



The Effect of Interactive Digital Learning Module on Student's Learning Activity and Autonomy

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ABSTRACT

In the modern society, the internet breaks through the restrictions on time and space and becomes a ubiquitous learning tool. Designing teaching activity for digital learning and flexibly applying technology tools are the key issues for current information technology integrated education. Interactive learning modules could be used in the classroom environment for effective learning. This study explored the effect of instructional modules for providing supplementary instruction in biology concepts. Interactive digital learning module was developed in order to assist students in biology learning. Interactive activities were considered in this study, include teacher - student interaction, student - student interaction, student - content interaction, and student - technology interaction. 180 students of Grade 11 in 6 classes at SMAN 2 Balige were selected as the research subjects. Three groups of students participated in biology learning course, (2 classes) using different modules were interactive digital module, digital module and text module. Goal of this research was to determine the impact of interactive digital learning module on students' learning activity and autonomy. Quantitative results obtained by using questionnaire to understand the student's learning activity and autonomy. Results showed student's activities and autonomy who learned with interactive digital learning modules significantly different with students who learned using text learning modules. The use of interactive features increased the activity and autonomy of learners and created the student-centered learning environment. Students under interactive multimedia instruction performed better than text module class. These findings suggested that learning activity and autonomy of students in biology could be enhanced by multimedia instruction.

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Introduction

Natural Sciences is expected to be a vehicle for students to learn about themselves and the natural surroundings, as well as the prospect of further development in applying it in their daily lives. The learning process emphasizes giving direct experience to develop competencies in order to explore and understand the natural surroundings in a scientific manner. For this reason, the teacher should strive to realize an active and enjoyable learning process by using innovative and creative learning media. To overcome the above problems, technology-based learning media can assist teachers in conveying learning material for students. The new paradigm of education 4.0 era demands a shift in student's learning pedagogy from a teacher-centered learning model to a learner-centered model. It is inevitable for teachers integrating information technology into subjects to assist in students' learning with teaching materials, teaching methods, and diversified teaching media. It is the common responsibility for educators to have teaching become more efficient, allow students being glad to learn, and cultivate the new generation with creative and rational communication and critical thinking with technologies and network information in the new era. As a matter of fact, this has made educators exert a lot of effort to help the learners to get interactive content that is full of multimedia as it has been proven that it has a significant effect on the process of learning. The design of teaching activity and the flexible application of technology tools or digital learning therefore become the primary issues for current information technology integrated education.

Doris Holzberger et al. (2013) regarded digital learning as delivery with digital forms of media (e.g., texts or pictures) through the Internet; and, the provided learning contents and teaching methods were to enhance learners' learning and aimed to improve teaching effectiveness or promote personal knowledge and skills. Basically, computers and network technology media were applied to learning situations, including synchronous and asynchronous network learning, to break through the restrictions on time, location, and schedule, and to achieve the learner-centered individualized learning (Kaklamanou et al., 2012). Miyoshi et al. (2012) organized the advantages of digital learning for the comparison with traditional teaching such as (1) digital learning allowed learners not being restricted on time and space as traditional learning so that learners could select the time and location for accessing learning media; (2) interactive digital learning is self-learning that the production of teaching materials should cover more media pictures, sound, or images than traditional ones to generate more attractive and lively teaching materials; and (3) enhancement of learning interests: Instruction could be more vivid and lively through information technology and the presentation of various media to enhance learners' interests, make learning more efficient, and promote learners' learning persistence (Kaklamanou, 2012). In summary, digital learning is attractive because the contents would not change with media or standards so that learners could easily operate to learn and break through the restriction on time and space for thorough learning and successful learning. This condition can improve learning activities and guide students to learn independently. For this reason, the educator should strive to realize an active and enjoyable learning process by using interactive digital learning media.

There have been many studies propose solutions to make interactive activities effectively support the learning process of students. Claudiu (2020) implemented interactive activities: the pace control, self-assessment, interactive simulation of his research and time of using the system is a factor affecting student results. The results of their study showed that students with better results have higher learning interaction activities with the system. There was a positive influence in the direction of time spent online and the results calculated by the scores of students. According Wiranda (2019), the characteristics of being autonomy in learning is having the ability to manage someone's own learning which then it influences the emergence of independent mentality. Hence, it is very important to develop and apply those three fields for the students in every learning activity.

