PROCEEDING
Indonesian Conference Series of Applied Linguistics
Volume 1 Issue 2 December 2023
E-ISSN: xxxx-xxxx

HETEROGENEITY IN STUDENTS' ENGLISH COMPETENCE AND NEEDS: ADAPTIVE LEARNING METHOD PROPOSED

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Abstract

Currently, the use of the latest technology, or known as Technology Enhanced Learning (TEL), in learning English has been proven effective. Autonomous learning or independent learning is also considered to greatly affect the success of learning English. One of the learning methods that combines the application of TEL and autonomous learning is adaptive learning which is defined as a computer-based learning method that provides students with a personal learning experience. In adaptive learning, the concept of a domain-specific knowledge graph can be applied to help regulate the automation of learning personalization. This research was conducted with the main objective of designing and developing technology enhanced English learning materials implementing adaptive learning method. This study was a Design and Development Research consisting of five stages, namely analysis, design, development, implementation dan evaluation. Respondents of the study were English teachers and students of a senior high school in Malang. Instruments of data collection included questionnaires, interviews, and focused group discussions. Findings from the analysis stage reveal students' need of additional time to learn English out of in-class activities. Students' level of English proficiency was heterogeneous, making the need to learn English varied in terms of difficulty level. Thus, the supplementary learning of English out of class could be done autonomously to effectively meet individuals' needs. Students' preference to use computer-based learning materials was also evident. In short, a web-based learning materials implementing adaptive learning was offered as a suggestion, and thus, designed and developed.

Keywords: Adaptive Learning; Autonomy; Heterogeneity; Technology Enhanced Learning

INTRODUCTION

Learning English as a foreign language in Indonesia so far still faces many obstacles, and it cannot be considered successful (for example, Marcellino, 2008). Some of the obstacles that have always been faced in the scope of vocational education in Indonesia are the lack of high motivation and interest in student learning which is also closely related to teaching methods and learning strategies (Budiasningrum, 2015). One of the main factors in increasing students' learning motivation is the selection of appropriate learning media, which are of interest to students and which are in accordance with students' learning styles and learning strategies. Currently, learning media utilizing the latest technology are considered the most attractive to students. In other words, Technology Enhanced Learning (TEL) can motivate students to study harder. There have been many studies (Ahmad, 2012; Putri, 2019) that prove the effectiveness of using learning media that are integrated with the latest technology (TEL) which can increase motivation to learn English and improve English language skills.

The use of the latest technology in learning English has been widely known and applied. Research has been conducted to review or develop mobile phones as an English language learning medium (Adlof et al., 2019; Ally & Samaka, 2013; Hao et al., 2019). In fact, Rohani et al. (2019) have developed an interactive mobile application for independent English learning in the context of Polynema students. This all underlines the importance of using the latest technology as a medium of learning that is in great demand by students and is effective in helping to increase learning motivation and English language skills.

Learning that leads students to be independent or what is known as autonomous learning or independent learning is also considered to greatly affect the success of learning English (for example, Illés, 2012; Xie, 2019). Effective learning will occur when each student's individual interests and abilities are of primary concern and when skills are practiced in real-world situations. By implementing autonomous learning, students can begin to

have the freedom to determine their learning strategies, tailored to their needs, learning styles, and learning goals (Bernat & Mueller, 2014). In fact, in this pandemic era, independent learning is a student's preference in learning English (Ariebowo, 2021).

One learning method that combines Technology Enhanced Learning and autonomous learning is adaptive learning. The adaptive learning method is defined as a computer-based learning method that provides students with individualized learning experiences. In this method, learning materials are delivered online, where student interaction with previous content determines the material to be delivered next; the process is automatic, dynamic, and interactive by utilizing a computer system; the goal is to produce a personalized learning experience (Kerr, 2016).

