Journal of Education Technology
Volume 6, Number 4, 2022 pp. 755-764
P-ISSN: 2549-4856 E-ISSN : 2549-8290
Open Access: https://ejournal.undiksha.ac.id/index.php/JET

The Urgency of Prototype Curriculum Based E-Book for Mathematics Learning for Vocational School Students

Lulus Budiarto[1*], Muhammad Akhyar[2], Djono[3]
[1,2,3] Department of Educational Technology, Sebelas Maret University, Surakarta, Indonesia

ARTICLE INFO

Article history:
Received September 01, 2022
Revised September 02, 2022
Accepted October 20, 2022
Available online November 25, 2022

Kata Kunci:
Kurikulum Prototype, Matematika, E-Book, Bahan Ajar, TIK

Keywords:
Prototype curriculum, mathematics, e-books, teaching materials, ICT

DOI:
https://doi.org/10.23887/jet.v6i4.53286

ABSTRAK

Perkembangan dan paradigma pembelajaran selalu diikuti dengan penyesuaian pada pelaksanaan aktivitas pembelajaran. Saat ini sedang ditawarkan sebuah solusi untuk meningkatkan kualitas pembelajaran melalui penerapan kurikulum prototype. Dengan tetap penerapannya melakukan integrasi dengan perangkat TIK untuk menunjang proses pembelajaran. Pada penelitian ini bertujuan untuk melihat potensi dan peluang pengembangan sebuah produk bahan ajar berbasis E-Book untuk pembelajaran matematika. Penelitian ini termasuk ke dalam pendekatan mixed method. Subjek penelitian terdiri atas guru, dan sejumlah 42 siswa. Sementara data yang dikumpulan berupa data kualitatif dan kuantitatif. Data kualitatif dikumpulkan dengan Teknik pengamatan, dan wawancara yang instrumennya yaitu lembar pengamatan dan pedoman wawancara. Data kuantitatif dikumpulkan dengan Teknik non tes yatiu Angket dan diikuti kuisioner sebagai instrumennya. Data hasil penelitian akan dianalisis dengan secara deskriptif dengan analisis interaktif melalui pengumpulan data, reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa selama pelaksanaan pembelajaran, guru pada dasarnya sudah menggunakan media berbasis TIK yang terbatas pada jenis slide presentasi dan internet, respon siswa menyatakan mereka butuh bahan ajar berbasis TIK untuk pembelajaran matematika (92,9%), sejumlah 90,5% siswa juga setuju terhadap pengembangan bahan ajar berbasis TIK dalam format e-book untuk pembelajaran matematika. Hal ini tentu merupakan inisiatif dan keinginan yang harus diwujudkan agar tercipta pelaksanaan pembelajaran yang inovatif. Dengan demikian, hasil penelitian ini dapat dijadikan sebagai dasar untuk mengembangkan sebuah inovasi melalui bahan ajar berbasis TIK dalam format e-book untuk peningkatan proses pembelajaran di SMK.

ABSTRACT

The development and learning paradigm is always followed by adjustments to the implementation of learning activities. Currently, a solution is being offered to improve the quality of learning through the implementation of *kurikulum prototype*. This study aims to see the potential and opportunities for product development of teaching materials based on E-Books for learning mathematics. This research belongs to the mixed methods approach. The research subjects consisted of teachers, and 42 students. While the data collected in the form of qualitative and quantitative data. Qualitative data were collected with technical observations, and interviews with the instruments, namely observations and interviews. Quantitative data were collected using a non-test technique, namely a questionnaire and followed by a questionnaire as an instrument. The research data will be analyzed descriptively with interactive analysis through data collection, data reduction, data presentation, and drawing conclusions. The results showed that during the implementation of learning, teachers had basically used ICT-based media which were limited to the type of presentation slides and the internet, student responses stated that they needed ICT-based teaching materials for learning mathematics (92.9%), total 90.5% of students also agrees with the development of ICT-based teaching materials in e-book format for learning mathematics, this is certainly an initiative and desire that must be realized in order to implement innovative learning. Thus, the results of this study can be used as a basis for developing an innovation through ICT-based teaching materials in e-book format to improve the learning process in vocational high schools.

1. INTRODUCTION

The impact of the COVID-19 pandemic on the world of education is vast with the implementation of PJJ (Distance Learning) during the emergency period of the spread of Covid-19, which resulted in educators and students having to adapt to the methods and learning models applied (Abbas et al., 2021; Almarashdi & Jarrah, 2021). On the one hand, students struggle with PJJ (Distance Learning) because not all students can access a smooth internet connection. That it becomes an obstacle during the teaching and learning process during the

* *Corresponding Author: Lulus Budiarto: budiartolulus@student.uns.ac.id*

covid-19 pandemic, and with various educational problems during the covid-19 pandemic, of course, it is not possible. It is too much if 2022 is a year of transformation for the world of education launched by the Ministry of Education and Culture, namely the 2022 Prototype curriculum, which is a revision of the 2013 curriculum and as a curriculum option for education units to recover during 2022 to 2024 due to the COVID-19 pandemic. Has resulted in a decline in the educational process and knowledge in general and specifically (Hamriana, 2021; P. Rosmana et al., 2022; P. S. Rosmana et al., 2022). Kemendikbudristek provides 7 (Seven) main themes that need to be developed into a module with topics, and more specific objectives. First, build the Soul and Body, Engineering and Technology to Build the Unitary State of the Republic of Indonesia, *Bhinneka Tunggal Ika*, Sustainable Lifestyle, Local Wisdom, Entrepreneurship, and Voice of Democracy (P. Rosmana et al., 2022). Second, focus on an essential material (focus on essential materials) so that there is time for basic competencies such as literacy and numeracy as well as deep learning discussions, group work, problem-based learning, and project-based learning (Agustin & Winarso, 2021; Shabrina, 2022; Tahmidaten, 2021).