The activities are closely related to the reinforcement of character education program arranged by the government. Among the values itself, there is an autonomy which is close related to the learning activity. Today's curriculum is a student-centered which means that the students have to be autonomy in order to achieve the goals in learning process. Thus, autonomy becomes the core value in developing student's behavior without ruling out the other character. Pichugova (2016) stated that the autonomy students are responsible, flexible, and full of curiosity.

Another idea that supports the benefits of the use of electronic learning media according to Sung, Chang, and Yang (2015) research. It is quite effective to enhance learner's autonomy in learning activity. The reasons are electronic media helped students to be personally control learning by deciding the preferable time, place, and pace. Also, it boosts students' interaction and cooperative learning between teacher and students or even peers so it can gain better. The improvement of the students' autonomy by the use of learning assisted technology-based instruction is also stated by Rusman (2013). He says that computer-based instruction is individual so it requires an independent learning. Based on parameters that can define and impact students' abilities in learning, in this study we examine the influence of interactive digital learning module on students learning activity and autonomy. Modular instruction enhances student's activity which lead learner autonomy. Our goal was to focus on interactive learning modules for fundamental concepts of digestive system that are utilized in teaching biology courses. Interactive learning approach is also beneficial for all the educators as it allows to measure student accomplishments for example lecturers making use of interactive teaching approach is better equipped to assess how well students master a given subject material. It also allows some flexibility in teaching whereby educators can apply training methods that involve two-way communications which will enable him/her to make quick adjustments in processes and approaches. Interactive instruction enhances the learning process and also student motivation. Interactive learning approach provides students more opportunity to engage in group discussion which make learning more fun.

The use of modules also encourages independent study. It directs students to practice or rehearse information. To gain mastery of the concepts, exercises are given following the progression of activities from easy to difficult. The arrangement of the exercises as such formalizes the level of difficulty that the learners can perform. Another benefit of using modules for instruction is the acquisition of a better self-study or learning skills among students. Students engage themselves in learning concepts presented in the module. They develop a sense of responsibility in accomplishing the tasks provided in the module. With little or no assistance from the teacher, the learners progress on their own. They are learning how to learn; they are empowered. Teachers themselves become enthusiastic. Since students have varied learning capacities, teachers who use modules can attend to different students who work on varied tasks. Monitoring students' activities can become more purposeful especially with students who need more guidance and attention. The modules allow them to be occupied with legitimate activities like preparing for another teaching task. Interactive digital learning module provide multimedia that brings animation and narration has high interactivity and effectiveness to increase the students' understanding of the material studied. Cognitive theory of multimedia learning scheme by Mayer & Moreno can be seen in Figure 1.

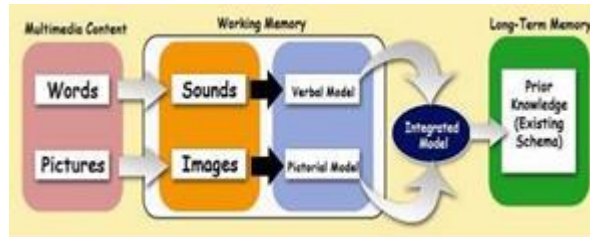


FIGURE 1. Cognitive theory scheme of learning multimedia

Source: Meyer & Moreno (2000)

Based on scheme of cognitive theory above (Figure 1), the content displayed within the learning multimedia will affect the thinking of students and next influence long-term memory of students on the material being studied. Therefore, the computers are an excellent media for developing biology learning materials that need visualization to explain the abstract concepts such as digestive system. Dale (1946) describes the role of media in the process of getting learning experience for students, which is described in a cone called as Dale cone of experience. Dale conveys large percentage of brain memory influenced by the type of students. It will explain clearly in this following Figure 2.

