TEACHERS' PERCEPTIONS OF PHYSICS SCIENTIFIC ARGUMENTATION TEST INSTRUMENTS BASED ON MODERN TEST THEORY USING QUESTION MODELING THROUGH E-LEARNING EDPUZZLE LMS

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ABSTRACT

The study aims to understand teachers' perceptions of scientific argumentation test instruments in physics based on modern test theory using question modelling through Edpuzzle LMS e-learning. It employed a mixed method with a Sequential Explanatory Design. Data were collected through questionnaires and analyzed descriptively. Initially, it was found that 75% of teachers had not developed assessment instruments capable of optimally training students, resulting in 68% of students struggling to understand physics learning. Additionally, 54% of students reported having identified and solved complex physics problems using scientific argumentation, while 46% had not. Based on survey results, 95% of students and teachers agreed that assessment activities encourage scientific argumentation, indicated by identifying scientific issues and explaining scientific phenomena. Hence, there is a need for a physics scientific argumentation test model based on modern test theory. For future research, it is suggested to explore how integrating this test model in different educational settings impacts students' scientific argumentation skills and understanding of physics concepts.

PERSEPSI GURU TERHADAP INSTRUMEN TES SCIENTIFIC ARGUMENTATION FISIKA BERBASIS TEORI TES MODERN MENGGUNAKAN PEMODELAN SOAL MELALUI *E-LEARNING EDPUZZLE* LMS

Kata Kunci:

Edpuzzle

E-learning

Teori tes modern

Tes argumentasi ilmiah

ABSTRAK

Penelitian ini bertujuan untuk memahami persepsi guru terhadap instrumen tes argumentasi ilmiah dalam fisika yang berbasis teori tes modern dengan menggunakan pemodelan soal melalui e-learning Edpuzzle LMS. Metode yang digunakan adalah metode campuran dengan Desain Eksplanatori Sekuensial. Data dikumpulkan melalui kuesioner dan dianalisis secara deskriptif. Awalnya, ditemukan bahwa 75% guru belum mengembangkan instrumen penilaian yang mampu melatih siswa secara optimal, mengakibatkan 68% siswa mengalami kesulitan dalam memahami pembelajaran fisika. Selain itu, 54% siswa melaporkan telah mengidentifikasi dan menyelesaikan masalah fisika kompleks menggunakan argumentasi ilmiah, sementara 46% belum. Secara keseluruhan, berdasarkan hasil survei, 95% siswa dan guru setuju bahwa aktivitas penilaian mendorong argumentasi ilmiah, yang ditunjukkan dengan mengidentifikasi isu-isu ilmiah dan

menjelaskan fenomena ilmiah. Oleh karena itu, diperlukan model tes argumentasi ilmiah fisika berdasarkan teori tes modern. Untuk penelitian mendatang, disarankan untuk mengeksplorasi bagaimana integrasi model tes ini dalam berbagai setting pendidikan mempengaruhi keterampilan argumentasi ilmiah siswa dan pemahaman konsep fisika mereka.

1. INTRODUCTION

The 21st Century is an era of knowledge that has driven the acceleration of technological development, characterized by a more comprehensive connection in science. In the 21st Century, education standards have changed to expose learners to real-world problems by implementing innovative learning models. These include using assistive technology, problem- and inquiry-based approaches, and developing higher-order thinking skills [1].

In the 21st Century, several abilities are the primary needs of students. One of these abilities is the ability to communicate effectively [2]. Good communication skills are essential in developing students' abilities in the 21st Century. To support this, students also need to have good scientific argumentation skills.

This research has vital significance in improving education in the 21st Century. Along with the development of science and technology, scientific argumentation skills are becoming increasingly vital in equipping students to think critically, reflect, and evaluate reasoning. The research focuses on scientific argumentation's important role in developing students' thinking skills as learners and future teachers [3].

The importance of these skills is not only limited to students' academic success but also plays a crucial role in facing real-world challenges, especially in social science [4]. Within this framework, this research makes a real contribution to preparing students as critical thinkers and responsive to global issues. Scientific argumentation skills are beneficial not only for students but also for teachers. It helps teachers in achieving learning objectives [5]. With scientific argumentation skills, teachers can be more effective in teaching and guiding students in the learning process.