Concerning independent learning, the Prototype Curriculum seeks to encourage learning according to students' interests, learning styles, and abilities and to provide more expansive space for character development and essential competencies that align with the concept of independent learning (P. Rosmana et al., 2022; Widiyono & Millati, 2021). The prototype curriculum has several characteristics, including project-based learning for developing soft skills and students' character that encourages faith; piety; noble character; cooperation; global diversity; independence; critical reasoning, and creativity. Critical reasoning is one of the goals of the prototype curriculum, which is part of the profile of Pancasila students that critical reasoning is different from ordinary or systematic thinking. Critical reasoning is an intellectual thinking process that deliberately assesses the quality of thinking reflectively, independently, and rationally (Puspita & Dewi, 2021; Rosdiana, 2020).

The term critical reasoning is the same as critical thinking ability, which is the ability to understand a problem by selecting relevant information that can finally draw valid conclusions (Ariyatun & Octavianelis, 2020; Fitriani et al., 2019). Critical reasoning ability or critical thinking of students in learning mathematics needs to be developed so that students have the ability to reason and solve problems in real life and in the industrial world (Saputra et al., 2019; Yamin et al., 2020), this is in accordance with goals in the prototype curriculum for the SMK level which includes increasing critical reasoning abilities (Darhim et al., 2020; Klisc et al., 2017; P. Rosmana et al., 2022). The prototype curriculum requires educators to adapt learning methods and models according to the interests of students (Maryati et al., 2019), learning styles and abilities of students, and to provide wider space for character development and basic competencies that are in line with the concept of independent learning (Shigang & Sheng, 2021; Widiyono & Millati, 2021). With project-based learning (project-based learning) and appropriate teaching materials for the development of soft skills and character of students, especially in improving critical reasoning abilities.

Based on the description above, the researcher wants to develop e-book teaching materials based on prototype curriculum in the learning process of class XI statistics material in order to increase students' critical reasoning abilities. E-books based on prototype curriculum which will be stored in electronic devices such as mobile phones, laptops, or ipads, in other words e-books based on prototype curriculum are more flexible when compared to printed books and are made more interesting in the learning process. E-Books based on the prototype curriculum also provide a solution for students' learning time to be able to repeat material that has not been understood by students, and as a solution for educators with learning teaching materials that are in accordance with the prototype curriculum (*kurikulum prototype*).

Another advantage of the prototype curriculum-based e-Book is that it is not only in the form of text but can include animated images, music videos or sound, which includes a Pancasila student profile containing the content or theme of believing in God Almighty, Diversity, creative, independent, mutual. mutual cooperation, and critical reasoning (Eladl & Musawi, 2020; Ormancı & Çepni, 2020; Susantini et al., 2021). In line with the problems faced by the government, it is supported by observations and interviews conducted by researchers together with teachers who join the MGPM Mathematics subject at State Vocational Shool of Puhpelem on January 3, 2022, teaching and learning activities have not maximally improved student learning outcomes. It can be seen that there are still many students who score below the KKM 78 and are supported by problems in the field related to the lack of improvement of students' critical reasoning skills in the learning process.

Several studies that have been carried out related to e-book Teaching Materials state that the Development of Problem Based Learning-Based Personnel Administration Learning E-books can Improve Learning Outcomes carried out in Vocational Schools (Alifya & Rahman, 2020; Astuti et al., 2017), research Others have also succeeded in developing an E-Book for Physics Subjects Oriented to Problem Based Learning (PBL) to improve mastery of material concepts, and an e-book that can also be developed for other subjects and their impact on the subject. contribute positively to improving student academic achievement (Dudung et al., 2022; Hadaya & Hanif, 2019; Harjono et al., 2020; Kumbhar, 2018).

These studies specifically discuss e-books with several approaches in K13, researchers see that there is a gap for research based on a prototype curriculum that contains the profile of Pancasila students in which it is necessary to increase students' critical reasoning abilities. If this problem is not immediately addressed, the students' critical reasoning abilities are weak so that students: 1) lack the ability to analyze facts, 2) lack the ability to generate and organize ideas, 3) lack the ability to defend opinions, 4) lack the ability to make comparison, 5) Lack of ability to draw conclusions, 6) Lack of ability to evaluate arguments, and 7) Lack of ability to solve a problem. The implementation of the new national curriculum called the prototype curriculum makes teachers must immediately make innovations so that there is harmony between the learning process and learning supporting equipment and media. The results of field facts show that if it is necessary to integrate ICT into the learning process as a form of learning innovation. In addition, students also need to be equipped with the competencies needed in the 21st century, one of which is the ability to think critically, which is in line with the objectives laid out in the prototype curriculum. Currently, there are many mathematics lessons that apply technology as a tool for learning, both to explain the material and to serve as a support for doing exercises.

However, no research has been found that utilizes ICT in mathematics learning with a prototype curriculum foundation as the basis for the learning process. As one of the subjects that is considered sufficient to require repetition of training, the integration between ICT and mathematics materials is expected to be able to provide options for students to practice and learn interactively (Amelia & Harahap, 2021; Salma Aprianka, 2020), and provide greater expectations as well. for students to be equipped with the skills needed in the 21st century (Habibi & Suparman, 2020; Yulianisa et al., 2018). Based on various descriptions based on several research results, it is considered important to be able to integrate ICT into the learning process in accordance with the curriculum implemented nationally. ICT-based teaching materials in e-book format with an opinion and referring to the prototype curriculum are seen as having a great opportunity to be implemented and developed in mathematics learning, this is because according to the results of the synthesis of relevant researches it is considered to be able to have a positive impact on the achievement of student competencies, especially in learning mathematics. Therefore, this study aims to identify the needs of students for the development of e-books that are in accordance with the characteristics of students, materials and according to the needs of the school.

