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ADAPTIVE LEARNING RECOMMENDATION SYSTEM BASED ON DATA SCIENCE ON STUDENT MOTIVATION AND LEARNING ACHIEVEMENT

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Abstract

Advanced technology allows learning platforms to analyze student data in real-time and present appropriate learning material according to their level of understanding. One of the main advantages of adaptive learning is the personalization of learning. The application of this learning method provides better hope for the world of education by adapting to using sophisticated, renewable technological devices. Adaptive learning methods can also be applied to adaptive teaching by class teachers. The benefit is managing student relationship patterns in carrying out education properly and correctly. Data Science can also be used to build predictive models to predict student academic performance. This will of course be based on historical data and relevant variables. That way, education businesses will be helped in providing appropriate interventions, effective classroom settings, and additional support for students who have potential difficulties. Schools must provide adequate training programs for teachers and students to ensure that they can use educational technology effectively. In addition, schools must provide sufficient support for students who do not understand or have difficulty using educational technology.

Keywords: Adaptive Learning, Data Science, Motivation, Learning Achievement

INTRODUCTION

Education is the key to opening the door to a bright future for every individual. In the era of information technology which continues to develop

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rapidly, traditional learning approaches are starting to shift towards more adaptive education (Batubara, H. H., & Ariani, D. N, 2019; Sitopu et al., 2024).

Adaptive learning is a learning system that is tailored to the individual needs and abilities of each student (Guna et al., 2024; Tubagus et al., 2023; Aslan & Shiong, 2023). Advanced technology allows learning platforms to analyze student data in real-time and present appropriate learning material according to their level of understanding (Shelle, G., et al, 2018). One of the main advantages of adaptive learning is the personalization of learning (Muharrom et al., 2023; Nurhayati et al., 2023; Nurdiana et al., 2023). Every student has a different learning style, varying levels of understanding, and different learning speeds. In traditional classes, teachers often find it difficult to give proper attention to each student because of the large number of students (Nadii, C. Y., & Adi, B. T. K, 2018).

However, with adaptive learning, students can learn in an environment tailored to their individual needs and abilities (Erwan et al., 2023; Sarmila et al., 2023; Sulastri et al., 2023). Adaptive learning algorithms can identify students' weaknesses and strengths in specific subject matter and present relevant and challenging learning content to help them achieve better understanding.

Adaptive learning also provides advantages in timely monitoring of student progress. Through continuous data analysis, an adaptive learning system can identify when a student is experiencing difficulties in understanding subject matter (Rachmayanti, E, 2022). When this happens, students will get additional help or material tailored to their difficulties to help improve their understanding before problems pile up. Conversely, students who have reached a higher level of understanding can be given greater challenges and more advanced material to maintain their interest and motivation in learning (Haddar et al., 2023; Aslan & Pong, 2023).

Likewise, teachers still use conventional methods (lectures, questions and answers and giving assignments) in providing learning materials, so that learning activities are still unidirectional where teachers are considered as repositories of knowledge, acting authoritarian and teachers who dominate the class. Meanwhile, students must sit neatly and listen, imitate the patterns given by the teacher, imitate the teacher's ways of solving problems (Eker, I., & Torun, Y, 2006). Conditions like this are likely to cause a lack of student understanding of the material being taught and will result in low student learning outcomes, especially in lessons (Tuhuteru et al., 2023; Astuti et al., 2023).

Seeing this fact, teachers are required to find alternatives that must be taken to improve student learning outcomes because teachers are educational figures who create a comfortable, conducive learning atmosphere and must be able to create an effective and efficient teaching and learning process. One alternative that must be taken is a more professional approach by developing an adaptive learning system through the role of science data.

Data Science can also be used to build predictive models to predict student academic performance. This will of course be based on historical data and relevant variables. That way, education businesses will be helped in providing appropriate interventions, effective classroom settings, and additional support for students who have potential difficulties.

RESEARCH METHOD

The study in this research is qualitative with literature. The literature study research method is a research approach that involves the analysis and synthesis of information from various literature sources that are relevant to a particular research topic. Documents taken from literature research are journals, books and references related to the discussion you want to research (Earley, M.A. 2014; Caruth, G.D. 2013).