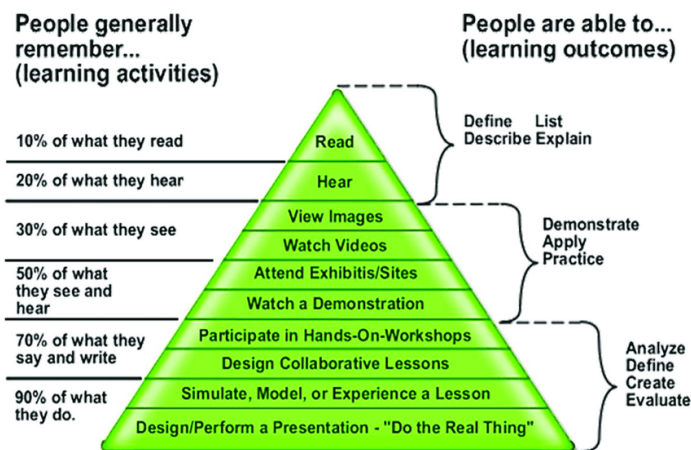


FIGURE 2. Dale cone of experience; Source: Dale (1946)

Dale cone of experience illustrates that a few learning activities is done, less percentage of learning outcomes in mind. For example, students are more easily remembered things to see and heard rather than just read or hear it. Video is media that combines the activities of hearing (audio) and activities of seek (visual). Video is the most interactive media to describe actual events. The use of video in learning can create the meaningful learning. It inspires the emergence of multimedia that combines text, images, audio, video, animation with the aim to enable the students to remember lesson effectively. The interactive digital learning media is the solution to provide the different of student's learning styles. It provides and helps students who are kinesthetic (learning best shown simulations, hands on activity). It allows students to see the object movement such as video simulation about the subject matter described. For example, biological materials of human digestive system. Kinesthetic students can watch the of biology concept videos in module. As a result, the subject matter can be understood easily. Students with auditory learning styles, they don't want to read much the subject matter. In addition, they can learn at any time by listening to a recording of the subject matter or accessing the learning materials from module. Interactive learning module serves each

student's learning style. As for visual learners, the interactive digital learning module provide good image, chart to communicate the ideas.

To properly address the need for instructional media innovation, this study was intended to focus on interactive modular instruction in biology and determine its effect on student's activity and autonomy. Further, to facilitate the inquiry into the effectiveness of modular instruction, the study aimed to determine whether the use of interactive digital learning module in biology would show positive results as compared to the electronic and printed text module. The significance of this study was that it raised the awareness of educators to the importance of using the interactive features of e-learning module as an important asset in teaching students. In this study two research hypotheses were examined to determine which hypothesis should be accepted and which should be rejected.

H1: Interactive digital learning module will give significant effect on student's learning activity.

H2: Interactive digital learning module will give significant effect on student's learning autonomy.

In this study, the p-value has been used to test the above hypotheses. p-value is a probability statement which answers the question: If the Null Hypothesis is true, then what is the probability of becoming aware of the test statistics at least as extreme as the one observed. A p-value of 0.05 or less rejects the null hypothesis 'at the 5% level' that is, the statistical hypothesis used suggests that only 5% of the time would the supposed statistical process to come to a finding to the utmost if the null hypothesis were true. 5% and 10% are common significance levels to which p-values are compared.

Methods

Instrument Tested

Questionnaires were used for assessing the learning activity and autonomy. The criteria on the results of questionnaire were determined by Likert scale with four ranges. There was three assessment indicators (making decision, resilience, dare to express ideas) which consists of 20 statements used in the autonomy questionnaire and five indicators (visual, listening, writing, mental and emotional activity) which consists of 20 statements used in the activity questionnaire. All instruments validated by validators then it was tested to small sample before implemented, the invalid items found have revised. The reliability value of learning activity was 0.853, autonomy was 0.859. The implementation of lesson plan for each group conducted in ten meetings. Both of instruments were given to all groups in the first and last meeting as the result after treatment.

Subjects

This research was conducted at SMAN 2 Balige in Jalan Kartini Soporung Balige. The population in this research was grade eleventh of students (n=180) at SMAN 2 Balige. The sample was selected by total sampling with taking all six classes. Research sample divided become three groups, each group consisted of two classes. Class selection for each group was done randomly. Groups treated with three different learning modules (interactive learning module, electronic learning module, printed text module) in digestive system topic. Shapiro-Wilk normality test showed all groups was normal distributed (0.112; 0.081; 0.120, $\alpha= 0.05$). Levene's test of homogeneity showed all groups of data have homogenous variants (sig.value 0.926, $\alpha= 0.05$).