Several studies have proven the effectiveness of adaptive learning methods in learning English (for example, Bourekkache & Kazar, 2020; Mei et al., 2017; Wang et al., 2019). So far, there have not been many studies that have produced an application for learning English using the adaptive learning method with the context of students in Indonesia, and there has not been any research conducted with the context of students in the city of Malang while the 'customized' element of students in adaptive learning is one of the main characteristics. Therefore, this study was designed with the main objective of designing and developing a domain-specific knowledge graph for TEL innovation in adaptive learning English.

REVIEW OF LITERATURE

Employing Updated Technology as Learning Media

One of the main elements in the learning process is learning media. As there are various learning media which can be offered to support the success of the learning process, it is essential to choose what learning media are of high interest to students and able to increase students' motivation to learn. In addition, the determination of learning media must consider the latest technological developments because technological developments affect many things, including the field of education (Spector, 2015).

Various of technology are used as a medium for learning English, including personal computer for Computer Assisted Language Learning (Golonka et al., 2014) and mobile phones (Ally & Samaka, 2013; Hamdani, 2013; Hao et al., 2019; Kodir Al-Baekani & Ridwan, 2018; Rohani et al., 2019). All of these studies support the statement of the important role of computer and mobile phone programs as very effective English learning media.

In the current research, learning media for web-based adaptive learning method computer programs were developed as the final product. Computers and mobile devices are considered as one of the most accessible media for students in Indonesia and the most popular among students in Indonesia.

Technology Enhanced Learning

Technology Enhanced Learning (TEL) itself is a term used in the application of information and communication technology (ICT) in the educational process to improve student learning experiences (Kirkwood & Price, 2014). Various technological sophistications such as computers and mobile devices are used to increase the effectiveness and efficiency of the learning process. Computers and mobile devices can not only function as learning media, but also as media where users can connect between web pages, tools that can respond to user questions and involve users in games and simulations. Technology Enhanced Learning (TEL) harnesses the power of this interactivity and has the potential to improve the quality of what students learn, how they learn and how teachers teach (Duval & Sharples, 2017).

In the current study, computers and mobile devices were used as media for applying technology to learning English with the Adaptive Learning method which is characterized by independent learning with a scaffolding system that is tailored to the needs of each individual student. To apply adaptive learning, all learning topics must be mapped in the form of a knowledge domain. The structure of the knowledge domain must be tiered so that a scaffolding model is formed between one material and another. Furthermore, the knowledge domain is modelled on a graph that has nodes and vertices to form a graph-based domain knowledge model. From this model, several graph processing algorithms, including Dijkstra's algorithm used to find the shortest path, will be applied in learning, so that it will produce an efficient process.

Domain-Specific Knowledge development theories state that humans have many independent and specialized knowledge structures (domains) that do not consist of one cohesive knowledge structure. Thus, training in one domain may not have an impact on other independent domains. To map a knowledge domain, a model is needed, one of which is a graph. Knowledge graphs are widely used for the systematic representation of real-world data. On a large scale, knowledge graphs have millions of facts (nodes) that are built from a set of data manually or automatically. In this study, the concept of domain-specific knowledge was used to design a multi-path or multi-branching path mapping in personalizing the flow of English learning using adaptive learning methods using TEL.

Autonomous Learning

Independent learning, also known as autonomous learning, began to be echoed in 1975 by Disick. Autonomous learning is defined as a learning approach that offers students free choices for four dimensions, namely objectives, time, methods, and learning content (Disick, 1975). The level of learning independence varies, it does not have to cover all dimensions, it can also be adjusted to the student's condition. In line with Disick and Benson (2007) defines autonomy as a capacity to take charge of, or take responsibility for, or control over your own learning. Autonomy also includes the abilities and attitudes of learners that are adjusted to their level of autonomy.

In its development, independent learning has been widely studied (for example, Andriani et al., 2018; Ariebowo, 2021; Xie, 2019). In the context of Asian culture, many students choose collectivism learning styles - where students prefer to study in groups, collaborate with other friends, prefer to ask friends or teachers rather than find solutions independently (read also, Rohani, 2012) - and often considered less independent in learning. However, autonomous learning actually does not require students to learn individually. In this case, teachers are expected to respect students' self-perceptions, including respecting collectivism learning methods and gradually direct and prepare students to be more independent and develop learning autonomy (Blidi, 2017).

