



Exploring digital technology integration in learning innovation

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Abstract

This study aims to explore digital technology integration in learning innovation. The learning process in schools has always placed students as objects that must be filled by a variety of information and a number of other piles of teaching materials. There is only one-way communication, namely between teachers and students by learning through an expository approach which is a mainstay in the learning method. This kind of teacher-student learning interaction has been going on for a long time which has an impact on rampant verbalism. This kind of learning is still conventional because the involvement of teachers with students in a classroom in the form of face-to-face is very important. Along with technological developments, especially advances in communication technology which causes the delivery system of subject matter can be done without having to face to face between teachers and students, but separate forms of learning between teachers and students but carried out simultaneously, that is distance learning (distance learning), such as tutorials. computer based, teleconference, correspondence courses, we based training and e-learning. The development of learning technology like this gives rise to computer-based learning, which presents packaging of learning materials in the form of hypermedia and learning through the internet such as electronic mail is no exception. This condition in learning is very beneficial, especially students will be stimulated to learn, there is active student learning, in fact students will learn more creatively because learning resources are very varied.

Keywords: technology, learning, integration

Introduction

The Industrial Era 4.0 is a term used to refer to an era with a fusion of technology that results in the physical, biological, and digital dimensions forming a blend that is difficult to distinguish ^[1]. For example, two people can share information directly with each other with digital assistance without having to be in the same place or simultaneously, both physically and biologically. The “digitalization of information and the massive use of artificial intelligence in various sectors of human life, including education, is a sign of the start of the industrial era 4.0” ^[2].

The development of digital technology in the current Industry 4.0 era has brought changes and influenced various aspects of human life, including education. Digital technology is “the thing that most influences the education system today, and it is due to the effectiveness, efficiency, and attractiveness of digital technology-based learning” ^[3]. If in the 1980s, artificial concrete objects dominated their use as a visualization tool for abstract concepts, now digital technology-based visualization is widely used as a more effective, efficient, interactive, and attractive ^[4].

One of the problems facing our world of education is the low quality of education, both in terms of the ongoing educational process and the product of education itself. The World Bank report on student reading test results in Indonesia is very concerning, not to mention the mathematics field from 38 countries. Indonesia is ranked 32nd ^[5]. Meanwhile, in terms of the educational process, especially learning, most of our teachers tend to learn in the sense of instilling subject matter that relies on low-level cognitive aspects such as remembering, memorizing, and accumulating information. Therefore, various accusations have been made against the government that does not care about the education of its nation. The low quality of educational products illustrates the quality of the process of

implementing the education system, which is related to many elements. However, the “teaching and learning process is the heart of education that must be taken into account because it is in this learning activity that the transformation of various concepts, values, and educational materials is integrated” ^[6].

Associated with future demands which are not only competitive but also closely related to various advances in technology and information, the quality of the learning system developed must be able to improve the existing weaknesses quickly. “One way to be developed is to change the conventional learning system to a more effective and efficient one with adequate facilities and infrastructure, and learning by utilizing information technology (IT) facilities through the Internet is an appropriate alternative” ^[7]. It can overcome various learning problems, even though the education system in Indonesia is very heterogeneous because of the geographical location problem, which has a considerable influence on the progress of IT.

We must realize that “the development of IT has entered various aspects of life, including the world of education, especially learning, which has been intervened by the existence of this technology, and along with the development of IT applications in the world of education, various learning materials have been produced and consumed by learners through the medium of IT in the form of very varied packaging” ^[8]. In contrast to the traditional learning process, which relies on the teacher as the first and foremost learning resource, other sources are only complementary to learning activities usually outlined in the teaching program outline. Electronic learning is essentially learning or learning through the use of computer technology or the Internet. Such learning technology can also be called web-based learning. This discussion about E-Learning is the main focus of learning this module. Therefore in detail, the

presentation of this module material includes an explanation of the concept of electronic learning, learning development models through the Internet, and packaging of learning materials through IT.