Scientific Argumentation is one way to improve student learning outcomes. The impact improves concept understanding, cognitive processes, investigative competence, critical thinking and literacy achievement and represents data. Scientific argumentation is one way to improve student learning outcomes if low student learning outcomes indicate low scientific argumentation skills [6].

Some research results found that students' scientific argumentation skills are still categorized as low. It was found that only about 26.31% and 25.19% of samples had scientific argumentation skills in the aspects of justification and support, respectively [7]. Not much different from previous findings, students' average scientific argumentation ability is only 63.71 out of a total score of 100 [8]. By designing assessment instruments based on modern test theory, this research shows seriousness in improving the quality of assessment and provides a new view of measuring student abilities. Not only that but even at the student level (prospective teachers), they still do not understand scientific argumentation well [9].

Scientific argumentation has three aspects: claim, evidence, and reasoning. Claim is a statement submitted to be accepted as an answer to a question or problem. Evidence is information supporting the answer, evidence in the form of data collected by students or from other sources such as books/internet. Reasoning is an explanation showing why data

is used to support the answer or claim. Reasoning connects evidence with claims and includes scientific principles [10].

These indicators can be used as a reference in the implementation of the evaluation; for this reason, a valid measuring instrument is needed to measure the students' scientific argumentation level. Learning evaluation determines how well students learn and is a separate part of the investigation to improve education. Related to current educational praxis, an assessment is carried out to measure students' scientific argumentation. The level of success in education is also seen from the assessment process carried out to measure the educational goals that have been proclaimed [11]. Assessment must be carried out continuously to see and interpret the development of the learning process that has been carried out [12].

Researchers want to develop a modern theory-based scientific argumentation instrument using question modelling through e-learning Edpuzzle to obtain valid and efficient scientific argumentation evaluation results. Educational assessment uses two types of measurement theory, namely classical measurement theory and modern measurement theory. In assessing subject competency tests, teachers usually use classical scores. As we know, modern test theory can overcome some of the weaknesses arising from classical test theory. So, there is a need for teachers to understand modern measurement further. The application of modern test theory in measurement is more valid than classical test theory. Research is needed to assess students' abilities using modern measurement theory. The modern measurement theory model explains the interdependence of test item characteristics with test takers and vice versa. This improves the weaknesses found in classical test theory in analyzing test item measurements [13].

Measurement experts are trying to find alternatives to overcome the weaknesses that exist in classical theory. An alternative model that has these characteristics is a measurement model called item response theory (IRT). Modern test theory or item response theory was developed by measurement experts in the fields of psychology and education as an effort to minimize the shortcomings that exist in classical test theory [14]. The development of physics questions based on Modern Test Theory can be designed and presented through the Edpuzzle learning management system (LMS).

Edpuzzle media is an application and video-based learning media that all teachers can use to make lessons as attractive as possible; videos can be taken via YouTube, Khan Academy and Crash Course, then the video is inserted into the Edpuzzle application, and the teacher can ask questions and track whether the student watched the video given and how much the student understands the material given.

The results of Silverajah's research found that Edpuzzle activities have good potential in developing students' self-learning skills and supporting learning; Edpuzzle provides additional resources to make learning easier so as not to be academically abandoned, which is a common practice in the classroom [15]. In addition, based on the results of the research found that students enjoy using Edpuzzle in learning and things that must be considered well before using this media, especially in online learning, include supporting facilities and infrastructure, mental readiness of students in receiving learning and course careful preparation from educators, starting from the planning stage, making learning videos, editing, to the evaluation stage.

Based on the results of the needs questionnaire analysis conducted on 28 students in 12 schools in Lampung Province through Google form, 68% of students have difficulty understanding physics learning. The assessment instrument used during teaching according to 64% of students make their own, while 36% use assessment instruments from books/take from the internet. The results of the needs analysis questionnaire show that as

much as 95% of students and teachers agree that learning outcomes assessment activities are necessary to encourage scientific argumentation based on indicators of identifying scientific issues and explaining scientific phenomena. Therefore, there is a need for research on a scientific argumentation assessment instrument based on modern test theory using question modelling through e-learning Edpuzzle. Overall, this research is a constellation of problems and offers concrete and progressive solutions. Through strengthening modern theories, integrating technology, and applying innovative assessment instruments, this research is a step forward in facing the demands of education in this digital era.