RESULT AND DISCUSSION

Adaptive Learning

A. Definition and Characteristics of Adaptive Learning

Adaptive learning is a learning process carried out by utilizing advances in the latest technological devices. So that you get better and faster learning results. Such as the use of artificial intelligence or computer algorithms as an example (Batubara, H. H., & Ariani, D. N, 2019).

The application of this learning method provides better hope for the world of education by adapting to the use of sophisticated, renewable technological devices. Adaptive learning methods can also be applied to adaptive teaching by class teachers. The benefit is managing students' relationship patterns in carrying out education properly and correctly (Carceles-Poveda, E., & Giannitsarou, C, 2007). In short, adaptive education tries to help students gain knowledge smoothly and optimally.

Adaptive learning was born from the emergence of artificial intelligence as a future technological innovation. Artificial intelligence became known in 1970. Various computer and electronic devices have started to use artificial intelligence which is still simple.

The form of implementation of adaptive learning is the use of learning methods in the past coupled with following developments in the present. Experts in the world of education often describe adaptive learning as learning a combination of old method material with the newest method according to current developments (Martin, F., et al, 2020). Including problem based learning methods. By using adaptive learning methods in schools, it will make it easier for students to comprehend, comprehend and carry out learning activities more actively according to students' needs.

In accordance with changing times in the world of education, several schools have begun to apply the basic concept of adaptive learning. All learning is carried out in accordance with the latest, more up-to-date developments and according to the needs of all students. So that every student can more easily understand the subject matter provided by teachers at school. The form of learning resulting from adaptive learning methods is accommodative and flexible (Kerr, P, 2016). This is the form of advantage and ideal education system that students have always needed.

B. Components and Basic Principles of Adaptive Learning

The aim of adaptive learning is to create a young generation who has high motivation in gaining knowledge and is able to be independent in learning as well as being broad-minded and superior. The key to success in achieving the goals in adaptive learning is of course in the hands of the teacher. Teachers must be able to know and understand the character of each student in learning. Today's children cannot be compared to children in the past, including in their teaching methods and techniques (Muñoz, J. L. R., et al, 2022).

Today's students who call themselves the millennial generation have a nature that likes challenges, is fast-paced, dynamic, multitasking, creative, intelligent and is used to using digital technology and the internet. However, the weakness of today's millennial students is that they tend to get bored more easily. Gadgets as digital technology products have now become very familiar to the millennial generation. A gadget is a mini-sized electronic item that has various specific uses. Gadgets are electronic equipment that has certain uses for each device. For example games, Android phones, computers etc.

Apart from the benefits, there are a number of negative impacts of gadgets that parents need to anticipate well. One of them is the impact of obesity. Children who often play with gadgets result in less movement. Until his body becomes fat and is very susceptible to several dangerous

diseases such as heart attacks (Rachmayanti, E, 2022). After knowing the dangers of gadgets and digital technology in early childhood, parents should be alert to these dangers. Don't let your beloved child experience the negative impact of using technology.

Regarding adaptive learning, the role of teachers plays a very important role in the use of digital technology for learning. This includes ensuring that students do not get bored quickly and give up easily in learning and teaching according to the students' learning characteristics. Adaptive learning in western countries is known as adaptive learning which is starting to be applied in every school (Carceles-Poveda, E., & Giannitsarou, C, 2007). Schools that use conventional learning methods have begun to be abandoned and are switching to this new method. Conventional or traditional education is no longer effective in advancing the learning process in schools. This is inversely proportional to adaptive learning which provides optimal results on a large scale. Adaptive education provides a different perspective from what previously existed. Students or learners are not the recipients of learning for all the information obtained which is generally passive. But also students as active parties (Liu, M., et al, 2017).

Data Science in Education

A. The Role of Data Science in Education

Data Science is a science that combines several other sciences, namely Mathematics/Statistics, coding (Computer Science), and an understanding of business. The combination of the three will produce an algorithm that can analyze data and find hidden insights in it. In the development of Data Science, this science has become very important in various fields. This is because almost all existing fields are affected by the development of digital technology (Romero, C., & Ventura, S, 2017).