Advances in IT have had a positive impact on the progress of today's world of education. "Especially computer and internet technology, both in terms of hardware and software, provide many offers and options for the world of education to support the learning process, and the advantages offered are the speed factor for obtaining information and multimedia facilities that can make learning more engaging, visual, and interactive" [9]. In line with the development of internet technology, many learning activities can be done by utilizing this technology. "With the developments in the field of learning as described above, the traditional-conventional learning process that occurs in the classroom in the current era of decentralization and globalization will slowly but surely begin to lose shape. In addition, on a larger scale, traditional-conventional learning activities require substantial costs in preparing the infrastructure (rooms, laboratories, libraries, furniture, learning media, and others). With such conditions, nowadays, many education providers are starting to look at the application of the concept of distance learning as alternative learning that is considered more effective and efficient, especially as the influence of the emergence of very rapid developments that occur in the field of telecommunications technology and IT" [10]. Various technologies and applications are created to support the operational activities of human and organizational life, including teaching and learning activities.

1. IT in Learning

The term IT was born in the twentieth century and began with the formation of the information society. The term IT, which uses the word information, is closely related to the term communication technology which was known earlier. "There is communication technology that functions as information distribution, and IT that functions as information storage and processing, and it last function causes people to call communication technology IT. IT is the processing, processing, and dissemination of data by a combination of computers and telecommunications" [11], and it is more about working on data. IT focuses its attention on how data is processed and processed using computers and telecommunications. Thus it is increasingly clear that the birth of the term IT is based on data processing technology development. If communication technology is a tool to increase people's communication ability, then IT is the processing of data by computers and telecommunications [12]. This separation of terms is moderately shown by the organization of international communication scholars who group communication scholars who study communication technology in the "Communication and Technology" division. In contrast, communication scholars who study IT are grouped into the information systems division [13].

In a broader context, IT includes all aspects of computers and communication machines and techniques used to capture, collect, store, manipulate, transmit and present an effective form of information. "Computers that control all forms of ideas and information play a significant role" [14]. Initially, IT was defined as hardware and software to carry out several data processing tasks. However, its development got a more comprehensive response, where IT also includes

communication techniques to send information. Thus, all forms of technology implemented to process and send information in electronic form, transaction processing software, software for worksheets, communication equipment, and networks, are included in the IT area [15]. IT not only as a physical means but can function as a transmitter of social values for its users.

Several views lead to the definition of E-Learning, including a) E-Learning is a convergence between learning and the Internet; b) E-Learning uses strengths and relationships, especially in internet technology, but can also occur in innovative work relationships and digital satisfaction for learning purposes; c) E-Learning is the use of networked technology to design, deliver, select, organize learning; d) E-Learning is learning that can occur on the Internet; e) E-Learning is dynamic, operates in real-time, collaborative, individual, comprehensive; f) E-Learning is sending something through electronic media including the Internet, intranet, extranet, satellite broadcast, audio/video tape, interactive television, and cd-room; g) E-Learning is the whole variety of internet and web technologies to create, deliver, and facilitate learning; and h) E-Learning uses strengths and work relationships for learning anywhere and anytime [16]. From the above definitions, it can be concluded that E-learning is an effort to connect learners with learning resources (database, experts/teachers, library) who are physically separated or even far apart. Interactivity in the relationship can be done directly (synchronous) or indirectly (asynchronous).

Technological advances that unite advances in computing, television, radio, and telephone into a single unit (integrated) are formed as a global information and communication revolution. This revolution is manifested by technological advances in personal computers, data communication and compression, bandwidth, data storage and access, multimedia integration, and computer networks, and IT can be a driving tool for the nation's progress. "One of the most significant impacts is development in the field of education" [17]. It is a bridge to a developed nation where people can have the tools to help them develop their businesses and enjoy the results quickly, cheaply, and evenly. Information and communication technology can help make significant changes in many countries. In today's global era, there are no more barriers to access to information so that all levels of society have the same opportunity to develop themselves in all aspects of life. Of course, as Indonesians, we cannot resist this "boom" of Information and Communication Technology. The role of the world of education is to become the main door to filter, transfer, and impose constraints so that traditional positive values are not easily eroded, and we even hope to join synergistically. We must think together to find the best format to utilize and evaluate the role of Information and Communication Technology in improving the quality of education in this beloved homeland. In a relatively short period since the Internet was first opened for public use, the information network has, and this communication has spread with extraordinary speed to all corners of the world, including Indonesia. According to the latest data, millions of people use the Internet, which is still growing, along with the need for information increasing awareness and the increasing number of conveniences that can be obtained through the Internet [18].