2. METHOD

A mixed method approach is used in the implementation of this research in order to collect the collected data (McKim, 2017). In this approach the data collected consists of qualitative data and quantitative data (Cresswell et al., 2003). Meanwhile, for research subjects for the purposes of quantitative data, 42 students in Vocational High Schools will use research subjects, with data collection techniques using a needs analysis questionnaire adopted from research and has been adapted to the needs of this research (Ormancı & Çepni, 2020; Susantini et al., 2021). Meanwhile, for qualitative data collection, a series of studies were conducted in September 2022 with a research sample namely Mathematics Subject Teachers, the sample selection technique used purposive sampling technique (Sugiyono, 2018) with the hope that the data collected was in accordance with the needs and could answer research questions. The data collection technique for this qualitative data uses the Interview and Observation method with the instruments, namely interview guidelines and observation sheets. The instrument grids used in this mixed methods study showed in Table 1, Table 2, and Table 3.

Table 1. The Lattice Instrument for Observing the Learning Process

No	Indicator	Item
1.	Giving Motivation	2
2.	Use of Media during the Learning Process	3
3.	Ability to Manage Learning	2
4.	Providing Feedback on Student Activities	2

Adaptation from (Ambarsari et al., 2021)

Table 2. Interview Instrument Grids for Teachers

No	Indicator	Item
1.	Use of Learning Strategies	2
2.	Use of Learning Media	2
3.	Facilities Available at School	1
4.	Adoption of Implemented Curriculum	2
5.	Achievement of Learning Outcomes / Student Achievement	2

Adaptation from (Bismala & Manurung, 2021)

Table 3. Questionnaire Instrument Grids for Students

No	Indicator	Item
1.	Mathematics Learning Process	2
2.	Use of ICT-based Learning Media	2
3.	Students' Needs and Views of ICT-based Learning Media	2

Adaptation from (Budiarto et al., 2020; Ambarsari et al., 2021)

The use of this instrument has been previously validated and consulted by a Advisory Lecturer who has a Doctoral Education background as a form of instrument validation through expert judgment (Nurtanto et al., 2020; Syauqi et al., 2020). The results of the data obtained will be analyzed, for research with a quantitative data format that has been analyzed descriptively, while the qualitative data format is analyzed using the Bogdan and Biklen model (Fathoni et al., 2021), and is described in descriptive form in a narrative and percentage mutually reinforcing between themes and subthemes according to the research objectives.

3. RESULT AND DISCUSSION

Result

This planning activity is basically a series of needs analysis which is then followed up in the initial design process related to digital teaching material products that will be developed in e-book format with the hope of improving students' critical reasoning abilities. Several data collection techniques used at this stage consisted of observing or observing the learning process (participation), interviews with teachers who teach Mathematics subjects in Vocational High Schools, particularly related to implementation and learning based on a prototype curriculum to improve students' critical reasoning abilities, and questionnaires. analysis of the need for the development of digital teaching materials in e-book format. Each result from this planning stage is described as follows. One of the data collection methods adopted at this stage of needs analysis is the interview method. Interviews were conducted orally with mathematics subject teachers in SMK, the data from this interview will be used as a benchmark for the needs of students and teachers for ICT-based teaching materials innovation in e-book format, as well as several other factors that can be integrated with e-books. The following is a summary of the results of interviews with mathematics teachers at SMK N 1 Puhpelem:

The teachers considered that in recent years, students tend to be more passive when participating in the learning process, however, the low level of student activity can also be overcome by the teacher by giving quizzes or questions related to the subject matter when entering the final stages of the learning process. During learning activities, teachers tend to use the one-way lecture learning method delivered by the teacher and assignments, because according to the teachers, mathematics lessons must always be interspersed with assignments so that students do not forget how to do it, and understand how to implement the formulas, not just memorize the questions. So far, it can be said that the cognitive performance of students in answering practice questions and assignments is included in the sufficient category, because it is balanced that there are some students who can indeed answer the exercise questions, and some others are still unable to answer correctly.

From the results of the interviews, it was identified that the teacher used learning media in the form of material text books, powerpoint presentation slides, and the internet. In addition, the teaching materials used by teachers are still not based on ICT, only printed teaching materials for the needs of teachers in conveying material to students. During learning activities, teachers tend to use the one-way lecture learning method delivered by the teacher and assignments, because according to the teachers, mathematics lessons must always be interspersed with assignments so that students do not forget how to do it, and understand how to implement the formulas, not just memorize the questions. So far, it can be said that the cognitive performance of students in answering practice questions and assignments is included in the sufficient category, because it is balanced that there are some students who can indeed answer the exercise questions, and some others are still unable to answer correctly. From the results of the interviews, it was identified that the teacher used learning media in the form of material text books, powerpoint presentation slides, and the internet. In addition, the teaching materials used by teachers are still not based on ICT, only printed teaching materials for the needs of teachers in conveying material to students.

In several additional questions given by the interviewer, the teachers basically agreed that the ability to think critically was one of the most important abilities or skills for students to have. In addition, the teacher also agreed that to be able to improve students' critical thinking skills or abilities, more than lecture or assignment-based learning methods were needed, and tools were also needed to deliver subject matter that could provide a more optimal stimulus to increase students' critical reasoning abilities. The mathematics teacher who was the resource person in this study basically agreed on the innovation of digital teaching materials to make it easier for students to understand the subject matter, and the use of a problem-based learning approach is one approach that

needs to be applied to the learning process in the hope of being able to provide a stimulus. optimally in order to improve students' critical reasoning abilities.

One effort that can be done is to implement and realize innovation in the form of integration between ICT-based digital teaching materials with a problem-based learning approach or method for solutions in the form of students' critical reasoning abilities. Mathematics teachers agree with an instructional product development plan, namely ICT-based teaching materials in e-book format that are integrated with problem-based learning methods in mathematics learning to improve critical reasoning skills. In addition to the data obtained from interviews with the semi-structured scheme, the process of identifying needs will be conveyed and described in other forms with different data collection methods, such as questionnaires and observation sheets.