Research Design

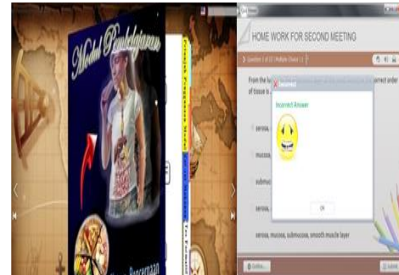
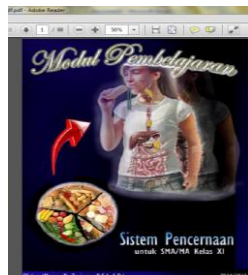
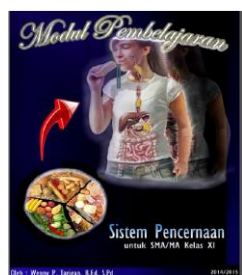
Type of this research was quasi experimental to investigate the effect of students' learning activity and autonomy. The independent variables used in this study were learning modules (text learning modules, electronic learning modules, interactive digital learning modules). Student's learning activity and autonomy as the dependent variable. Researcher has trained three biology teachers about the procedure of this study. Teachers implemented the lecture method (meeting 1-8) and discussion (meeting 9-10) for all groups but they had different modular instruction. Each digital learning module provided by password. The differences of learning modules treatment used in this research can be seen in Table 1.

Table 1. The differences of learning modules

Differences	Learning Modules		
	Text Module	Electronic Module	Interactive Digital Module
System Provided	The system is not connected with internet servers and web-based, not multimedia sharing.	The system is not inter-operable with internet servers and web-based, not multimedia sharing.	The system is interoperable with internet servers and web-based for seamless connection with applications such as multimedia sharing.
Interactivity Learning Materials	Students learning material refers to teaching material at class. Materials don't keep the learners active because there is not feedback from module to the students as users. Students read the module look like a text book.	Self - Learning Material (SLM) refers to teaching materials at class. Materials don't keep the learners active because there is not feedback from module to the students as users. Students read the module look like a text book.	Self - Learning Material (SLM) refers to teaching materials at class. Materials keep the learners active because the feedback from module to the students as users and help to improve their cognitive skills.
Media Provided	Learning module is rich of texts, figures and not provided by video, interactive quiz, music.	Learning module is not provided by video, interactive quiz, music. The appearance of module looks like PDF module.	Learning module provided by video, interactive quiz, music. Interactive and flexible learning programs are such materials that follow self-study approach.
Accessing	It can be read anywhere and anytime by bringing the textbook.	It can be read anywhere and anytime without bringing the textbook.	It can be accessed anywhere and anytime on the weblog.
Convenience of learning	Improve students' confidence levels during learning at class	Improve students' confidence levels, attitudes towards their own learning.	Improve students' confidence levels, attitudes towards their own learning, promote opportunities for students to learn through collaboration and conversation online, provide access to global communities with expertise and perspectives that can enrich learning.

Differences	Learning Modules		
	Text Module	Electronic Module	Interactive Digital Module

Module



Data Analysis

Requirement testing for data analysis used validity, reliability, normality, and homogeneity test. Determining the increasing of learning autonomy and activity counted by using One Way Anova performed using SPSS application version 21 at significant level 95%. If the value $p > 0.05$, H_0 will be accepted and H_a will be rejected. If the value $p < 0.05$, H_0 will be rejected and H_a will be accepted.