Adaptive learning

Adaptive learning is a concept of a learning method that actually started in the 1900s under the umbrella of 'mastery learning'. Moskal et al. (2017) define adaptive learning as a personalized learning method, which aims to provide an efficient, effective, and customized personal learning path for each student. The adaptive learning method uses a data-based approach both in the delivery of the main learning materials and in remedial materials for improvement. The system can dynamically adapt to student interactions and performance levels, by delivering learning content in an order tailored to the needs and performance levels of each individual student at any given time.

A similar definition is conveyed by Kerr (2016), that in the context of language learning and teaching, adaptive learning has different meanings for different people. In the most general terms, it can be defined as a way of delivering learning material online, where the learner's interaction with the previous content determines (at least in part) the nature of the material delivered later. The process is automated, dynamic, and interactive. The goal is to produce a personalized learning experience.

There have been many studies that have proven the effectiveness of adaptive learning methods in language learning (Bourekkache & Kazar, 2020; Mei et al., 2017; Ruan et al., 2019; Wang et al., 2019; Woodrow, 2006). Then, Mei et al. (2017) developed a learning model of adaptive learning method for English Literature courses in China while Ruan et al. (2019) developed a Quizbot to improve English vocabulary mastery of students at Stanford University. Furthermore, Wang et al. (2019) developed a Japanese language learning media based on an adaptive learning method with a focus on vocabulary mastery. Likewise, Bourekkache and Kazar (2020) who in their research on adaptive learning in English learning in Algeria, support the need to develop a learning system with adaptive learning methods.

METHOD

Research Design

This research was conducted as a mixed-methods research that combines qualitative and quantitative approaches. More specifically, this research was carried out using Design and Development Research (DDR) design, which belongs to product and tool research cluster. The goal of the study was designing and developing an English learning system using adaptive learning methods implemented in a web-based adaptive learning method computer program.

The procedure follows the model proposed by Richey and Klein (2014), comprising five stages, namely analysis, design, development, implementation, and evaluation. Figure 1 presents the flow of the research.

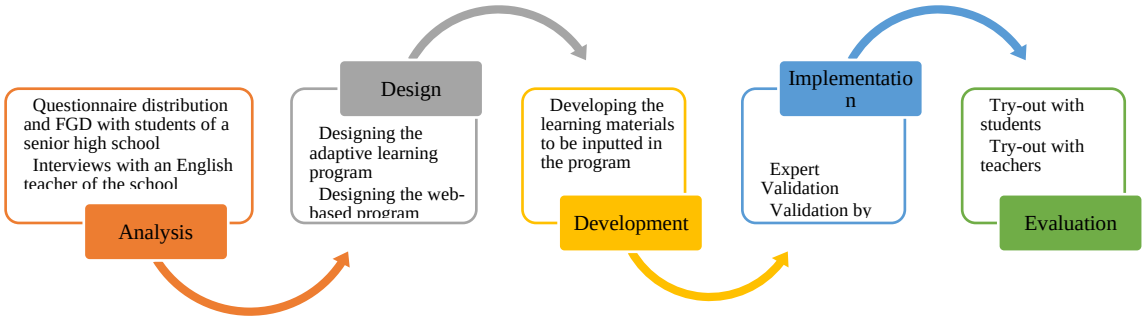

Figure 1 Procedure of Design and Development Research

At the Analysis stage, qualitative and quantitative data were collected. At this stage, a needs analysis was carried out by conducting interview with the teacher, distributing questionnaires to students, and focus group discussions with students. Data collection was focused on collecting data on the evaluation on the learning materials currently used, evaluation on students' level of competence, preference of the way of learning English, willingness to improve English skills, and preference of English learning media.