This section will present the results of identifying the needs of students for the development of an ICT-based teaching material in the format of an electronic book or e-book to support mathematics learning in SMK. This questionnaire was distributed to several classes of SMK N 1 Puhpelem with a total of 42 students as respondents. This questionnaire contains several questions to plan learning resources according to the needs of students, in this questionnaire there are 6 choice questions and 1 question which is expressed in the form of an opinion or comment. The distribution of this questionnaire is important because in the development of learning products, one of which is that ICT-based teaching materials must be able to pay attention to the level of student development, both in terms of cognitive and affective and can overcome the problems students face to acquire certain competencies. Through development that pays attention to the characteristics of students and pays attention to needs in accordance with the field, it is expected to optimize the provision of learning stimuli so that students' critical reasoning abilities become higher. The results of the questionnaire distributed to students are described in the table 4.

Table 4. Results of the Needs Analysis Questionnaire

No	Question	Student Response (%)	
		Yes	No
1.	Is the implementation of Mathematics learning that has been going on fun?	19%	81%
2.	Is Mathematics one of the subjects you look forward to the most and enjoy?	35,7%	64,3%
3.	In your opinion, is the material on the Matrices/Matrix chapters one of the difficult materials to understand?	64,3%	35,7%
4.	Have all this time teachers use ICT-based learning media?	85,7%	14,3%
5.	Regarding the previous question, do you need ICT-based teaching materials for learning Mathematics?	92,9%	7,1%
6.	Do you agree with the development and implementation of an innovative ICT-based teaching material in an electronic book/e-book format?	90,5%	9,5%

Referring to the table of student responses, it can be seen that so far the mathematics learning activities that have taken place at SMK N 1 Puhpelem tend to be unpleasant for students, this result can be seen from 42 students who filled out the questionnaire and 81% percent said so. This response is also in line with the next question that, 64.3% of students included mathematics as a subject that they were not waiting to learn, perhaps one of the reasons was that some of the chapters they studied were difficult to understand. One of them is a chapter or material on the Matrix, a total of 64.3% of students stated that the material on the Matrix is one of the chapters that are difficult for them to understand. Even though the school has provided material books on subjects and chapters that will be studied by students, this has not been able to make it easier for students to understand the material. Teachers should be able to provide additional learning aids, or additional learning resources to students, one of which is through the use of ICT-based learning media. Like student responses to the presence of ICT-based teaching materials in e-book format, almost all students or 92.9% of students responded if they needed the ICT-based teaching materials.

Referring to the results of student responses, basically students need and want ICT-based teaching materials as an alternative to integrating ICT into the learning process that is in line with technological advances and innovative learning models in the 21st century. This is supported by student responses to teaching materials. ICT-based in e-book format, which almost all students or 90.5% of students agree with, students are very supportive and enthusiastic to apply ICT-based teaching materials as a learning resource in learning mathematics. This observation activity was carried out in two schools, namely SMKN 1 Puhpelem. This observation or observation activity was carried out on September 22, 2022 in class X TBSM A, XI PM A, and XII TBSM C.

From the observations, the researchers managed to identify some facts in the field that have been going on, the following are presented descriptively on the results of observations of the learning process; in each class, the preliminary activities went well, this was based on field findings which showed that every teacher during the

learning process had provided motivation, conveyed learning objectives, and conducted questions and answers to explore initial information related to the material to be studied. Furthermore, during the process of delivering the material, it can be seen from the observation that during the learning process the teacher is still minimal in utilizing learning media, this is of course very unfortunate considering the role of the media is quite important in helping teachers to deliver the material.

Utilization of learning resources is included in the good category as well as teacher management when learning activities take place. In addition to learning media which tend to be less varied, the findings also show that teachers only use printed teaching materials such as material books provided by the school. There are no available ICT-based teaching materials that can be used or accessed by students to learn the subject matter. In the closing session, all teachers presented a summary of the material and did not forget to provide feedback either in the form of words of encouragement and thanks for the participation of students during the learning activities. This is certainly a positive activity that must be maintained, considering that this section is also considered important so that students can once again recall the material presented during the learning process.

Referring to the results of student responses, basically students need and want ICT-based teaching materials as an alternative to integrating ICT into the learning process that is in line with technological advances and innovative learning models in the 21st century. This is supported by student responses to teaching materials. ICT-based in e-book format, which almost all students or 90.5% of students agree with, students are very supportive and enthusiastic to apply ICT-based teaching materials as a learning resource in learning mathematics. Based on the observational data, there are several things that attract the attention of researchers, namely the use of learning media and teaching materials used. It is unfortunate if digital technology, whether it's smartphones, laptops, computers, cannot be optimized to support the learning process that has been going on so far. The presence of innovative use of ICT-based materials in electronic book format can be an alternative which can then be utilized during the learning process, with the hope of facilitating students to achieve the competencies they need in the 21st century.

Based on a brief analysis and identification of preliminary studies, it is known that an innovation of ICT-based teaching materials is needed in the format of electronic books or e-books. This is expected to provide a stimulus for improving students' critical reasoning skills or abilities, considering that in the 21st century, in addition to achieving learning outcomes, other competencies such as critical reasoning skills are also needed which will be one of the learning outcomes. E-books as one of the ICT-based teaching materials are considered to be able to attract students' attention, help increase student learning independence and indirectly are expected to contribute to improving students' critical reasoning abilities.