The number of internet users in Indonesia reached 205 million in January 2022. It means that 73.7% of Indonesia's population has used the Internet. The value is also 1% higher than the previous year's period ^[19]. In January 2021, the number of internet users in Indonesia was recorded at 203 million people. Seeing the trend, the number of internet users in Indonesia continues to grow every year. In 2012, the number of internet users in Indonesia was only 39.6 million. This year, the number of internet users in the country has increased five times compared to a decade ago. Meanwhile, the surge in users occurred in 2017 when the number became 136 million. Furthermore, the average Indonesian uses the Internet for 8 hours and 36 minutes daily. In addition, 94.1% of internet users in Indonesia use mobile phones. However, Indonesia is one of the countries where many people are not connected to the Internet. We Are Social noted that 73.05 million people in the country are not yet connected to the Internet. That number is the eighth largest in the world. India occupies the first position with 742 million people not connected to the Internet. China is in second place with 421.43 million people who are not connected to the Internet. After that, 144.43 million people in Pakistan are not connected to the Internet ^[20]. The government is expected to continue supporting internet coverage expansion to all corners of the country. Because, in this digital era, the Internet can help people access information, whether for education, business, or entertainment purposes.

Public awareness from both content providers and user audiences is also quite encouraging. At this time, five sites in Indonesia form an online education community. The seven sites grew because of the public's need for an education service through the Internet, and apparently, this need was responded to positively by the private sector, which received support from the Ministry of National Education ^[21]. Particular sites in the field of education grew from the initiative of the Association of Indonesian Internet Network Entrepreneurs, which later received support from the Ministry of National Education and other private parties such as computer manufacturers. With the Ministry of National Education's support, the school has now succeeded in forming an educational community that has. More and more schools are being incorporated. With the education community, the increasing number of internet cafes, and the increasing number of households that have computers connected to the Internet, the opportunities for students to use the Internet are also getting higher. Thus, it can be assumed that the opportunity to use the Internet for educational purposes or, more specifically, to learn in schools in Indonesia is possible and feasible to implement.

2. Learning through IT

The development of human civilization is accompanied by the development of ways of delivering information. Starting from meaningless pictures on cave walls, laying milestones in the form of inscriptions to the introduction of the world of information flow, which became known as the Internet. The information conveyed has also evolved from simply describing the situation to fighting tactics. Specifically, the use of the Internet for educational purposes, which is increasingly widespread, especially in developed countries, shows that with this media, it is possible to hold a more effective teaching and learning process ^[22]. It happens because the nature and characteristics of the Internet are

pretty distinctive, so it is hoped that it can be used as a learning medium as other media have been used previously, such as radio, television, interactive CDROM, and others. Using the Internet as part of school learning activities is not as simple and easy as imagined because many things must be studied, explained, and done seriously before implementing it ^[23]. As a medium that is expected to be part of a teaching and learning process in schools, "the Internet must be able to provide support for the implementation of an interactive communication process between teachers and students as required in a learning activity. The conditions that must be able to be supported by the Internet are mainly related to the learning strategies to be developed, which, if described simply, can be interpreted as communication activities carried out to invite students to carry out assignments and assist students in obtaining the knowledge needed in order to do the assignments" ^[24].

"Learning strategies which include teaching, discussion, reading, assignments, presentations, and evaluations, in general, their implementation depends on one or more of the three basic modes of communication dialogue as follows" ^[25]: a) Dialogue/communication between teachers and students; b) communication between students and learning resources; and c) communication among students. "An optimal learning process is hoped to occur if these three aspects can be carried out with a harmonious composition. The design of a lesson by prioritizing a balance between the three communication dialogues is essential in a Web-based learning environment" ^[26]. The Internet is a multi-faceted medium. On the one hand, the Internet can be used to communicate interpersonally, for example, by using e-mail and chat as a means of one-to-one communication.