Numerous studies on scientific argumentation have been conducted, including the impact of problem-based learning models with a scientific approach on scientific argumentation skills [7], enhancing students' scientific argumentation abilities [8], Toulmin's argument pattern (tap) based argumentation learning to improve argumentation skills [16], and comparing teachers' beliefs about high, medium, and low argumentation [5]. However, there is yet to be a study on teachers' perceptions of physics scientific argumentation test instruments.

Therefore, this study aims to determine the teacher's perception of the physics scientific argumentation test instrument based on modern test theory using question modelling through the Edpuzzle e-learning LMS. The sophistication of this research lies in integrating modern test theory and e-learning technology, which provides a holistic approach to assessing students' ability to develop physics scientific argumentation. The research gap filled by this study includes the need for research integrating modern test theory with e-learning in physics scientific argumentation. This research attempts to bridge that gap and provide a more complete picture of how this approach can be applied and contribute to the effectiveness of assessment in this area.

2. METHOD

The participants of this study consisted of 12 teachers and 128 students in 12 schools in Lampung Province. This study used a mixed research method adopted from Creswell, 2002 by combining Sequential Explanatory Design data collection strategies and qualitative and quantitative data analysis. The first step taken by the researcher was to conduct a literature study of the latest research results regarding the assessment of scientific argumentation. Then, the researcher developed a needs analysis instrument in physics learning, and the instrument was distributed to 12 teachers and 128 students through Google Forms in 12 schools in Lampung Province.

The data analysis techniques used in this research are data collection, reduction, display and verification. Data collection begins with inserting researchers into the research location conducted in 12 schools in Lampung Province. After the data was collected, the next step was to reduce the data by focusing on important things related to the core of the research, discarding unnecessary data, summarizing completely, then presenting the data and drawing conclusions.

The next step was the interview, which was conducted to discover the learning process in the school where the research was conducted. Interviews were also conducted to determine the respondents' reasons regarding the learning system in schools, the application of scientific argumentation in the classroom, the forms of evaluation conducted, and the use of digital or electronic platforms to conduct evaluations.
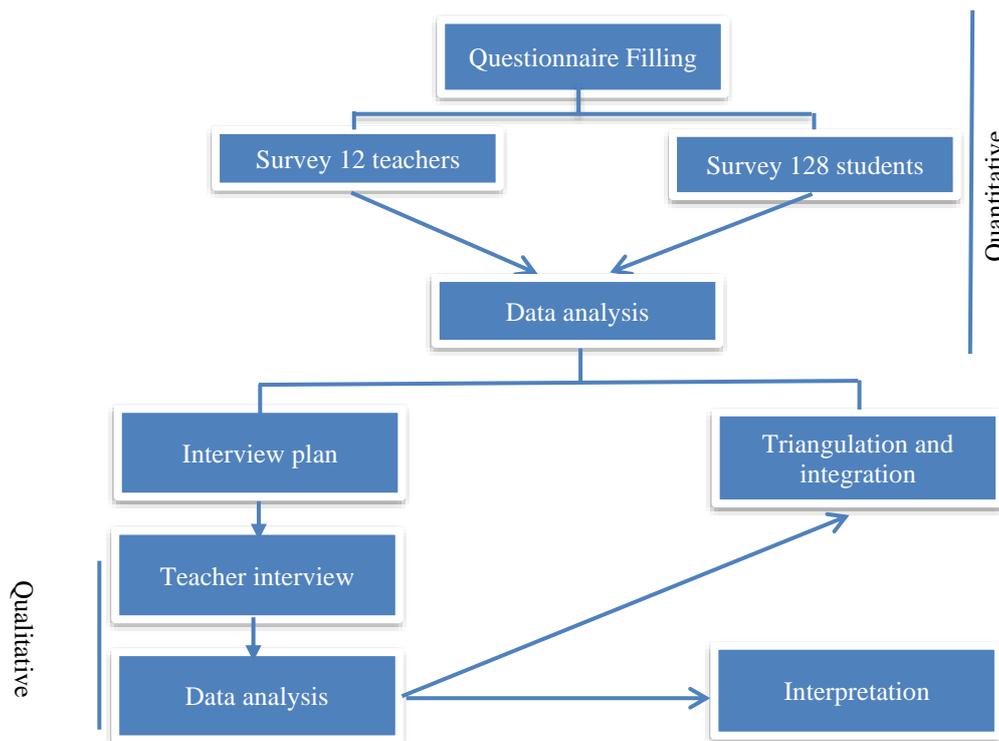
Figure 1. Schematic Research Design