Discussions

Referring to the results of observations made during several meetings and interviews with several teachers with the same subject, namely mathematics. Overall, the results of the interviews showed that during learning activities, the teacher still dominated the delivery of material because the teacher used the lecture method when delivering learning material which tended to be one-way, although in several meetings it was also interspersed with several assignments. The results of the interviews were also confirmed by the results of observations made in several classes, although the learning process was already good, where each session at the beginning of the learning process the teacher always provided motivation so that students could keep their spirits up. Meanwhile, it can be seen from the observations that teachers are still unable to optimize the use of ICT-based learning resources, such as digital teaching materials and digital-based learning media, teachers only use printed teaching materials such as material books provided by the teacher, without being accompanied by other teaching materials. Looking at the two data sources that have been collected, it can be seen that an ICT-based teaching material in e-book format has not yet been developed, and the use of a learning approach that tends to be one-way, such as the use of the lecture method. Whereas in the era of the development of technology and information as it is today, the presence of learning resources and ICT-based learning materials seems to be an obligation for educational institutions (Kursch, 2021; Nasrulloh & Ismail, 2018). This of course cannot be separated from the benefits provided when in learning activities, ICT plays an important role in improving various competencies and student learning outcomes (Azmi & Widiaty, 2021; Har et al., 2019).

Even though students are now accustomed to the presence of technology, and according to the results of the questionnaire distributed to students, they need an ICT-based teaching material for the mathematics learning process, this can be seen from the response of 92.9% of students who stated so. In addition, 90.5% of students also agree with the presence of innovative ICT-based teaching materials to support the mathematics learning process. It is undeniable that mathematics learning should be accompanied by the use of ICT tools (Agyei & Agyei, 2021; Martínez-Marquez, 2021), this is of course in the hope of making it easier for students to understand the material. Some research also shows that the use of ICT in the form of teaching materials, learning media, learning multimedia also contributes to student learning outcomes (Albana & Sujarwo, 2021; Aripin & Suryaningsih, 2019; Şimşek & Yazıcı, 2021; Suyantiningsih et al., 2016). Besides being important for teachers

to make it easy for students to achieve learning goals, it is important to remember that teachers must also be able to facilitate students to master various skills needed in the 21st century. In the prototype curriculum that is currently being implemented and implemented in several schools in Indonesia, it is stated that one of the abilities that must be given to students is critical reasoning ability (P. Rosmana et al., 2022; P. S. Rosmana et al., 2022). These competencies or abilities are certainly in line with what students need in the 21st century so that they can compete in the era of globalization (Christian Pilarta Oliquino, 2019; ÖNÜR & KOZİKOĞLU, 2020).

The achievement of both learning objectives and abilities as outlined in the prototype curriculum in schools, can basically be achieved by students through a series of learning processes that are able to coexist with ICT. Therefore, the combination of innovative and modern teaching materials can be an alternative choice of learning resources that can be used by students to support the learning process (Har et al., 2019; Munje & Jita, 2020). The integration of ICT into the learning process can be realized by presenting innovative ICT-based teaching materials that have not previously been developed in schools. Considering that innovation through the integration of ICT into the learning process is also aimed at preparing human resources that can compete in the current global era (Permana P & Manurung, 2020; Wahyuni et al., 2022), because through the integration of ICT into learning aspects, has been shown to be able to contribute positively to the development and quality of education (Hoerunnisa et al., 2019; Siregar & Marpaung, 2020).

Optimization of the use of ICT, and the integration of ICT into the learning process need to be followed up if it refers to the results of the needs analysis. As research states that innovative learning is one of the strategies that emphasizes the delivery of material in two directions, and the use of learning resources that are in accordance with the needs and materials presented, thus learning objectives can be achieved, both cognitive, affective and psychomotor goals (Hakim, 2021; Ishaq et al., 2020; Prajana & Astuti, 2020; Rahmawati & Ramadan, 2021). In addition, as a developing country, before optimizing a digital-based economy, it must begin with the use of digital devices and optimizing digital devices in the education sector, considering that currently there are very few ICT-based digital devices that are applied to the education sector, specifically the learning process (Lim et al., 2020; Roemintoyo et al., 2022). Overall, it looks good from the research results which show that so far ICT-based teaching materials in the format of electronic books or e-books have not been developed and used by teachers to support learning activities, especially in mathematics. Therefore, this ICT-based teaching material in the format of an electronic book or e-book has a huge opportunity to be applied and utilized during learning activities. In addition, it is hoped that if the learning process that optimizes ICT is facilitated, then one of the competencies that becomes important to master in the implementation of the prototype curriculum, namely the ability to think critically can be achieved and achieved by students. The results of several relevant research and discussions indicate that it is necessary to innovate and develop an ICT-based teaching material in the format of an e-book or electronic book, characteristically this teaching material will be filled with several components such as text, images, learning videos and some practice questions that can be used. done by students so that it can support a series of learning activities.

4. CONCLUSION

The learning process that had been going on so far still tended to be less than optimal and not in line with the implementation of the prototype curriculum. During teaching and delivering material, teachers are also limited to using ICT-based learning media in the presentation slide format, this is certainly a hole that must be closed considering that there are many types or formats of ICT-based learning media in the digital era like now. The synthesis of various research results has also succeeded in finding empirical facts that ICT-based teaching materials in e-book format make a positive contribution to improving student academic achievement. Therefore, the results of this study are expected to be the basis for the sustainability of the process and product development of ICT-based teaching materials with e-book formats based on prototype curriculum in vocational high schools by other researchers who are considered to have a large enough opportunity to develop e-book products. In addition, through the results of this research, it is also considered sufficient for teachers to start improving their skills and competencies in terms of developing ICT-based teaching materials, considering that students are also currently familiar with the use of ICT-based devices.

5. REFERENCES

Abbas, J., Mubeen, R., Iorember, P. T., Raza, S., & Mamirkulova, G. (2021). Exploring the impact of COVID-19 on tourism: transformational potential and implications for a sustainable recovery of the travel and leisure industry. *Current Research in Behavioral Sciences*, *2*. https://doi.org/10.1016/j.crbeha.2021.100033.

Agustin, A. R., & Winarso, W. (2021). Profile of Student Academic Procrastination Behavior in Problem

Solving and Mathematical Digital Literacy. *Jurnal Didaktik Matematika*, *8*(2), 190–207. https://doi.org/10.24815/jdm.v8i2.21367.