Data Science is closely related to the data analysis process. In the field of education, there are many things that can be used as data sources for analysis, one of which is student data. Data Science can help businesses in the education sector to analyze student data, including academic data, behavior and demographic data (Collins, A, 1992). This analysis aims to help understand individual student needs, identify learning patterns, and to design more effective learning strategies.

B. Data Science Techniques and Methods Used in Adaptive Learning

Data Science can also be used to build predictive models to predict student academic performance. This will of course be based on historical data and relevant variables. That way, education businesses will be helped in providing appropriate interventions, effective classroom settings, and additional support for students who have potential difficulties. However, keep in mind that the results of this prediction have the possibility of being different from the actual situation, given the existence of factors that cannot be controlled.

Every student is a different person, so the treatment given in the learning process cannot be equalized. Data Science enables education businesses to apply a more personalized learning approach to students. By analyzing student data, businesses can provide learning content tailored to each student's needs, level of understanding, and learning preferences (Romero, C., & Ventura, S, 2017). By applying Data Science in the business of education, educational institutions can increase learning effectiveness, improve student experience, increase retention rates, and improve the overall quality of education. The development of Data Science in various sectors means that we have to start opening our eyes to see this big opportunity.

Motivation to learn

A. Learning Motivation Theories

A person will be successful in learning if he himself has the desire to learn. This is the first principle and law in educational and teaching activities. The desire or urge to learn is what is called motivation (Cook, D. A., et al, 2016). So education and teaching will be very difficult to achieve its goals optimally without motivation or encouragement for each individual who has a relationship with educational activities.

According to Atkinson, motivation is explained as a person's tendency to act increasingly in order to produce one or more results. AW. Bernard defines motivation as a phenomenon involved in stimulating action towards certain goals where previously there was little or no movement at all towards certain goals. Motivation is an effort to enlarge or create movement to achieve certain goals (Filgona, J., et al, 2020).

The basic understanding of learning motivation is the internal conditions of organisms, both humans and animals, that encourage them to do something. In this case, learning motivation includes a source of energy (energizer) for directed behavior. Motivation is the process of

giving enthusiasm, direction and persistence of behavior. Motivated behavior is behavior that is full of energy that is directed and long-lasting (Santrock, J. W., & Santrock, J. W, 2007).

In psychology, there are several known theories of motivation, starting from physiological motivation theory, Maslow's self-actualization theory, Murray's motivation theory, outcome motivation theory, motivation theory from psychoanalysis and intrinsic motivation theory and learning motivation theory. The following will explain some of these motivation theories: (Halamish, V., et al, 2019)

1. Physiological Motivation Theory

   This theory was developed by Morgan as the Central Motive State (CMS). This theory relies on physiological processes which are seen as the basis of human behavior or the center of all human activities. The characteristics of CMS are that it is permanent, long-lasting, that is, the central motif exists continuously without being influenced by factors outside or within the individual concerned.

2. Maslow's Self-Actualization Motivation Theory

   Abraham Maslow (1908-1970) was a humanist psychologist who argued that humans can work towards a better life. Maslow stated that there are five levels of basic human needs. These five levels of basic needs are then used as key understanding in studying human motivation (Abnisa, A. P, 2020).

B. Factors that influence student learning motivation

1. Learning methods

   Students are more motivated to learn if the methods provided are different. Innovative learning methods provide something new so that students do not get bored of learning. Each student's learning style may be different, therefore adaptive and innovative learning methods are needed in the teaching and learning process (Wardani, A. D., et al, 2020)

2. Teacher Behavior and Personality

   If a student has negative emotions such as fear or dislike towards their teacher, it can have a negative impact on their attitude towards the subject as a whole. On the other hand, kindness, optimism, positive feedback, and positive encouragement can influence students' motivation to learn.

3. Class Structure and Curriculum

   When students feel or see that the class follows a structure, and the curriculum and class materials have been prepared beforehand, it can

give students a greater sense of security. A sense of security is one of our basic needs. When it is provided in a learning environment, it allows students to fully focus on the learning material.

4. Parental Habits and Involvement
   Parental habits can indirectly influence children's motivation, especially intrinsic motivation. Motivation can take the form of attention by showing interest in the child's learning material, asking about lessons at school, actively listening, and helping with assignments or special skills taught at school.
5. Family Problems and Instability
   Just like a lack of safety in the classroom, a lack of safety at home can negatively impact motivation in education. Students who live with both parents, on average, get better grades than children who don't.