The research data obtained from the teacher & student questionnaires were analyzed by grouping the scores and giving a score to each answer according to the scoring criteria, calculating the total score of each question's answer. The questionnaire uses a Guttman scale, which has an answer choice according to the content of the question, namely: "Yes" and "No" with a score of "1" and "0". Then, the percentage score is calculated and interpreted qualitatively, while the formula used to calculate the percentage score of each item is as follows [17].

$$\%Jin = \frac{\sum Ji}{N} \times 100\ \% \qquad (1)$$

Description:
% J_{in} = Percentage of answer choices-i
$\sum J_i$ = Number of respondents who answered answer-i
N = Total Number of respondents

3. RESULTS AND DISCUSSION

The following is part of the discussion and research findings based on the data analysis found. The results of distributing questionnaires to 12 teachers through Google Forms in 12 schools in Lampung Province are shown in Table 1.

Table 1. Interpretation Results of Teacher Perception Questionnaire

No	Question	Percentage (%)	
		Yes	No
1	After the current COVID-19 pandemic, is learning done offline?	81%	19%
2	Do you use your assessment instruments in learning?	81%	19%

3	Do you create assessment instruments containing models of assessment questions for various representations such as verbal, visual, symbolic, and mathematical?	19%	81%
4	Have you ever seriously developed an assessment instrument to train students to achieve competencies optimally?	25%	75%

Table 1 shows that none of the physics teachers have fully implemented scientific argumentation-based learning through modern test theory using problem modelling through e-learning Edpuzzle. Therefore, they realize the importance of scientific argumentation through modern test theory using problem modelling through e-learning Edpuzzle. This is in line with the demands of 21st-century learning, where scientific argumentation has a vital role in developing students' abilities in the 21st Century, such as critical thinking, reflection, and evaluating reasoning [3]. Scientific argumentation helps students develop critical thinking skills by enabling them to analyze arguments carefully. However, researchers want to examine this study's scientific argumentation dimensions.

It is expected that learners can follow and familiarize themselves with ways of learning that can improve their scientific argumentation. Thus, they will have broader thinking skills, not limited to understanding and basic knowledge (C1 to C3). In addition, it is hoped that students will not only rely on the pattern of questions presented by teachers who often only take information from printed books or student worksheets as their primary learning source without paying attention to the importance of scientific argumentation. The level of success in education is also seen from the assessment process carried out to measure the educational goals that have been proclaimed [11]. Assessment must be carried out continuously to see and interpret the development of the learning process that has been carried out [18].

In the era of globalization with the rapid development of technology, most students prefer to use learning and evaluation based on existing technology. For example, using learning platforms for teachers and students, such as Schoology, WhatsApp, Telegram, Google Classroom, Zoom Meeting, and Quiziz, is better than traditional evaluation tools on paper sheets. With scientific argumentation test instruments based on modern test theory using question modelling through e-learning, Edpuzzle can help and facilitate learning activities and the evaluation process so that students do not feel bored with the evaluation model that is commonly used, namely through paper sheets and students become more interested in understanding scientific argumentation test questions.

Scientific argumentation has three aspects: claim, evidence, and reasoning. Claim is a statement submitted to be accepted as an answer to a question or problem. Evidence is information supporting the answer, evidence in the form of data collected by students or from other sources such as books/internet. Reasoning is an explanation showing why data is used to support the answer or claim. Reasoning connects evidence with claims and includes scientific principles. In reality, only 25% of active learning processes implement and lead to the development of scientific argumentation.

Teachers conduct learning to students after the COVID-19 pandemic, namely 81% offline, 6% online, and 13% blended learning (offline and online). Teachers and students' learning platforms include Schoology, WhatsApp, Telegram, Google Classroom, Zoom Meeting, Google Meeting, and Quiz. In its implementation, teachers make assessment instruments based on students' competence during learning with a percentage of 81%, and 19% buy from publishers or take via the internet. This means that, in its implementation, teachers have not 100% made test instruments according to competencies, including the competence of scientific argumentation. Of the characteristics of the assessment

instruments teachers usually use in schools, as much as 81% contain simple question model assessments.