Agyei, E. D., & Agyei, D. D. (2021). Promoting Interactive Teaching with ICT: Features of Intervention for the Realities in the Ghanaian Physics Senior High School Classroom. *International Journal of Interactive Mobile Technologies*, *15*(19). https://doi.org/10.3991/ijim.v15i19.22735.

Albana, L. F. A. N. F., & Sujarwo, S. (2021). An interactive e-module develompent to increase the self-regulated learning of basic graphic design. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *5*(2). https://doi.org/10.21831/jk.v5i2.33278.

Alifya & Rahman, E. S. (2020). Efektivitas penerapan interaktif e-book mata pelajaran pemrograman dasar pada siswa SMK. *Jurnal Media Elektrik*, *17*(2), 14–18. https://doi.org/10.26858/metrik.v17i2.14040.

Almarashdi, H., & Jarrah, A. M. (2021). Mathematics distance learning amid the COVID-19 pandemic in the UAE: High school students' perspectives. *International Journal of Learning, Teaching and Educational Research*, *20*(1), 292–307. https://doi.org/10.26803/IJLTER.20.1.16.

Ambarsari, R., Sartono, E. K. E., Mustadi, A., Zubaidah, E., Jhon, W., & Rafsanzani, M. A. (2021). Needs Analysis for the Development of Electronic Story Calender Media to Improve Spirit of Nationalism. *Journal of Education Research and Evaluation*, *5*(3), 398–405. https://doi.org/10.23887/jere.v5i3.33281.

Amelia, D. P., & Harahap, A. (2021). Application of Interactive Multimedia-Based Mathematics Learning Media to Increase Students' Interest in Learning. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *4*(2), 3153–3161. https://doi.org/10.33258/birci.v4i2.2040.

Aripin, I., & Suryaningsih, Y. (2019). Pengembangan Media Pembelajaran Biologi Menggunakan Teknologi Augmented Reality (AR) Berbasis Android pada Konsep Sistem Saraf. *Sainsmat : Jurnal Ilmiah Ilmu Pengetahuan Alam*, *8*(2), 47. https://doi.org/10.35580/sainsmat82107192019.

Ariyatun, A., & Octavianelis, D. F. (2020). Pengaruh Model Problem Based Learning Terintegrasi Stem Terhadap Kemampuan Berpikir Kritis Siswa. *JEC: Journal of Educational Chemistry*, *2*(1), 33. https://doi.org/10.21580/jec.2020.2.1.5434.

Astuti, D., Siswandari, P., & Santosa, D. (2017). E-Book for Problem Based Learning to Improve Learning Outcome of the Students. *Proceedings of the International Conference on Teacher Training and Education 2017 (ICTTE 2017)*, *158*, 220–227. https://doi.org/10.2991/ictte-17.2017.45.

Azmi, C., & Widiaty, I. (2021). ICT-based e-learning implementation. *IOP Conference Series: Materials Science and Engineering*, *1098*(2), 022109. https://doi.org/10.1088/1757-899x/1098/2/022109.

Bismala, L., & Manurung, Y. H. (2021). Student satisfaction in e-learning along the covid-19 pandemic with importance performance analysis. *International Journal of Evaluation and Research in Education*, *10*(3), 753–759. https://doi.org/10.11591/ijere.v10i3.21467.

Budiarto, M. K., Joebagio, H., & Sudiyanto, S. (2020). Student's View of Using Digital Learning Media in Classroom Activities: A Case of Public Senior High School in Cirebon, Indonesia. *Jurnal Pendidikan Progresif*, *10*(1), 47–54. https://doi.org/10.23960/jpp.v10.i1.202006.

Christian Pilarta Oliquino, J. (2019). 21st Century Skills of Students in a Technical Vocational Education and Training Institution in the Philippines. *Jurnal Pendidikan Progresif*, *9*(2), 146–155. https://doi.org/10.23960/jpp.v9.i2.201903.

Cresswell, J. W., Plano-Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of Mixed Methods in Social and Behavioral Research*, 209–240.

Darhim, Prabawanto, S., & Susilo, B. E. (2020). The effect of problem-based learning and mathematical problem posing in improving student's critical thinking skills. *International Journal of Instruction*, *13*(4), 103–116. https://doi.org/10.29333/iji.2020.1347a.

Dudung, A., Hasanah, U., Salman, I., Priyanto, S., & Ramdhan, T. W. (2022). Achievement of student graduates: The role of e-readiness, e-learning and e-book. *International Journal of Data and Network Science*, *6*(2), 375–382. https://doi.org/10.5267/j.ijdns.2021.12.017.

Eladl, A., & Musawi, A. Al. (2020). Effects of students attitudes towards using E- books on their self-efficacy and academic motivation. *European Journal of Educational Research*, *9*(3), 1167–1176. https://doi.org/10.12973/EU-JER.9.3.1167.

Fathoni, A., Surjono, H. D., Mustadi, A., & Kurniawati, W. (2021). Peran Multimedia Interaktif Bagi Keberhasilan Pembelajaran Sistem Peredaran Darah. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *5*(2), 147–157. https://doi.org/10.21831/jk.v5i2.33931.

Fitriani, H., Asy'ari, M., Zubaidah, S., & Mahanal, S. (2019). Exploring the prospective teachers' critical thinking and critical analysis skills. *Jurnal Pendidikan IPA Indonesia*, *8*(3), 379–390. https://doi.org/10.15294/jpii.v8i3.19434.

Habibi, H., & Suparman, S. (2020). Literasi Matematika dalam Menyambut PISA 2021 Berdasarkan Kecakapan

Abad 21. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *6*(1), 57. https://doi.org/10.30998/jkpm.v6i1.8177.

