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Bibliometric Analysis: Interactive Learning Model Assisted by Digital Technology

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Abstract

The world of education is evolving rapidly alongside technological advancements, demanding educators to adapt to the changing times and leverage technology. Consequently, various teaching models have emerged, prompting an analysis to evaluate their effectiveness. This study employs meta-analysis, drawing data from multiple scholarly journals, to assess existing teaching models. Such models are indispensable in education, particularly in school settings. Notable examples include ASSURE, POE, ARIAS, PBL, virtual labs, and technology-based approaches such as online platforms like WhatsApp, Google Classroom, and YouTube applications. Each teaching model exhibits distinct characteristics, allowing educators to integrate or select them according to specific needs. This analysis aims to empower educators to make informed decisions regarding the adoption and customization of teaching models.

Keywords: *ARIAS, ASSURE, POE, Teaching Model, Virtual Lab*

Introduction

Education plays a pivotal role in preparing the next generation with high knowledge and intelligence, equipping them with diverse competencies. It serves as a bridge leading to a learning society that continually evolves, aiming to achieve a foundational framework reflecting the noble task of education in enhancing a nation's standard of living [1]. With the progression of time, educators are evolving, and consequently, teaching models are becoming more diverse. Previously, learning primarily involved passive listening to lectures from teachers, supplemented by homework assignments to gauge students' understanding. However, contemporary educational practices foster greater student engagement through various active and interactive teaching models, facilitating two-way communication. The goal is to enhance student enjoyment and comprehension of the material.

In reality, many students remain passive or disengaged in class, merely serving as listeners. Yet, teachers play a crucial role in students' learning processes, enabling them to discern between students who genuinely comprehend the material and those who merely grasp superficial knowledge. For instance, through the presentation of case studies or diverse problem-solving tasks, teachers can identify students with varying levels of understanding and involvement in the learning process.

In light of these challenges, we analyzed several journals focusing on teaching models utilizing both digital technology (online) and conventional methods. A teaching model refers to a plan or pattern used as a guideline for planning classroom instruction or tutorial learning [2]. An effective teaching model can boost students' enthusiasm, encouraging active participation in classroom activities. This assertion is supported by Ref. [3], who emphasizes the importance of optimal student engagement in

achieving educational goals, stating that the appropriateness of instructional materials alone does not guarantee educational success.

The ASSURE (Analyze, State, Select, Utilize, Require, Evaluate) teaching model emphasizes the utilization of media and technology to create desired learning processes and activities. One characteristic analyzed in the ASSURE model is prior knowledge. Prior knowledge refers to the level of knowledge possessed by students before the commencement of learning. Often, teachers assume uniformity in students' prior knowledge, yet this may not be the case. Prior knowledge significantly impacts learning outcomes, with students possessing strong prior knowledge demonstrating better learning capabilities [4],[5].

Another teaching model that integrates students' cognitive, affective, and psychomotor abilities is the POE (Prediction, Observation, and Explanation) model. Prediction, observation, and explanation are fundamental steps in the scientific method for studying factors influencing physical phenomena [6]. The POE model facilitates optimal mental and physical activity among students, aiding in concept comprehension and psychomotor skill development. According to White and Gunstone [7], the POE model efficiently fosters student discussions on scientific concepts. This strategy involves students predicting phenomena, observing through demonstrations or experiments, and subsequently explaining their predictions and observations. Thus, students acquire a deeper understanding of the concepts they learn. Problem-based learning (PBL) is a versatile teaching model that allows teachers to clarify the flow of learning, ultimately leading to better student comprehension, thus making the teaching and learning process in the classroom more enjoyable [8]. PBL involves clarifying a problem, defining it, gathering ideas based on prior knowledge, and identifying what students need to solve the problem, and what they do not know about the problem.