At the Design stage, an English learning system was designed as a web-based program implementing the adaptive learning method. Included in this stage are:

1. Determine which English language skills to be included in the program,
2. Determine which language components to be included in the program,
3. Determine which grammar topics to be covered in the program,
4. Determine the number of vocabulary levels to be covered,
5. Determine the number of paths or paths for each language skill and component
6. Determine the design and layout of the web-based program

In the Development phase, adaptive learning method computer program was developed and learning materials along with practices and quizzes were developed. The development of a adaptive learning method computer program was carried out by applying a domain-specific knowledge graph to the English learning system employing the adaptive learning method. At this stage, a web-based adaptive learning method computer program was developed as a basis. Learning materials along with practices and quizzes were also developed.

Next, expert validation would be carried out. The developed web-based adaptive learning method computer program to the expert by giving a questionnaire and conducting interviews. There will be two expert validations, namely IT experts and language experts or the content of the application. The IT expert will validate the adaptive learning method computer program while the language and content expert will validate the content of the adaptive learning method computer program.

Respondents

Respondents of the study were 62 year 11 students of a public senior high school in Malang, East Java, Indonesia. These students were of two science classes. Respondents of the study were purposively selected by the voluntary teacher respondent who was the English teacher of the two classes. Respondents were assumed to be of equal competences, and no classification of students based on their competence. All classes were assumed to be of equal competences.

At the Development and Implementation stages, respondents were IT experts to validate the web-based adaptive learning method computer program developed and English teachers to validate the content of the adaptive learning method computer program.

The Evaluation stage would be done with the respondents of students and English teacher. Respondents would need to evaluate the developed program.

In this paper, findings and discussion are limitedly presented for Analysis, Design, and Development stages, yet not up to expert validation.

Instruments

To collect data, several data collection instruments were used. At the Analysis stage, quantitative data were collected through the distribution of questionnaire to 62 student respondents. Other methods used to collect

qualitative data were an interview with the teacher respondent and a focused group discussion with the student respondents.

Data collection instruments used at the development stage was a questionnaire and an interview guide. The main purpose of data collection at this stage was to validate the applicability of the adaptive learning method computer program. At the Evaluation stage, data collection instruments used were questionnaire and focus group discussion guide. Instruments were designed with the aim to identify the usefulness of the adaptive learning method computer program.

Data analysis

Data analysis was done through several phases following the research stages. Both quantitative and qualitative data were collected. Data taken from the Analysis stage were used to confirm the necessity to design and develop the adaptive learning method computer program as well as to determine the design of the program. Thus, the design and development stage would not be able to be completed before the completion of data analysis at Analysis stage.

When the adaptive learning method computer program has been developed, expert validation needs to be done. Data from the expert validation needs to be analysed, and the findings will determine the revisions need to be made. Finally, when revisions have been made and Evaluation stage is done, data gathered from this stage will determine the success of the development of the adaptive learning method computer program.

FINDINGS AND DISCUSSION

Findings of the study are presented and elaborated regarding the analysis, design, and development stages.

Students' Heterogeneity in Competences and Needs

In the Analysis stage, data were gathered through distribution of questionnaire to students, interview with a teacher, and focused group discussion with students. The main purpose of conducting Analysis Stage was to identify students' and teacher's perception of the learning materials as well as teaching and learning process done in the English classes.

Questionnaires were distributed to students, exploring students' perceptions and evaluation of the English learning in the previous semester/year. Several questions were raised, identifying level of difficulties of the learning materials, the in-class activities, the time allotment of English classes, and self-evaluation on English level of competence and needs as well as learning preference. Data taken from interviews with the teacher and FGD with students were used to get further responses on their comments on questionnaires.