Hadaya, A., & Hanif, M. (2019). The Impact of Using the Interactive E-Book on Students' Learning Outcomes. *International journal of instruction*, *12*(2), 709–722. https://doi.org/10.29333/iji.2019.12245a.

Hakim, B. (2021). Role of ICT in the process of EFL teaching and learning in an Arab context. *Humanities and Social Sciences Letters*, *9*(1), 58–71. https://doi.org/10.18488/JOURNAL.73.2021.91.58.71.

Hamriana, H. A. (2021). Implementasi Pendidikan Karakter Dalam Kurikulum 2013. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *10*(2). https://doi.org/10.33578/jpfkip.v10i2.8095.

Har, E., Khairi, A., & Roza, W. (2019). Teachers' skills and ICT facilities for science learning at senior high school in Padang city. *Australian Educational Computing*, *34*(1).

Harjono, A., Gunawan, G., Adawiyah, R., & Herayanti, L. (2020). An interactive e-book for physics to improve students' conceptual mastery. *International Journal of Emerging Technologies in Learning*, *15*(5), 40–49. https://doi.org/10.3991/IJET.V15I05.10967.

Hoerunnisa, A., Suryani, N., & Efendi, A. (2019). the Effectiveness of the Use of E-Learning in Multimedia Classes To Improve Vocational Students' Learning Achievement and Motivation. *Kwangsan: Jurnal Teknologi Pendidikan*, *7*(2), 123. https://doi.org/10.31800/jtp.kw.v7n2.p123--137.

Ishaq, K., Azan, N., Zin, M., Rosdi, F., Abid, A., & Ijaz, M. (2020). The Impact of ICT on Students' Academic Performance in Public Private Sector Universities of Pakistan. *International Journal of Innovative Technology and Exploring Engineering*, *9*(3), 1117–1121. https://doi.org/10.35940/ijitee.c8093.019320.

Klisc, C., McGill, T., & Hobbs, V. (2017). Use of a post-asynchronous online discussion assessment to enhance student critical thinking. *Australasian Journal of Educational Technology*, *33*(5), 63–76. https://doi.org/10.14742/ajet.3030.

Kumbhar, R. (2018). Trends in E-book research. In *DESIDOC Journal of Library and Information Technology* (Vol 38, Number 3, bll 162–169). https://doi.org/10.14429/djlit.38.3.12382.

Kursch, M. (2021). Impact of a one-off demonstration on the use of ict in the teaching of andragogy students on their change of attitude towards the use of ict in education. *International Journal of Cognitive Research in Science, Engineering and Education*, *9*(1), 121–134. https://doi.org/10.23947/2334-8496-2021-9-1-121-134.

Lim, B. C. Y., Liu, L. W. L., & Choo, C. H. (2020). Investigating the Effects of Interactive E-Book towards Academic Achievement. *Asian Journal of University Education*, *16*(3), 78–88. https://doi.org/10.24191/ajue.v16i3.10272.

Martínez-Marquez. (2021). ICT uses in education. Theoretical framework proposal for its characterization and analysis. *Journal of Systems and Educational Management*, 16–23. https://doi.org/10.35429/jsem.2021.22.8.16.23.

Maryati, M., Prasetyo, Z. K., Wilujeng, I., & Sumintono, B. (2019). Measuring Teachers' Pedagogical Content Knowledge Using Many-Facet Rasch Model. *Jurnal Cakrawala Pendidikan*, *38*(3), 452–464. https://doi.org/10.21831/cp.v38i3.26598.

McKim, C. A. (2017). The Value of Mixed Methods Research: A Mixed Methods Study. *Journal of Mixed Methods Research*, *11*(2). https://doi.org/10.1177/1558689815607096.

Munje, P. N., & Jita, T. (2020). The impact of the lack of ICT resources on teaching and learning in selected South African primary schools. *International Journal of Learning, Teaching and Educational Research*, *19*(7), 263–279. https://doi.org/10.26803/IJLTER.19.7.15.

Nasrulloh, I., & Ismail, A. (2018). Analisis Kebutuhan Pembelajaran Berbasis Ict. *Jurnal Pendiidkan Teknologi Informasi dan Komunikasi (PETIK)*, *3*(1), 28–32. https://doi.org/10.31980/jpetik.v3i1.355.

Nurtanto, M., Sofyan, H., Pardjono, P., & Suyitno, S. (2020). Development model for competency improvement and national vocational qualification support frames in automotive technology. *International Journal of Evaluation and Research in Education*, *9*(1), 168–176. https://doi.org/10.11591/ijere.v9i1.20447.

ÖNÜR, Z., & KOZİKOĞLU, İ. (2020). The Relationship between 21 st Century Learning Skills and Educational Technology Competencies of Secondary School Students. *Journal of Theoretical Educational Science*, *13*(1), 65–77.

Ormancı, Ü., & Çepni, S. (2020). Views on interactive e-book use in science education of teachers and students who perform e-book applications. *Turkish Online Journal of Qualitative Inquiry*, *11*(2), 247–279. https://doi.org/10.17569/tojqi.569211.

Permana P, N. D., & Manurung, I. F. U. (2020). Penggunaan Bahan Ajar Digital Berbasis Inquiry pada Masa Pandemi Covid-19 untuk Mata Kuliah Pembelajaran IPA di SD Kelas Tinggi. *el-Ibtidaiy:Journal of Primary Education*, *3*(2), 73. https://doi.org/10.24014/ejpe.v3i2.11008.