Each teaching model possesses its characteristics to differentiate one model from another. As stated by Ref. [8], the characteristics of the Problem-Based Learning model include: posing questions or problems, focusing on interdisciplinary connections, authentic investigation, producing products or works and presenting them, and collaboration. The Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS) teaching model aims to instill confidence in students, capture students' interest, foster independence through evaluation, and cultivate pride or satisfaction in students' achievements. Initially challenging material becomes more manageable as it is often encountered in everyday life. Thus, with the integration of the ARIAS teaching model, students' confidence is expected to be high, resulting in good learning outcomes [9].

The Aptitude Treatment Interaction (ATI) teaching model consists of specific treatments that are effectively used for students according to their abilities. The use of the ATI teaching model in group work or peer collaboration emphasizes the enhancement of students' learning outcomes. The Team Assisted Individual (TAI) model provides individual assistance within a group, with students being responsible for their learning [10]. The advanced organizer teaching model emphasizes the organization of prior knowledge to strengthen students' cognitive structures, while instructional videos can make learning more engaging and interactive. The combination of the advanced organizer teaching model with instructional videos is expected to have a significant impact on students' physics learning outcomes [11].

Videoscribe learning media is computer-based multimedia, consisting of audiovisual animations with narrated images and text, also known as whiteboard animation. The benefits or values arising from the use of animation media in learning include assisting students in studying a wide range of subject matter, containing various concepts, facts, and specific principles related to the subject matter [12]. Currently, educators utilize online learning through platforms like WhatsApp, Google Classroom [13], and YouTube [14]. Online teaching models were frequently employed during the pandemic. By leveraging available technology, educators aim to enable students to learn independently while maintaining interactive communication, thus ensuring students understand the content delivered by the teacher.

The education system must be sensitive to the dynamics of national life, which currently demands changes in various fields, as well as the dynamics of global changes known as the wave of globalization. Education in the knowledge age requires modern and professional educational management with an emphasis on technology utilization. By harnessing the advancements in information technology (IT), education is expected to become better and more flexible, both in the systems to be developed, the accessible materials for students and teachers, instructional media, the learning process to be applied, and how to find alternative solutions when obstacles arise for students, teachers, or education providers.

Methods

According to Ref. [15], teaching models are general patterns of learning behavior aimed at achieving the desired learning objectives. Teaching models will continue to evolve to the changing needs of learners. Professional teachers are required to develop teaching models, both theoretically and practically, covering aspects, concepts, principles, and techniques. Most teaching models are implemented using quasi-experimental methods, such as the ATI (Aptitude Treatment Interaction) and TAI (Team Assisted Individually) teaching models [10]. Additionally, initial and final assessments are conducted to gauge students' understanding of the lesson/topic [16]. To assess student progress, control, and experimental tests can be conducted [12]. In contrast, the POE teaching model is implemented through Classroom Action Research (CAR) or in Indonesian, known as *Penelitian Tindakan Kelas* (PTK). The aim is to find the appropriate action format to enhance the program and quality of teaching [6]. The method used in this research is the explanatory experimental quantitative method. This method is highly effective for data collection to measure the influence or effectiveness of a tool or media under specific conditions [17]. In this study, the variables are IT-based learning media as the independent variable and students' learning outcomes as the dependent variable. The operational definitions of each variable are as follows: The IT-based learning media used in this study consists of a computer equipped with interactive chemistry learning modules downloaded from www.e-dukasi.net. Students' learning outcomes in this study are limited to the cognitive domain. These outcomes are obtained from primary data in the form of student grades measured after the learning process. Indicators used to measure the impact of using IT-based learning media include students' learning outcomes, specifically: test scores after students undergo conventional learning processes and test scores after students undergo learning processes with IT-based learning media.

Results and Discussions

From the search of relevant journals for the study, 10 journals were obtained from various authors. Table 1 shows the results.