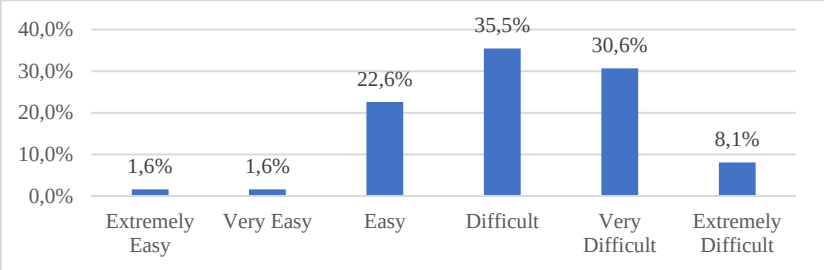

Figure 1 Level of Difficulty of the Learning Materials

Students perceived high variability in terms of learning materials level of difficulty. Around 35.5% of the respondents believed that the materials were difficult while 22.6% of them claimed that the learning materials were easy. In general, more than 74% of the respondents are on the right side of the graph, meaning that most of them believed that the learning materials were difficult.

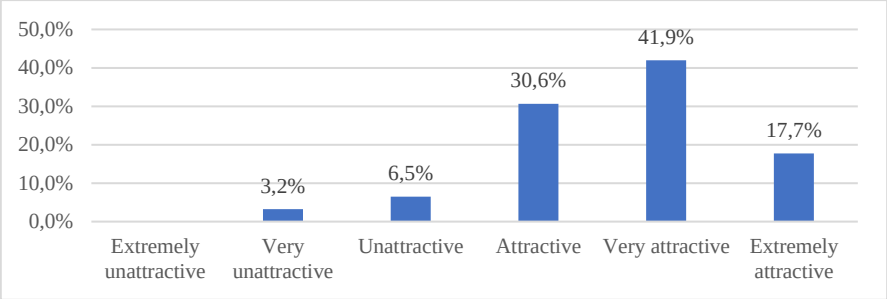

Figure 2 Level of Attractiveness of the Learning Materials

As seen on Figure 2, most respondents (more than 90%) found the learning materials were attractive. Only less than 10% of the respondents found the learning materials not attractive.

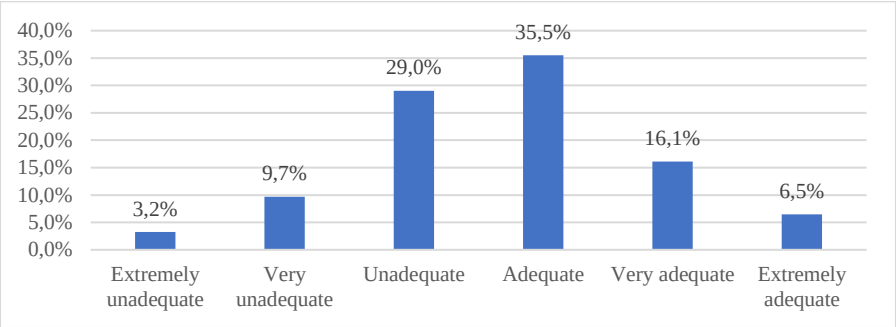

Figure 3 Adequacy of Time Allotment of In-class Activities

Regarding the time allotment of in-class activities, students responded variedly. Many of them believed that the time allotment for in-class activities in English classes was adequate; however, several others thought the time allotment was not adequate. This confirms the different perspective to look at the time allotment adequacy of English in-class activities.

From the focused group discussion with student respondents, it was identified that time allotment to learn English at school was adequate. Budi, for example, stated the reason, "*Belajar Bahasa Inggris di kelas, kalua terlalu lama ya bosan, Ma'am*" (Learning English in class for a long period in every session would be very boring, Ma'am). This may convey students' view that they do not need more hours for in-class activities.

However, when confronted to the teacher's opinion, different point of view was found. Pak Raden, the teacher, mentioned that "*Pembelajaran bahasa Inggris di kelas sekarang ini hanya 2 jam pelajaran seminggu, yang berarti hanya 70 menit per minggu. Ini sangat kurang*." (English class is given only two lesson-hour per week; the English class is only 70 minutes per week. This is not adequate at all).

It can be concluded that time allotment adequacy of in-class English courses was seen differently by students and teachers. Very student may need different time allotment to learn English well while the teacher confirmed the inadequacy of time to finish the learning materials to be completed. Thus, there should be a solution to overcome this discrepancy.

