use them for subsequent views. The three-step process in adaptive sequences is collecting data, analyzing data and adjusting the content [15]. In collecting data, the application will collect data in the form of topics (general), specific topics, skills and cognitive difficulty level. Once the data are collected, then the system will analyze what skills have been mastered by students and which topics have not been. Also, the system will analyze the student's performance as a whole and help find the right and best content to help students improve their performance based on the standards that the system has set. The last step is to provide the right content based on the results of the analysis; the content can be an additional assignment to be completed or optional resources.

Figure 7 illustrates how students can receive different treatments according to the data that have been collected and analyzed. Student 1 seems to have mastered all the material and is ready to learn the next material, but the student two still has problems with the material, so she must learn again the material on chemicals and completed the material until the progress more than more than 80 percents. The system will give the right material and adjustment according to the result of the mistaken analysis for the student to be able to answer the quiz correctly and can then go on to the next process. Figure 8 shows the learning progress interface of the student according to their performance. With this data, the student will know how far they have studied and figure 9 illustrates student needed and additional learning based on their previous performance.
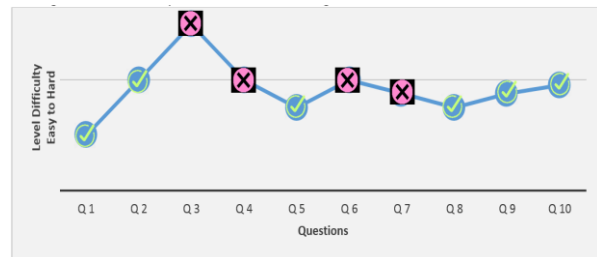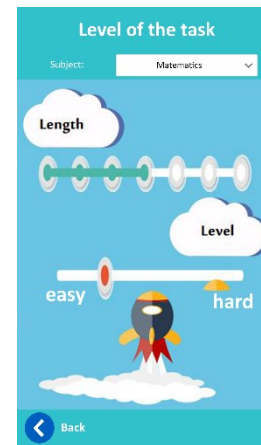

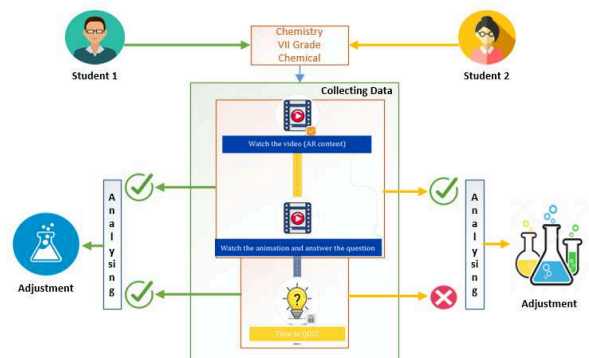Figure 5. Adaptive Assessment

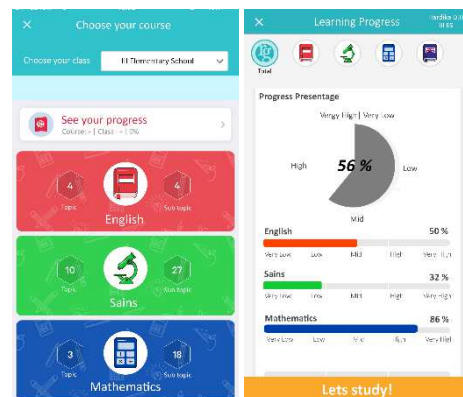Figure 6. Level of task interface

Figure 7. Adaptive Sequence

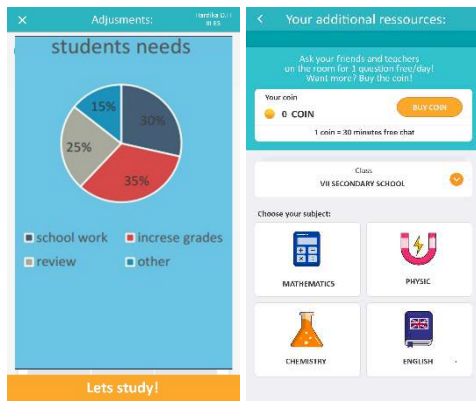Figure 8. Learning progress data interface

Figure 9. Adjustment and additional resources interface

TABLE 1. SUMMARY OF ADAPTIVE MOBILE LEARNING

	Adaptive Content	Adaptive Assessment	Adaptive Sequence
Description	Respond to students such as feedback, hints and additional material based on the student's mistakes.	Adjusting the student's ability to answer questions, the level of difficulty of the problem will continue to grow if the student answers correctly, and decreases to an easier level if wrong.	Analyze student data in real time than analyze and make an adjustment for a student based on the result of analysis and data.
Input	Correct and incorrect questions	Correct and incorrect questions	General data, real-time data, material, correct and incorrect questions, the overall answer
Output	Feedback, hints, supporting material	More difficult question or easier question	New material or take back material, additional resources

V. SUMMARY

Table 1 shows an overview of the concept of adaptive learning adopted by the Nearby Wisdom app in developing applications that are divided based on three element levels according to the element division suggested by EdSurge [15]. The table compares the three elements based on the description, input and output. Basically, inputs on adaptive content and assessment are same, correct and incorrect answers. But the adaptive sequence looks more complicated because it must collect various data which will then be analyzed first. For output, each element has a difference, where adaptive content has output in the form of feedback, hints and supporting materials, the adaptive assessment will produce output by reducing the level of the questions or raising it. While in adaptive sequence, data in the form of new content or take back material or

provide additional resources in accordance with the results of the analysis.

Regardless, in developing adaptive mobile learning, systematic thinking skills and sophisticated algorithms become an essential part, especially in adaptive sequences. The development requires competent technical teams, their understanding of the concept of adaptive learning and logic algorithms to be one of the key applications can be appropriately developed.

An understanding of the concept can be done by the project owner. Project Owner must know the whole process and how the program works and explain the concept to the entire team including the technical team. In addition, the project owner can also invite some experts in related fields to strengthen the product and understanding team. In addition, the selection of technical teams that have systematic thinking skills also need to be considered; track records can be a reference in choosing the best team.

VI. CONCLUSION

Nowadays, many mobile learning tools have been developed but they do not yet fulfil the principle of adaptive learning. The development of adaptive mobile learning applications is necessary, in addition to the penetration of smartphone users the number of whom continue to increase; thus, the existence of adaptive mobile learning is also a perfect solution to solve students' problems that have different characteristics. Adaptive mobile learning can provide the right content based on student performance and their characteristics so that students can learn the right material. Here are some common factors that need to be considered and are recommendations for developing adaptive mobile learning: 1) User, 2) Content, 3) Skill or difficulty level and 4) performance. Users are the essential component, so by knowing the characteristics and purposes of the user, we can provide the right material support to reach the goal. Second is the content, so providing the right content or resources is certainly an important factor to improve students' skills. The third is the level of skill or level of distress, and by knowing the level of the ability of students to answer questions, tools can provide the best type of questions or questions and also material based on the level of ability. The last is performance. By measuring student performance as a whole, the tool can analyze progress, offer appropriate material, provide a remedy or give a recommendation for the student to proceed to the next level or material.

However, the development of adaptive mobile learning requires systematic thinking skills and sophisticated algorithms, especially for adaptive sequences. Developing adaptive mobile learning that adopts three elements is also not easy, so we need to consider the resources we have, technical teams, conceptus and team's ability to develop products. It could be that the concept we have is outstanding and

proper, but if it is not supported by an adequate technical team, it will be a problem in itself.

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