Results and Discussion

Result of Research

The results of research showed that the students' learning activities who used interactive digital learning modules ($\text{mean} \pm \text{SD} = 70.56 \pm 10.340$), electronic learning modules (66.44 ± 7.750) and text learning modules (63.04 ± 3.65). Interactive learning module gave the significant effect toward student's learning activity with $F = 25.106$, $df = 2$, $p = 0.000 < 0.000$. It means, H_0 was rejected and H_a was accepted. Based on the results of Tukey test showed that the value of learning activities who used electronic to text module or vice versa was 0.005, interactive – text, electronic or vice versa was 0.000, $p < 0.05$. The average of students' learning activities that learned with interactive digital learning module gave the effect of 6.29% ($70.56: 66.44$) was higher compared with electronic learning modules. Electronic learning modules provide the effect of 5.32% ($66.44: 63.04$) is higher than using text learning modules. Students who learned with interactive learning modules give the effect of 11.95% ($70.56: 63.04$) is higher than text learning modules (Figure 3a).

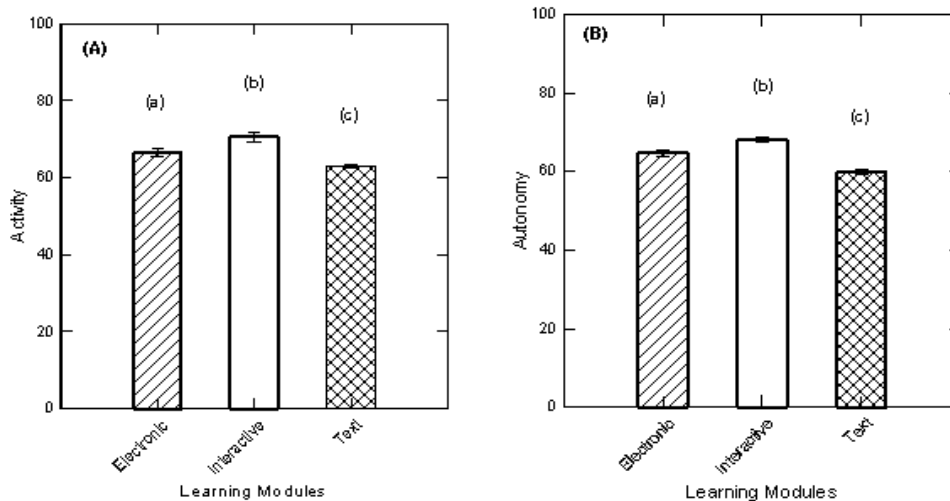


FIGURE 3. The effect of interactive digital learning module, electronic, and text learning module on students' learning Activity

Notes: (A), Autonomy (B) in the digestive system topic grade XI SMAN 2 Balige ($df=2$, $p = 0.000$). Error bar indicates standard error. Data was measured by using One Way Anova Test. Letter (a), (b) and (c) inside the graph box mean the significant differences between three modules.

The results of research showed that student's autonomy who used interactive digital learning modules (mean \pm SD= 68.17 ± 5.76), electronic learning modules (64.46 ± 5.15) and text learning modules (59.95 ± 4.20). Interactive digital learning module gave the significant effect toward the student's autonomy with $F= 66.502$, $df = 2$, $p = 0.000$. H_0 was rejected and H_a was accepted. Based on the results of Tukey test showed that the value of learning autonomy who used electronic to text module or vice versa was 0.000 , interactive - text, electronic or vice versa was 0.000 , $p < 0.05$. The average of students learning autonomy who learned with interactive digital learning module gave effect of 5.44% ($68.17:64.65$) was higher compared with electronic learning modules. Electronic learning modules provided the effect of 7.83% ($64.46: 59.95$) was higher than using text learning modules. Students who learned with interactive learning modules gave effect of 13.71% ($68.17: 59.95$) was higher than text learning modules.

Discussion

Many studies have shown that effective use of electronic learning could help increase student outcome such as learning activity and autonomy. It should also increase student class participation, and improved behavior and performance on core subjects. One of the crucial factors for student's success in e-learning process is the usefulness and sense of media. The integration of information and communication technologies with the learning process can maximize student's autonomy. Student learning activity consists of physical activity (visual, verbal, listening, movement, writing, metric), mentally and emotionally. Each type of learning activities mentioned above will be achieved by utilization interactive digital learning module during learning activities. It is in accordance with Goldstein who states that interactive learning media creates a learning environment which demands the independent and interactive learning so there is a satisfaction towards each students' learning method. This condition allows students to socialize with respect differences (opinions, attitudes, achievement capability) and practice to work together to communicate ideas, creations, and findings to the teacher and other students as one of emotional learning activity. On the one hand, teachers need to develop and restructure the courses in a way that suits interactive

modular instruction requirements.