Regarding students' need to improve their English competence, majority of the respondents (around 93%), claimed that they need to improve English skills. As presented in Figure 4, only a few respondents (less than 7%) mentioned they do not need to improve their English competence.

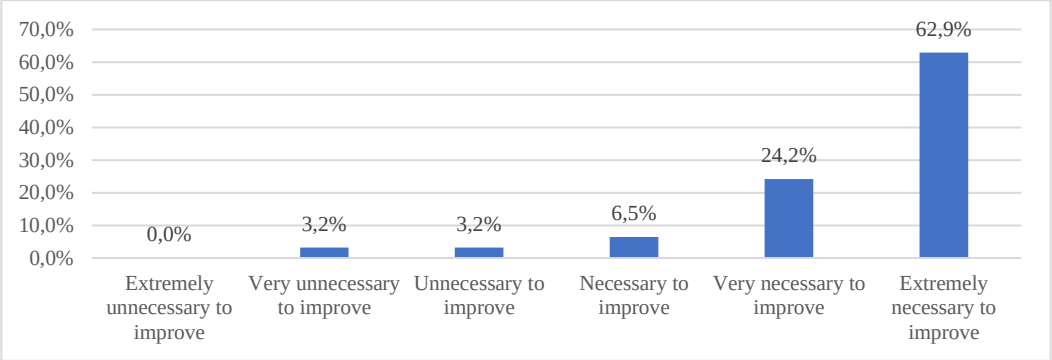

Figure 4 Students' Opinion of the Need to Improve English Skills

Deeper analysis on the data may reveal that students admitted that their English competence is lower than their expectation. Therefore, they needed to find ways to improve their English competence out of their English lessons in class. Table 1 presents respondents' view on their own English competence.

Table 1
Students' Mastery of English Competence

	Questions	**English Skills and Components**			
		Reading	**Listening**	**Speaking**	**Writing**
Which mastery level is your English skills? (1 to 4)		3,52	2,42	2,06	2,69
		Vocabulary	**Grammar**	**Pronunciation**	
Which mastery level is your language components? (1 to 3)		2,21	1,48	2,26	

As can be seen on Table 1, in average, students believed that their speaking skill was the lowest while reading skill was the highest. Furthermore, averagely, they admitted that their grammar mastery was the poorest while pronunciation was the highest.

When asked to determine the most effective way to learn English, whether learning independently, learning with friends, explained by teacher, or learning from communication media, averagely, students preferred communication media. Figure 5 presents the detailed responses.

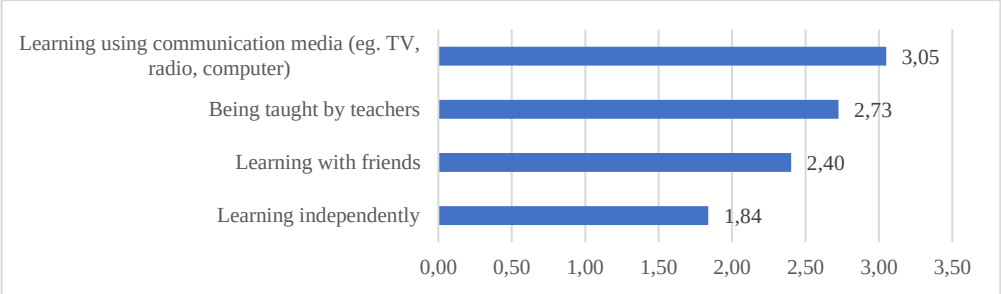

Figure 5 Students' Preferred Way to Learn English (1 for the least effective and 4 for the most effective)

As presented on Figure 5, when students were to score the most effective way to learn English, they scored 'learning using communication media' the highest while 'learning independently' the lowest. This may reveal their preference to use communication media to learn English while learning from teachers follows the second.