In comparison, 19% contain various representation assessment question models in verbal, visual, symbolic, and mathematical. This means that the use of modern test types or models of questions is still much less used, which means that teachers use more simple or classic test models. Preliminary facts show that 75% of teachers have not developed assessment instruments that can train students to achieve competencies optimally.

The following are the results of distributing questionnaires to 128 students through Google Forms in 12 schools in Lampung Province, which can be seen in Table 2.

Table 2. Student Perception Questionnaire Interpretation Results

No	Question	Percentage (%)	
		Yes	No
1	Is physics difficult to understand?	68%	32%
2	Do teachers use their assessment instruments in learning?	64%	36%
3	Have you ever identified and solved complex physics problems around you by asking for scientific opinions/arguments?	54%	46%
4	Do you agree that the assessment instrument contains model questions for assessing multiple verbal, visual, symbolic, and mathematical representations?	93%	7%

Based on Table 2, 68% of students stated that physics learning is still difficult to understand. Of the assessment instruments used during teaching, according to students, 64% make their own, while 36% use assessment instruments from books / take from the internet. Learners stated that 54% had never, while 46% had never identified and solved complex physics problems by asking for scientific opinions/arguments. In the assessment system, 93% of learners expect teachers to objectively assess and measure scientific argumentation in verbal, visual, symbolic, and mathematical forms.

Effective utilization of learning resources can significantly positively impact learning productivity, both for educators and learners. Varied and relevant learning resources can help improve learning productivity [19]. Learners can access various information and learning materials that support their understanding of specific topics. Utilizing learning resources allows learners to learn independently and adapt at their own pace. This can help them achieve maximum levels of mastery as they can focus on areas that require extra attention. A total of 95% of learners agreed that learning outcome assessment activities encourage scientific argumentation based on indicators of identifying issues scientifically explaining scientific phenomena. From several field facts and statements given by students and teachers, researchers want to develop a breakthrough: an instrument based on modern test theory using question modelling through e-learning Edpuzzle to measure students' scientific argumentation in physics material that can facilitate the evaluation process for both teachers and students.

The following is data from interviews with 12 Physics teachers. This is done to determine their reasons for modern test theory-based instruments using question modelling through e-learning Edpuzzle to measure scientific argumentation in physics material.

3.1 Teacher's Opinion on the Importance of Using E-Learning like Edpuzzle

In general, data collected through the results of a questionnaire to respondents shows positive results; namely, teachers already know that using e-learning, such as Edpuzzle, is a breakthrough in presenting technology-based tests or evaluations. In this interview, I will be asked about the urgency of the instrument using e-learning Edpuzzle with the following interview data:

Teacher 1, as the resource person, stated:

"The use of technology in learning can have a significant positive impact on learners' intrinsic motivation, self-efficacy, as well as their performance in examinations. This is supported by the fact that learning with technology tends to be preferred by learners. In this context, learners become more eager and excited in completing learning tasks independently, with minimal assistance from the teacher, especially after the use of apps like Edpuzzle in the classroom. One of the reasons why the use of tools like Edpuzzle is effective is because they provide engaging visualizations. These visualizations help learners to better understand and master the concepts being taught. In this way, learning becomes more interesting and relevant to the learner. Learner self-efficacy can also increase through the use of technology. When learners feel that they can cope and succeed in the tasks given through these tools, their confidence grows. This in turn can increase their intrinsic motivation to learn and achieve. In addition, learners tend to be more motivated when they have more control over their own learning, as provided by technological tools. They feel more independent and have the freedom to explore learning materials according to their own pace and learning style. Overall, the use of technology tools, such as Edpuzzle, can provide a more engaging, motivating and effective learning experience for learners. This can have a positive impact on their academic achievement and competency building in various aspects of learning."

Teacher 2, as the resource person, stated:

"The reason underlying the importance of using Edpuzzle-based E-Assessment is so that students also know the development of technology in the world of education, and are able to utilize the existing technology. By using Edpuzzle-based E-Assessment, the evaluation process becomes easier, besides being able to be done anywhere and anytime, the platform used is free so it doesn't require a lot of Internet bandwitdh, it is environmentally friendly because doing questions is no longer traditionally using paper."