Students' autonomy who learned with interactive digital learning modules differ significantly with students that learned using text and electronic learning modules. These standpoints are supported by Littlewood, who asserts that autonomous learners can carry out their own decisions independently. He divides the capacity into two components, ability and willingness. The former refers to decision-making skills. The latter involves learner motivation to carry out their decision responsibly. A common factor to be seen in their statements is that autonomous learning is a kind of ability, which can be considered to be a form of sustainable learning skills for lifelong learning.

Based on the results of research conducted, students who learned with using interactive digital learning modules are required to be able to participate more actively to build their own knowledge so students can obtain a deep understanding about digestive system concept. Besides that, interactive learning media provide more varied activities such as video, image, and quiz which can be accessed via internet. This condition creates a meaningful learning process which increase learning outcomes. Meaningful learning trigger student in memorable learning experience. In biology learning, students should be fully involved actively during learning process. This is in line with the view Ansari and Khan (2020) states that the learning activities allow students to socialize with respect differences (opinions, attitudes, achievement capability) and practice to work together to communicate ideas, creations, and findings to the teacher and other students. Therefore it is necessary for students to learn independence either alone or with friends to develop the potential of each in learning biology.

The application of multimedia technology in educational activities is supported by constructivism. Multimedia technology which includes various media forms, for instance audio, video, image, animation, text, and so on, can create a real and operational learning environment for students; under such an environment, students' mutual communication are promoted. Meanwhile, students' interests of learning also can be stimulated by rich and colorful information. In consequence, students can explore and construct new knowledge autonomously. Compared with to previous research, the analysis in this study was more detailed, for example, in using both quantitative analysis methods, and conducting both independent and dependent variables.

Conclusion

Interactive learning modules give significant effect toward students' learning activity and autonomy. The interactive learning module is the superior module than the other modules used. Utilization the modular instruction in biology brings better student's performance than using the lecture-discussion method without modular instruction. It allows students to learn according to their individual capacities. Based on practical experiences about our interactive modules and student motivation, we would have the same conclusion with Michau, Gentil, and Barrault (2001) that there is a promising view about web-based modules or the use of instructional technology for increasing student learning interest so that to motivate the digital generation to learn better. Our study results support the claims about the positive impact of popularity to use instructional technology, specifically for biology students. It improved student's learning activity and autonomy through addressing their learning habits or styles and using their favorite means to deliver content knowledge. While, we agree with some researchers (e.g., Walddeck, & Dougherty, 2012) that technology-based learning could be a double-edged sword for students' autonomy if not used appropriately because the result is dependent on whether the technologies are used effectively. Some studies (e.g., Tai & Ting, 2015) found that learning module assisted technology use may satisfy student interest, because students may take technology use. Therefore, the interactive learning module assisted technology has to appropriately map the content knowledge with a right amount of usage.

Limitation and Future Study

There are some limitations in the current study. Even though we confidently claim the positive impact of the interactive learning modules as an intervention on student activity and autonomy in learning, we agree that the treatment length was relatively short. However, with the current promising results from the relatively short period of treatment, we can reasonably assume more positive effect if we could have longer or more sessions to implement the interventions. However, our current study focuses on the assessment of student's learning activity and autonomy as learning performance. With regards to student learning autonomy as the specific construct we studied, it is justifiable for our claims on causality of the positive effect of the program because student learning autonomy can be both positively and negatively influenced by the instructions. We agree that it is beneficial for us to further assess the effects of the modular instruction on student learning activity. With regards to the statistical inference, we are planning to conduct further studies with a quasi-experiment control group design to assess the program effect focusing on student learning and its associations with student learning autonomy and activity toward learning achievement and critical thinking. The current study result echoes the exiting literature regarding learning activity and autonomy. It is hoped that this teaching-learning innovation would give ideas to teachers to help them design instructional modules to produce quality graduates both in biology courses. Furthermore, the learners may gain interactive learning experience to acquire and develop their knowledge.

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