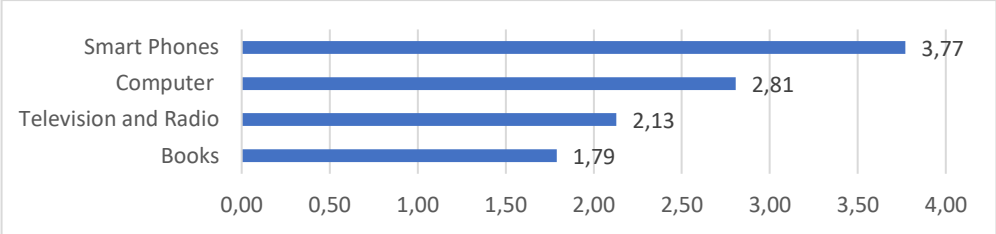

Figure 6 Students' Preferred Learning Media (1 for the least effective and 4 for the most effective)

Furthermore, students were asked to select their preferred learning media. They were given four options to rank: smart phones, computer, television and radio, and books. It turned out that students selected smart phones as the most effective media to learn English. This was followed with computer while books were considered the least effective media.

Designing and Developing Adaptive Learning Method Computer Program

Data from the Analysis stage were essential to lead the next stage of the study, namely design and development. Thus, from the Analysis Stage, it was confirmed that the design and development of Adaptive Learning program for the learning of English at senior high school students.

The first step to do at the design was determining the format of the program. It was decided that the Adaptive Learning method to be designed was a web-based program. It was planned when the web-based program could be successfully developed and found effective, a program with Android or IOS based would be done in the following years.

It was decided to design and develop Adaptive Learning method for Grade 10 students of a Senior High School in Malang. There were 15 chapters covered in the book. It was decided to develop discrete learning materials, in which each chapter consisted of two English skills, namely listening and reading skills as well as vocabulary and grammar components. The English skills and language components were named as 'section'. Each section was decided to cover five to six levels or grades.

The main characteristics of Adaptive Learning method is the presence of customized-to- individual learning path developed employing advanced technology or computer programs. The design of the Adaptive Learning program designed in the current study is presented in Figure 7. As viewed in Figure 7, each chapter consists of four sections, namely reading, listening, vocabulary and grammar with each section consists of five to six levels of learning materials, practices, and quizzes. Determination of providing four subsections was to respond students' needs in terms of English skills and language components. Then, the provision of different levels for each subsection is the representation of customization of the learning materials to individual needs.

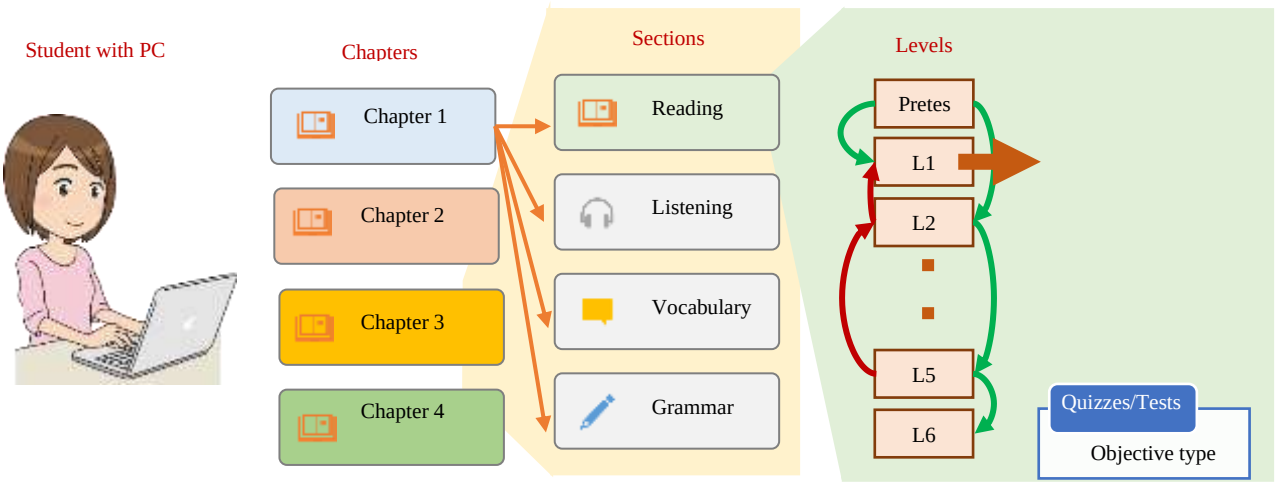

Figure 7 Design of the Adaptive Learning Method

The learning materials in each chapter, section, and level may be in the forms of texts, linked videos, audios, and linked YouTube. The practices and the quizzes are presented as objective tests to ease the automatic scoring to determine the next level of placement.