On the other hand, with e-mail, users can communicate with more than one-to-many communications). Even as mentioned earlier, the Internet can facilitate discussion and collaboration activities by a group. In addition, its ability to organize face-to-face communication (teleconference) allows internet users to communicate audiovisually so that real-time verbal and non-verbal communication is possible. The Internet will "indeed be able to be used in learning settings in schools because it has distinctive characteristics, namely 1) as an interpersonal media and also as a mass media that allows one-to-one and one-to-many communication to occur; 2) has interactive nature, and 3) enabling synchronous and asynchronous communication, thus enabling the implementation of the three types of communication dialogue which is a requirement for the implementation of a teaching and learning process. Several studies have shown that the Internet can be used as a learning medium, such as a study conducted on approximately fifth and sixth graders of elementary school" ^[27]. The students were included in two groups: the experimental group, which in their learning activities were equipped with access to the Internet, and the control group. After two months, it showed that the experimental group got a higher score based on the final test results. Another study on using the Internet to support English teaching and learning activities showed that the students involved in the experiment significantly improved their ability to write and compose in English. The Internet has a very strategic role. Even with its distinctive characteristics, the Internet can become the most prominent and widely used learning media in the future.

As a basis for using the Internet as a learning medium in a school setting, several things need proper attention and handling so that the implementation of the use of the Internet for learning can be successful, namely: a) Environmental factors, which include educational institutions and the community; b) Students or learners include age, background, culture, language mastery, and various learning styles; c) Teachers or educators include background, age, teaching style, experience, and personality; d) Technological factors include computers, software, networks, connections to the Internet and various skills needed to be related to the application of the Internet in the school environment ^[28].

The areas in question are design, development, utilization, management, and assessment. The design area is often limited to the planning function at the macro and micro levels. Regarding technology use, research and design theory often follow the practitioner's exploration of the impossibility and capabilities of new hardware or software. In general, the design in the area of learning technology is to determine the conditions of learning. The aim is to create product strategies at the macro (program and curriculum) and micro (lessons and modules) levels. The design area covers at least four areas of theory and practice. The design area includes studying instructional system design, message design, learning strategies, and learning characteristics ^[29].

The development area is rooted in the issue of media production. The development in question is translating design specifications into physical form. This area covers a wide variety of technologies used in learning and consists not only of learning hardware but also of software. The development area can be explained by content-driven messages, theory-driven learning strategies, and physical manifestations of technology (hardware, software, and learning materials). This technology is the driving force of the development area, which can be organized into four categories: printing technology, audio-visual technology, computer-based technology, and integrated technology ^[30].

The utilization area is the oldest area of the learning technology area. This area originated from the visual education movement with the establishment of school museums. One of the concrete forms is to prepare exhibitions for learning purposes. The function of this area is so important because it discusses the relationship between students and learning materials or systems. This function is critical because the learner's use is the only reason for learning materials. Why bother procuring and manufacturing learning materials if they are not used or cannot be utilized. The four categories in this utilization area are media utilization, innovation diffusion, implementation, institutionalization, and regulatory policies. The management area includes controlling learning technology through planning, organizing, coordinating, and supervising. The complexity of managing various sources, personnel, design, and development efforts will increase as the business of an educational institution grows. In short, there are four categories in the management area: project management, resource management, delivery system management, and information management.

3. Integrating Learning with Technology

Three forms of learning systems through the Internet are worthy of consideration as the basis for developing a learning system by utilizing the Internet, which will be

explained as follows: a) The web course uses the Internet for learning purposes, where all parts of learning materials, discussions, consultations, assignments, exercises, and exams are fully delivered via the Internet ^[31]; b) Some learning materials, discussions, consultations, assignments, and exercises are delivered via the Internet ^[32]; and c) Web-Enhanced Course is the use of the Internet for education to support improving the quality of teaching and learning in the classroom ^[33].

4. Learning Model Development Using Technology

It is necessary first to examine all the elements and aspects described above to obtain a guide as decision-making material in developing an internet-based learning system to develop an internet-based learning system ^[34]. In addition, it is also necessary to consider and evaluate several things that are no less important, including:

1. Profits

The extent to which the internet-based learning system will provide benefits for the institution, teaching staff, managers, and especially the benefits that students will obtain in improving their quality when compared to the conventional face-to-face learning implementation;

2. Cost of infrastructure development and procurement of software equipment;

3. The costs required to develop infrastructure and procure equipment and software are not small. For this reason, it is necessary to consider whether to build a network in whole or in stages and whether to procure utterly new equipment or upgrade existing ones. It should be noted that the original software is not pirated, but the price is relatively high. For this reason, the ability to provide funds is considered in every decision-making;