Table 1. Title and Authors

No	Title	Author
1	*Penerapan model pembelajaran POE (Prediction, Observation, Explanation) untuk meningkatkan hasil belajar fisika siswa kelas X1 SMA Negeri 1 Padang Ulak Tanding Tahun Pelajaran 2016/2017* [Application of the POE (Prediction, Observation, Explanation) learning model to improve physics learning outcomes for class X1 students at SMA Negeri 1 Padang Ulak Tanding for the 2016/2017 academic year]	Algiranto [6]
2	*Pengembangan Media Interaktif Menggunakan Model Assure Untuk Membantu Guru Dalam Pembelajaran Fisika Tentang Alat Ukur Listrik* [Development of Interactive Media Using the Assure Model to Help Teachers in Learning Physics about Electrical Measuring Instruments]	Puguh Santoso [18]
3	*Upaya Peningkatan Hasil Belajar Fisika Siswa Melalui Penerapan Model Pembelajaran Problem Based Learning (PBL)* [Efforts to Improve Student Physics Learning Outcomes Through the Implementation of the Problem-Based Learning (PBL) Model]	Parasamya & Wahyuni [19]
4	*Efektivitas Penerapan Model Pembelajaran ATI (Aptitude Treatment Interaction) dan Model Pembelajaran TAI (Team Assisted Individualy): Dampak Terhadap Hasil Belajar Fisika Siswa* [Effectiveness of Implementing the ATI (Aptitude Treatment Interaction) Learning Model and the TAI (Team Assisted Individually) Learning Model: Impact on Student Physics Learning Outcomes]	Antomi et al. [10]
5	*Pengembangan Modul Fisika Berbasis Model Pembelajaran Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS) Pada Materi Kalor dan Perpindahannya* [Development of a Physics Module Based on the Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS) Learning Model on Heat and Transfer Materials]	Ali [9]
6	*Pengaruh Penggunaan Media Pembelajaran Berbasis Videoscribe Terhadap Pemahaman Konsep Fisika Siswa SMP Ittihad Makassar* [The Effect of Using Videoscribe-Based Learning Media on the Understanding of Physics Concepts for Ittihad Middle School Students in Makassar]	Sakti [12]
7	*Pengaruh Model Pembelajaran Advance Organizer Menggunakan Video Pembelajaran Terhadap Hasil Belajar Fisika Peserta Didik Kelas XI* [The Influence of the Advanced Organizer Learning Model Using Learning Videos on the Physics Learning Outcomes of Class XI Students]	Hamdanillah et al. [11]
8	*Pengaruh Pembelajaran Daring Berbantuan Laboratorium Virtual Terhadap Minat Dan Hasil Belajar Kognitif Fisika* [The Effect of Online Learning Assisted by a Virtual Laboratory on Interest and Cognitive Physics Learning Outcomes]	Dewa et al. [16]
9	*Pengaruh Whatsapp, Google Classroom, dan Google Meet dalam Pembelajaran Fisika Terhadap Hasil Belajar Siswa* [The Influence of WhatsApp, Google Classroom, and Google Meet in Physics Learning for Results Student Learning]	Nupura et al. [13]
10	*Pengaruh Media Pembelajaran Berbasis Aplikasi Youtube Terhadap Aktifitas dan Hasil Belajar Siswa Kelas X pada Mata Pelajaran Mesin Konversi Energi di SMK Negeri 1 Koto XI Tarusan* [The Influence of YouTube Application-Based Learning Media on the Activities and Learning Outcomes of Class X Students in the Subject of Energy Conversion Machines at SMK Negeri 1 Koto XI Tarusan]	Delfisanur & Hasanuddin [14]

Table 2 displays the learning models and designs implemented by researchers.

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Table 2. Learning Models and Research Design