The concept of domain-specific knowledge was used to design a multi-path or multi-branching path mapping in personalizing the flow of English learning using adaptive learning methods using TEL.

Prior to getting into a certain level of a certain section in each chapter, students need to do an entrance test. Results of the entrance test determine which level she/he can start the lesson. In each level, students would individually learn the learning materials, do the practices, as well as sit on the quizzes. Results of the quizzes would determine whether the student can go further to the next level, go back to two levels below, or leap to the next two or three levels above. In this case, students individual needs to improve which language skill and component is facilitated, following students' individual level of English competence. In this way, heterogeneity in students' needs and competence levels can be accommodated.

DISCUSSION

Findings from the Analysis, Design, and Development stages of the current study can be interpreted and analysed in several points of discussion presented in this section.

Students' heterogeneous characteristics were evident as resulted from the questionnaire distributed to respondents of the currents study, who were year 11 students of a senior high school in Malang, Indonesia. Heterogeneity was found in students' level of English competence, learning materials difficulty levels, needs of improving English competence, preference of ways of learning, and time allotment to learn English. Such heterogeneous characteristics may cause challenges on the part of the teachers. This condition was highlighted by Syafryadin et al. (2022) in their study on teachers' readiness and challenges to implement autonomy in ICT-based English learning activities.

In the current study, despite the heterogeneity in students' level of English competence, many confirmed the high difficulty level of the English learning materials. High difficulty level that students encountered may result in low learning motivation and further impacts on low achievement (for example, Vandergrift, 2005). Therefore, attending students' difficulty and offering a solution would be a way to assist students to achieve their goals to improve their English competence as most of the respondents admitted in the current study.

Students' preference to learn English using latest technology seemed to be significant. When students' favoured learning media is fulfilled, their success in the learning may be positively impacted. Such findings support previous studies (for example, Ahmad, 2012; Putri, 2019), proving the effectiveness of the use of latest technology in learning English as a foreign language. Students' favour of using smartphones and computer in the current study was also in line with findings of previous studies (for example, Adlof et al., 2019; Ally & Samaka, 2013; Hao et al., 2019).

That implementing adaptive learning method as proposed in the current study may be a solution to the abovementioned problems, especially students' heterogeneity, are supported by several theoretical and empirical reasons. Individualized learning is one good solution offered to overcome the problem of heterogeneity. Previous studies (Bernat & Mueller, 2014; Kanoksilapatham & Khamkhien, 2022; Ngo et al., 2020) support this proposal. Bernat and Mueller (2014) even highlight the effectiveness of combining individualized learning and the use of technology in meeting the needs of high school students; this definitely implements adaptive learning method.

CONCLUSION

Conclusions can be drawn upon the completion of the stage of design and development of the current study. Students are in various levels of English competence and in different needs to improve their English skills. Thus, autonomous learning could be a solution. When time allotment to learn English in class is very limited and students believe that they do not need to have more hours of in-class activities, independent learning or autonomous learning done out of class could be a solution. The use of appropriate and effective learning media is essential to consider for the development of autonomous learning system. Students' preference to use smartphones could be accommodated. It is necessary to develop an autonomous learning system using TEL media. Thus, Adaptive Learning needs to be realized.

ACKNOWLEDGEMENTS

The research was funded by the Directorate General for Vocational Education as a Decentralization Research within the scheme of *Penelitian Produk Vokasi Unggulan Perguruan Tinggi* 2022.

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