4. Operational and maintenance costs

A system will work if it is appropriately managed. Thus, this internet-based learning system also requires high operational and maintenance costs. Operational costs, management fees, Internet Service Provider subscription fees, separate telephone line subscription fees, and telephone credit fees if you wish to use dial-up. Meanwhile, maintenance costs include replacing damaged parts due to age or incorrect usage procedures. It can be done to overcome these operational and maintenance costs by utilizing the system to generate income, among others by opening internet cafes for the public, conducting pieces of training, and others;

5. Human resources

Human resources with high competence and integrity are required to develop and manage learning networks and systems. It includes teachers who must understand the principles of learning through the Internet. For this purpose, identification and preparation of this person should be carried out, whether it can be supplied from within or must recruit new workers. Training needs to be given to equipping these workers, taking into account the length of the training time, the place of training, and the method of training so that they can produce qualified personnel;

6. Students

No less important to note is knowing the extent to which students are prepared to participate in learning activities using the Internet that will be held. If the Internet is something new for most students, it is necessary to make a series of efforts to condition them

so that they are ready to participate in the new learning system actively. It is not easy to change the habits of those who have been accustomed to conventional face-to-face learning for years, which has become an ingrained learning style or habit.

5. Learning Applications Using Technology

In the learning process, e-learning applications can cover planning, implementation, and evaluation aspects. Learning planning is a picture of a plan (scenario) that projects several activities and actions to be taken during the learning process. Thus, the application of learning planning based on e-learning contains plans, estimates, and an overview of learning activities using computer networks, intranet, and the Internet. Learning planning has four main components: teaching materials/materials, teaching and learning activities, and evaluation. The objective component determines the direction of learning activities^[35]. From the formulation of learning objectives, it must be projected how the learning process takes place and the student's abilities as a result of learning. The formulation of learning objectives describes not only the results but also the activities or processes—the determination of teaching materials that will serve to give meaning to efforts to achieve goals. In conventional learning, teaching materials for each subject are already available in textbooks and are delivered face-to-face by the teacher using the chosen learning method. While teaching materials for e-learning, apart from taking advantage of the available sourcebooks, they can also directly access teaching materials/information on several previously created web pages. Thus the acquisition of learning information will be broader, deeper, and varied. Teaching and learning activities included in the lesson plan essentially contain descriptions of teaching materials/materials, learning methods, and learning tools/media. For e-learning-based learning media, the determination of teaching materials only contains the main points, while a complete description of the main points of teaching materials is provided on a web page that students will access. Evaluation as the last component in learning planning measures the extent to which the learning objectives have been achieved and what actions must be taken if these objectives have not been achieved. Through an e-learning-based learning approach, evaluation activities to find out the results can be carried out in various ways, and each student can see and follow orders on the web page. It can be in the form of questions, assignments, or exercises students must do^[36].

6. Packaging the Learning Material through IT

Learning materials can be translated as a set of materials used by someone to carry out learning activities. Learning materials are part of the dynamic elements in the learning process in addition to student motivation, learning aids, learning atmosphere, and condition of the subject of study^[37]. Learning materials are learning elements that are important to be considered by teachers. Through these materials, students can learn things needed to achieve learning goals. For this reason, the determination of learning materials must follow the objectives to be achieved, whether in knowledge, skills, attitudes, or other experiences^[38]. In the learning process at school, these learning materials are usually outlined in the learning program outlines or syllabus.

Teaching materials or learning materials are learning materials that are directly used for learning activities. Thus, teaching materials usually contain all coverage of material from all subjects. The material is a medium or means used to convey learning messages; it can be in the form of visual, audio, or audio-visual messages. Generally, the media can convey messages and can be categorized into two: printed and non-printed materials. In this case, teaching materials can be developed as teaching materials projected as printed materials, although the learning materials will be developed as learning materials transferred for the benefit of learning via the Internet or e-learning^[39]. Teaching materials are included in the category of instrumental input, which acts as a support and is a sub-system for implementing learning activities. This teaching material is not only used as a teacher's guide in teaching but must be used for individual student learning activities. Students, in this case, can study learning objectives and subject matter and assess the achievement or success of learning activities that have been carried out.