No	Learning model	Research design
1	POE (Prediction, Observation, Explanation)	Learning with the POE model uses three main steps of the scientific method, namely (1) making predictions, (2) observations about what is happening, and (3) explanation of the conformity of allegations (predictions) with facts (observation results)
2	ASSURE (Analyze, State, Select, Utilize, Require, Evaluate)	The stages of elaboration of the Assure learning model are as follows: 1. Learner Analysis. The main goal of the analysis is to discover students' learning needs so that they can obtain the maximum level of knowledge in learning. 2. Determining Standards and Goals. The next stage in the Assure learning model is to formulate goals and standards. In this way, it is hoped that students can gain certain abilities and competencies from learning. 3. Select Strategies Technology, Media, and Materials. The next step in creating effective learning is to support learning by using technology and media in the systematic selection of strategies, technology, and media as well as teaching materials. 4. Utilize Technology, Media, and Materials. 5. Developing Learner Participation.
3	Problem-based learning (PBL)	The instruments used in this research include initial test (pretest) and final test (post-test) sheets, teacher activity observation sheets, teacher ability observation sheets to manage learning, and student response questionnaire sheets.
4	ATI (Aptitude Treatment Interaction) and TAI (Team Assisted Individually)	This research uses a quasi-experimental design with a static group pretest-posttest using two experimental classes. Sampling was carried out using a simple random sampling method because the population was considered homogeneous. Using three variables, namely one dependent variable and two independent variables.
5	Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS)	This type of research is development research. The development model used in this research is the ADDIE (analyze, design, develop, implementation, and evaluation) model. The research instrument used a questionnaire.
6	Videoscribe	The research uses quasi-experiments. This research variable consists of the independent variable, namely videoscribe-based learning media, and the dependent variable, namely students' understanding of physics concepts. The research design used was a static group comparison. The research procedures used include the preparation stage, implementation stage, and final stage. Data collection techniques using tests and documentation. The research instrument used in this research was a test of understanding physics concepts.
7	Advance Organizer	The type of research used is quasi-experimental to find the effect of certain variables on other variables under controlled conditions. This research involves the independent variable, namely the advanced organizer learning model using learning videos, and the dependent variable, namely the students' physics learning outcomes. The sampling technique used was saturated. The instrument used in this research was an objective test, while for the affective domain (attitude) it was an observation sheet, and for psychomotor (skills) it used a performance assessment.
8	Online (Virtual Laboratory)	This type of research is quasi-experimental with the research design used, namely one group pretest-posttest. The sampling technique uses a saturated sample technique. Interest questionnaires and cognitive learning outcomes tests were given before and after online learning assisted by a PhET simulation-based virtual laboratory.
9	Online (WhatsApp, Google Classroom, and Google Meet) combined with an inquiry learning model	This research design uses an experimental class and a replication class (repetition of an experiment) with a one-group pretest-posttest design.
10	YouTube Application	The method used in this research is a quick experiment. 1. Conduct an initial test (pretest) on the same group of students receiving treatment 2. Provide treatment using YouTube media in the experimental class 3. Provide direct treatment to the control class.

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	4. Teaching and learning activities are carried out four times. 5. Carry out a final test (post-test) on the class group after they have been given different treatments.

After knowing the learning model and research design of each journal, Table 3 below shows the results of each research journal that has been carried out.