Teacher 3, as the resource person, stated:

"Educators today not only need to have the ability and mastery of technology, but are also required to be more creative in developing teaching materials and test instruments by utilizing technology. The aim is to support effective learning and keep it going well, especially in an era where technology has become an integral part of students' daily lives. Technology-based test instruments are one of the ways educators can integrate technology in learning. One example of a tool that can be used is Edpuzzle, Edpuzzle allows educators to create interactive test instruments that can be tailored to the learning material being taught. By combining creativity with technology, educators can create test instruments that are more interesting and effective, thus supporting students' learning process better. In addition, the use of technology in learning can help students be more engaged and motivated to learn."

Teachers' opinions on using E-Learning tools like Edpuzzle show a positive trend. They acknowledge that tools such as Edpuzzle bring innovation in presenting technology-based assessments. Based on interviews, teachers expressed several essential aspects related to the use of technology in education. Teacher 1 highlighted the impact of technology on students' intrinsic motivation and self-efficacy, as well as improved exam performance. Teacher 2 emphasized the importance of using Edpuzzle-based E-Assessment to introduce students to technology development in education. Teacher 3 believes educators must integrate technology to develop teaching materials and test

instruments. Overall, this study affirms the importance of using technology in education and aligns with other research showing the positive impact of technology on learning. Technologies like Edpuzzle not only enhance student interest and motivation but also simplify the assessment process and assist students and teachers in achieving adequate learning outcomes.

3.2 Teacher's Opinion on Students' Scientific Argumentation in Physics

In general, data collection carried out through the results of a questionnaire to respondents shows positive results on the importance of measuring scientific argumentation through Edpuzzle-based test instruments. Still, teachers experience several obstacles in the application of physics learning. These obstacles are conveyed in the following interview results:

Teacher 1, as the resource person, stated:
"I am constrained because some students' interest and motivation in learning is still very low".

Teacher 2, as the resource person, stated:
"I have not practiced this skill because I have not made a test instrument based on modern test theory using Edpuzzle to measure students' physics scientific argumentation skills in physics material. In addition, there is a need for training in making instruments for physics scientific argumentation questions so that they can be in accordance with the provisions, and so that older dominant teachers can keep up with existing technological developments."

Teacher 3, as the resource person, stated:
"I feel that the allocation of learning time for students is still lacking, the concept of learning is only focused on the material and has not implemented the habituation of the learning process that leads to physics scientific argumentation, and the teacher is not accustomed to making evaluation questions for physics scientific argumentation so that for making questions as an evaluation, students are only limited to copying the questions in the existing learning resources".

The research findings highlight teachers' significant challenges in implementing scientific argumentation in physics education. Teacher 1 points out the issue of low interest and motivation among students, suggesting a need for more engaging teaching strategies. Teacher 2 emphasizes a lack of proficiency in creating test instruments based on modern test theory using Edpuzzle. This indicates a gap in training and familiarity with technological advancements, especially for more experienced teachers. This is further compounded by Teacher 3's observation of inadequate learning time allocation and a focus that is too narrow, centred only on the material, without cultivating a learning process conducive to scientific argumentation. Moreover, Teacher 3 notes a lack of practice in crafting evaluation questions for scientific argumentation, leading to a reliance on existing learning resources that may not adequately challenge students' argumentative skills. Collectively, these insights underscore the necessity for comprehensive training for teachers, both in technological tools and in designing effective learning and evaluation methods that foster scientific argumentation among students.

4. CONCLUSION

Based on the results and discussion, the perceptions of physics teachers and students in 12 schools in Lampung Province, there is a need for habituation between teachers and students in practising physics scientific argumentation skills to advance education and create students who can compete with the outside world in the era of the industrial revolution 4.0. In addition to the need for habituation, it is necessary to hold training in making physics scientific argumentation questions following the indicators of scientific argumentation competence. To measure the indicators of scientific competence tested by students, it is necessary to have a test tool in the form of a valid and efficient instrument so that it can facilitate the teacher and the students themselves, namely by utilizing advances in current educational technology, one of which is Edpuzzle. Based on the results of interviews with teachers regarding student evaluation instruments in 12 schools, an evaluation test tool is needed, namely a modern test theory-based physics scientific argumentation test instrument using question modelling through e-learning Edpuzzle LMS.

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