Prajana, A., & Astuti, Y. (2020). Pemanfaatan Teknologi Informasi dan Komunikasi Dalam Pembelajaran oleh Guru SMK Di Banda Aceh dalam Upaya Implementasi Kurikulum 2013. *JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran): Kajian dan Riset Dalam Teknologi Pembelajaran*, *7*(1), 33–41.

https://doi.org/10.17977/um031v7i12020p033.
Puspita, V., & Dewi, I. P. (2021). Efektifitas E-LKPD berbasis Pendekatan Investigasi terhadap Kemampuan Berfikir Kritis Siswa Sekolah Dasar. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(1), 86–96. https://doi.org/10.31004/cendekia.v5i1.456.
Rahmawati, F., & Ramadan, Z. H. (2021). Improving High-Level Thinking Skills in Students Through Powtoon-Based Animation Video Media. *Journal of Education Technology*, *5*(4), 654. https://doi.org/10.23887/jet.v5i4.41037.
Roemintoyo, R., Miyono, N., Murniati, N. A. N., & Budiarto, M. K. (2022). Optimising the utilisation of computer-based technology through interactive multimedia for entrepreneurship learning. *Cypriot Journal of Educational Sciences*, *17*(1), 105–119. https://doi.org/10.18844/cjes.v17i1.6686.
Rosdiana, S. R. (2020). Kemampuan Berpikir Kritis Siswa dalam Pembelajaran Inquiry-Discovery. *Science Education and Application Journal*, *2*(2), 101. https://doi.org/10.30736/seaj.v2i2.286.
Rosmana, P., Iskandar, S., Fatimah, F. S., Aprillionita, R., Arfaiza, S. A., & Hamidah, W. (2022). Penerapan Kurikulum Prototype pada Masa Pandemi Covid-19. *FONDATIA*, *6*(1), 62–75. https://doi.org/10.36088/fondatia.v6i1.1706.
Rosmana, P. S., Iskandar, S., Fauziah, H., Azzifah, N., & Khamelia, W. (2022). Kebebasan dalam Kurikulum Prototype. *AS-SABIQUN*, *4*(1), 115–131. https://doi.org/10.36088/assabiqun.v4i1.1683.
Salma Aprianka, S. (2020). Penerapan Bahan Ajar Matematika Berbasis Realistic Mathematics Education (RME) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa. *Jurnal PEKA (Pendidikan Matematika)*, *3*(2), 60–63. https://doi.org/10.37150/jp.v3i2.796.
Saputra, M. D., Joyoatmojo, S., Wardani, D. K., & Sangka, K. B. (2019). Developing critical-thinking skills through the collaboration of Jigsaw model with problem-based learning model. *International Journal of Instruction*, *12*(1), 1077–1094. https://doi.org/10.29333/iji.2019.12169a.
Shabrina, L. M. (2022). Kegiatan Kampus Mengajar dalam Meningkatkan Keterampilan Literasi dan Numerasi Siswa Sekolah Dasar. *Jurnal Basicedu*, *6*(1), 916–924. https://doi.org/10.31004/basicedu.v6i1.2041.
Shigang, X., & Sheng, W. (2021). Research on the Classification and Selection Strategy of Physical Education Teaching Model Based on Modern Information Technology. *Journal of Physics: Conference Series*, *1881*(4). https://doi.org/10.1088/1742-6596/1881/4/042057.
Şimşek, M., & Yazıcı, N. (2021). Examining the digital learning material preparation competencies of preservice mathematics teachers. *Participatory Educational Research*, *8*(3), 323–343. https://doi.org/10.17275/per.21.68.8.3.
Siregar, Z., & Marpaung, T. B. (2020). Pemanfaatan Teknologi Informasi dan Komunikasi (TIK) Dalam Pembelajaran di Sekolah. *BEST Journal (Biology Education, Sains and Technology)*, *3*(1), 61–69. https://doi.org/10.30743/BEST.V3I1.2437.
Sugiyono. (2018). Metode penelitian kuatintatif , kualitatif dan R & D. In *Bandung: Alfabeta*.
Susantini, E., Puspitawati, R. P., Raharjo, & Suaidah, H. L. (2021). E-book of metacognitive learning strategies: design and implementation to activate student's self-regulation. *Research and Practice in Technology Enhanced Learning*, *16*(1). https://doi.org/10.1186/s41039-021-00161-z.
Suyantiningsih, Munawaroh, I., & Rahmadona, S. (2016). Pengembangan Multimedia Pembelajaran Berbasis Scientific Approach Terintegrasi Nilai Karakter. *Jurnal Kependidikan*, *46*(1), 1–13.
Syauqi, K., Munadi, S., & Triyono, M. B. (2020). Students' perceptions toward vocational education on online learning during the COVID-19 pandemic. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(4), 881. https://doi.org/10.11591/ijere.v9i4.20766.
Tahmidaten, L. (2021). Project-based Learning Untuk Mengembangkan Kompetensi 4C: Implementasinya Pada Pembelajaran Sosiologi SMA. *Jurnal Sikola: Jurnal Kajian Pendidikan dan Pembelajaran*, *3*(2), 201–220. https://doi.org/10.24036/sikola.v3i2.172.
Wahyuni, Y., Edrizon, E., & Fauziah, F. (2022). Pengembangan Bahan Ajar Matematika dengan Pemanfaatan Geogebra. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 1120–1130. https://doi.org/10.31004/cendekia.v6i1.1139.
Widiyono, A., & Millati, I. (2021). Peran Teknologi Pendidikan dalam Perspektif Merdeka Belajar di Era 4.0. *Journal of Education and Teaching (JET)*, *2*(1), 1–9. https://doi.org/10.51454/jet.v2i1.63.
Yamin, M., Saputra, A., & Deswila, N. (2020). Enhancing Critical Thinking in Analyzing Short Story "The Lazy Jack" Viewed from Identity Theory. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *3*(1), 30–39. https://doi.org/10.23917/ijolae.v3i1.9948.
Yulianisa, Rizal, F., Oktaviani, & Abdullah, R. (2018). Tinjauan Keterampilan Abad 21 (21st Century Skills) di Kalangan Guru Kejuruan (Studi Kasus: SMK Negeri 2 Solok). *Journal of Civil Engineering and Vocational Education*, *5*(3), 1–8. https://doi.org/10.24036/cived.v5i3.102505.