Table 3. Research result

No	Research result
1	This research was carried out in three cycles, cycle I and the topics used were heat and temperature changes. The topic of material in cycle II is heat and changes in form and in cycle III the material taught is heat transfer. In learning results by applying the POE model from the cognitive aspect (mastery of concepts), the results show a significant increase from cycle I-cycle III, namely reaching 93.54%, the psychomotor aspect results show a significant increase from cycle I-cycle III, namely reaching 89, 55%, the affective aspect (student attitude) showed a significant increase from cycle I-cycle III, namely reaching 81.85%
2	Validation results using a questionnaire by material experts showed that students were declared suitable for use as interactive media for Physics of Electrical Measuring Instruments with a very good score of 60%, interactive media design experts showed that students were declared good, observation of activity by the teacher so that This media can be declared suitable for use as an interactive media for the Physics of Electrical Measuring Instruments for high school students in class X.IPA. Developer Activity By Teacher shows more presentations reaching 100%
3	Based on the research conducted, there was an increase from cycle I to cycle III, both the increase in individual completeness rose to 94% and classical increased to 80%, the increase in teacher and student activities rose to 87% (students) and 90% (teachers), and increasing teachers' abilities in managing to learn.
4	effect size test result is 0.69, which is a medium criterion, for the effectiveness of the two experimental classes, which apply the ATI (Aptitude Treatment Interaction) learning model, and the class that applies TAI (Team Assisted Individually) learning. The effect size value is positive, so it can be concluded that the ATI learning model is more effective than the TAI learning model
5	The results of the N-gain test calculation of student learning outcomes show a high result, namely 0.72
6	From the results of hypothesis testing, the t-count value was 2.24, while the t-table value was 1.68. Because the Titun value is not in the H0 acceptance area, H0 is rejected and Ha is accepted, so it can be said that there is an influence on the learning outcomes of understanding physics concepts for the group of students taught with Videoscribe-based learning media and the group of students taught conventionally.
7	Based on data analysis higher than the t-table, the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted that there is an influence of the advanced organizer learning model via video learning on the second-grade physics learning outcomes of MIA SMAN 2 Labuapi students.
8	The results of data analysis can be concluded that there is an influence of online learning assisted by a virtual laboratory on students' interest in learning with a sig (2-tailed) value of less than 0.05 (0.0063 < 0.05) and there is an influence of online learning assisted by a virtual laboratory on students' cognitive learning outcomes with a sig (2-tailed) value smaller than 0.05 (0.000 < 0.05).
9	The level of effectiveness is in the strong effect interpretation, the four classes have scores that are not much different, meaning there is consistency in the treatment given to student learning outcomes.
10	The average learning outcomes in the experimental class (YouTube) were 83.75 and 86.16, while the average learning outcomes in the conventional control class were 74.11 and 75.00, respectively. The value of student learning outcomes and activities. So it can be concluded that the learning process using YouTube media is more significant for student learning outcomes and activities compared to using conventional media.

The results of the POE teaching model indicate an improvement in students' cognitive, affective, and psychomotor aspects of learning physics. There is a difference between the ATI (Aptitude Treatment Interaction) teaching model and the TAI (Team Assisted Individually) teaching model. The size effect tests show that the ATI Learning Model is more effective in physics learning [6].

In the results of learning using the ARIAS model, students' needs show that many students have other reference books for studying heat and its transfer, but they encounter difficulties in understanding it. Furthermore, most students do not have physics modules on the topic of Heat and its transfer.

Additionally, from students' responses, it can be concluded that students are rarely involved in demonstration or simulation activities. Although many students find the topic of heat and its transfer not difficult, almost all students require alternative methods to study physics, especially concerning heat and its transfer. Therefore, the development of Physics modules on this topic is necessary [9]. From the observation of Teacher Development Activities using the PBL model, the results indicate that there is a need for Physics learning modules based on students' and teachers' needs, school resources, and learning resource inventories [19].

Each teaching model has its characteristics, so when choosing a teaching model, it is essential to select one that meets the needs. For example, if students do not understand the previous material, it is advisable to conduct a quiz before presenting new material so that teachers can assess whether students have understood or not. If they have not understood, the ASSURE teaching model can be used. Online teaching models that utilize technology can still be implemented; however, other teaching models supporting student learning are needed. Technology serves as an auxiliary learning media that can be utilized, especially if schools lack equipment and materials for practical work, or if the material is difficult to understand or abstract. In such cases, virtual labs can be utilized, allowing students to experience and visualize the material they have acquired.

Conclusion

The implementation of teaching models can be tailored to the specific concepts and conditions in the classroom and combined with other teaching methods to enhance students' understanding of concepts. Therefore, when selecting a teaching model, teachers must consider factors such as the subject matter, class hours, students' cognitive development levels, learning environments, and available supporting facilities to ensure that the learning objectives are achieved. IT-based learning media can be used as a means to conduct simulation-based learning activities due to their ability to integrate color components, sound, and graphic animation, thereby delivering information and knowledge more vividly. When using technology-based or online learning media, consider the readiness of the equipment and materials that will be used, ensuring easy access and supportive environments. From the research findings, the use of IT-based learning media in chemistry learning processes can improve students' learning outcomes, showing a significant difference between the learning outcomes of students using IT-based learning media compared to those in conventional learning processes.

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