Learning achievement

A. Definition and Indicators of Learning Achievement

The teaching and learning process is important for an educator to know the level of success of students. How far are students' ability to understand and accept various things that have been conveyed by the lecturer? According to Syaiful Bahri Djamarah (Setyaningrat, E, 2016) learning achievement is the result obtained in the form of impressions that result in changes in the individual as a result of learning activities. Meanwhile, according to Bernard*, R. M., et al (2004), "learning achievement achieved by an individual is the result of the interaction between various factors that influence it, both within the student (internal factors) and from outside the individual (external factors)."

Based on this description, it can be concluded that learning achievement is the result of changes that a person has achieved after making learning efforts within a certain time as evidenced by success in mastering a number of knowledge and skills developed by subjects which are expressed in the form of letters and numbers obtained through tests. Learning achievement is an important factor in human life, because humans always need measurement and at the same time as a means to measure their abilities. For students in higher education, learning achievement is an important factor in knowing the extent to which students have succeeded in mastering the material studied during one semester.

Indicators are used as benchmarks to state that learning achievement can be declared successful if it meets the provisions of the

enhanced curriculum. According to Zheng, L., et al (2020) "Evaluation is an assessment of the level of success of students in achieving the goals set in a program." This can be seen to what extent changes have occurred through teaching and learning activities. Teachers must know the extent to which students will understand the material to be taught. Assessment provides information on the results of the teaching that has been implemented. To find out student learning achievements, you can use a tool to evaluate, namely tests.

Based on the opinion above, it can be concluded that knowing learning achievement can be done by providing an assessment or evaluation by giving a test, both written and verbal, which covers all the material that has been taught in the subjects taken in one semester.

B. The Effect of Educational Technology on Learning Achievement

The use of educational technology can help students learn more effectively and efficiently. Studies show that the use of educational technology can improve student learning achievement at school (Brasiel, S., et al 2016). One of the educational technologies that is popularly used is gadgets and the internet. Students can access various learning resources via the internet, such as video tutorials and learning applications. The use of gadgets and the internet can also improve students' ability to search, filter and evaluate information.

Apart from that, educational technology can also be used to increase interaction between students and teachers. For example, by using online learning applications, teachers can assign assignments and evaluate student achievement in real-time. Students can also communicate with teachers and other students through online discussion groups. The use of educational technology can also increase student learning motivation. Students will be more interested in learning if given access to interesting and interactive technology. In addition, students can also learn independently and pursue their interests through educational technology.

Overall, the use of educational technology can improve student learning achievement at school. However, to achieve optimal results, students, teachers and schools must work together and pay attention to several necessary things. The use of educational technology must be combined with effective teaching methods and learning strategies that suit student needs. In addition, schools must ensure that students have sufficient access to educational technology and can use it well (Cheung, A. C., & Slavin, R. E, 2013).

Therefore, schools must provide adequate training programs for teachers and students to ensure that they can use educational technology effectively. In addition, schools must provide sufficient support for students who do not understand or have difficulty using educational technology. In addition, schools must ensure that students can use educational technology well and can utilize this technology to learn effectively and efficiently.

CONCLUSION

Adaptive learning refers to a technology-driven approach that delivers personalized learning, enabling organizations to offer bespoke learning according to the individual needs and preferences of each employee. As a technology-enabled approach for personalized skill development, adaptive learning can help organizations cater to a diverse workforce. Adaptive learning platforms leverage technologies such as AI, ML, and Big Data analytics to personalize learning experiences based on learner interaction. Incorporating elements such as gamification, adaptive content delivery, and mobile optimization, make learning more engaging and accessible. Further, with adaptive assessments and immediate feedback, these learning platforms help improve learning outcomes and productivity through continuous skill development.

Adaptive learning based on data science is very necessary for students in learning motivation and learning outcomes. By applying Data Science in the business of education, educational institutions can increase learning effectiveness, improve student experience, increase retention rates, and improve the overall quality of education. The development of Data Science in various sectors means that we have to start opening our eyes to see this big opportunity.

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