Teaching materials developed must follow the curriculum of a subject, used as the primary source of learning, such as textbooks or teaching materials that are supporting for the benefit of enrichment or teaching materials that are in the category of supplements. With teaching materials as the primary source, students do not need to look for other sources; they just need to study the primary teaching materials carefully^[40]. The use of teaching materials related to teaching and learning activities can be divided into two categories, namely the categories of teaching materials used in teaching learning activities with direct guidance from the teacher, such as using textbooks as face-to-face materials. Second, teaching materials are used by students to study independently without the help of teachers, for example, using modules or other specially designed teaching materials such as Independent Learning Materials. Learning materials can be categorized into two groups, namely the printed material group and the non-printed tire group. Printed materials include books, modules, program packages, comics, comics, posters, and leaflets, while non-printed teaching materials include audio, videos, and films. Characteristics of printed learning materials are: a) Teaching materials intended for curricular, instructional, and scientific development purposes; b) Teaching materials also accommodate regional resources (potential) without ignoring the previous points; c) Teaching materials that optimize independent learning, especially for students; d) Teaching materials can provide enrichment, especially for student learning activities, through assignments, and other recommended source references and 5) The teaching materials developed are teaching materials whose primary readers are students.

Packaging is applied equally to all consumer products and industrial products. There are two main reasons related to the function of packaging, and the first is the existence of a more complex civilization and a higher standard of living which makes it necessary for a product to have neater packaging in a practical sense. Second, packaging becomes an essential part of the process. Sales or distribution is related to the user's interest in buying or using the product^[41]. Good packaging will not sell anything if the packaging concept is wrong, even though it does not mean selling a lousy product.

In contrast, insufficient packaging can give a bad image of an excellent product, however good the thought and concept of the packaging. Suppose the packaging is used to its fullest in the marketing process. In that case, it must immediately perform several vital functions, protect the product and keep it in good condition, giving the impression of being easy to use, easy to distribute economically, cost-effectively, and marketable. Based on the concept of packaging and packaging above, it can be understood that the packaging aspect is part of the design process related to the function and appearance of a product. The product in question is learning materials through IT. Thus the learning materials (products) in question must meet the requirements of being protected and maintained in good condition, giving the impression of being easy to function, easy to distribute economically, cost-effectively, and having marketability.

Conclusion

Utilizing IT both as a source of learning and learning media is one way that is expected to be effective in overcoming the weaknesses of conventional learning problems. By using IT, it is expected that learning interactions will occur between students and students, and students with learning resources are more communicative. Through the various learning models offered, it is hoped that student learning interactions will form, which not only emphasize the process of utilizing but also searching, researching, or extracting various learning resources so that a more comprehensive and integrated way of thinking is formed. Through these interactions, it is hoped that there will be an increase in thinking skills, interaction skills, and other ideal skills. It can be done when support from institutions, teachers, students, communities, and technology contributes positively to implementing IT-based learning. Learning models through the Internet that deserve to be considered as the basis for considering learning systems using the Internet are web courses, web-centric courses, and web-enhanced courses. Each has advantages and disadvantages depending on the angle from which the needs can be met. It is a consideration for deciding the development of learning through the Internet, such as benefits for institutions, operational and maintenance costs as well as infrastructure development, human resources which have high competence and integrity, and no less important is the readiness of students who will take part in learning activities using the Internet. Based on further studies and considerations, learning systems can be developed through fully existing internet facilities, learning program development software with internet web course tools, and own development of learning programs. Each method can be chosen depending on the model used to implement learning via the Internet. The model in question can be selected as selective, sequential, and laboratory models. Learning materials are a set of materials a person uses to carry out learning activities. Learning materials can be packaged in such a way as to attract learners so that they are easily distributed effectively and efficiently in achieving learning goals. Learning materials can be categorized into two groups: printed teaching materials and non-printed or non-printed learning materials. The developed learning materials can be used as the primary source of learning and supporting learning materials for enrichment or supplement categories. These two groups can be seen from the use of teaching materials in the learning process, namely teaching materials used in

learning with direct guidance from the teacher and teaching materials used by students for independent study without direct guidance from the teacher. About e-learning, there is a tendency that teaching materials are suitable for distance learning purposes, such as modules.

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