Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4, 2610-2624
2025
Publisher: Learning Gate
DOI: 10.55214/25768484.v9i4.6610

The urgency of flipped classroom learning by integrating android-based multimedia to support digital literacy skills of elementary school students

Candra Dewi[1], Budi Eko Soetjipto[2*], Sugeng Utaya[3], Syarif Suhartadi[4], Fauzatul Ma'rufah Rohmanurmeta[5]
[1]Department of Doctor of Elementary Education, Graduate School, Universitas Negeri Malang, East Java, Indonesia.
[2]Department of Management Masters Program and Doctoral Program of Management Science Study Program, Faculty of Economics and Business, Universitas Negeri Malang, East Java, Indonesia; budi.eko.fe@um.ac.id (B.E.S.).
[3]Department of Geografi, Faculty of Social Sciences, Universitas Negeri Malang, East Java, Indonesia.
[4]Department of Mechanical Engineering, Faculty of Engineering, Universitas Negeri Malang, East Java, Indonesia.
[5]Department of Primary Teacher Education, Faculty of Teacher Training and Education, Universitas PGRI Madiun, East Java, Indonesia.

Abstract: This research aims to determine the urgency of implementing flipped classroom learning integrated with Android-based multimedia to support elementary school students' digital literacy skills. Conditions in the field show that existing learning uses something other than learning media that can also support digital literacy capabilities. The application of flipped classroom learning integrated with multimedia is aimed at fifth-grade elementary school students aged 9-12 years. The research method used is mixed. The research began by exploring data in the form of qualitative data and then developing it using quantitative data. The respondents of this research were 164 fifth-grade elementary school students. The sample was selected using a cluster random sampling technique; the researcher divided the population into several groups. Research findings show that flipped classroom learning integrated with interactive multimedia learning is needed for elementary school students classified as digital natives. Teachers, as educators, need to integrate digital-based media into implementing flipped classroom learning both outside and inside the classroom.

Keywords: *Android-based multimedia, Digital literacy, Elementary school, Flipped classroom.*

1. Introduction

Education research has been widely studied by experts in education over the last five years, especially at the elementary school level. Research widely discussed includes the learning process, moral education, social literacy, child behavior, remedial education, and elementary school teacher competency [1-5]. Various educational studies discuss their respective fields in depth. Various research on education studied by various experts does not mean that all problems in education have been resolved. For example, educational problems that arise include children's emotional problems, problem-solving abilities, gender differences, development of children's creativity, learning achievement, learning motivation, and also digital challenges in implementing learning in elementary schools [6-12]. Various educational problems that exist in elementary schools are challenges that must be resolved.

The problem of elementary schools' ability to face digital challenges is a problem faced in various countries. Digital literacy is emerging as a key in helping education understand students' competitive demands in a digital society. Elementary schools' efforts to improve digital literacy skills take the form of less than optimal use of digital-based learning media [13, 14]. For example, students in New Zealand who carry out digital classes using digital devices in elementary school learning differ from classes that do not facilitate learning with digital devices [15]. Meanwhile, research in Germany shows

History: Received: 5 February 2025; Revised: 11 April 2025; Accepted: 15 April 2025; Published: 26 April 2025
* Correspondence: budi.eko.fe@um.ac.id

that digital-based learning media encourages students' emotions to participate in learning actively; learning media combined with constructivist learning will provide broad competencies for students and can even be used for informal learning [16, 17].

High-tech tools such as computers, laptops, and gadgets are not only used by adults; from childhood, they have been familiar with this technology and have changed literacy in society [16, 17]. Children are adept at using sophisticated technological tools connected to the internet to access various information. The millennial generation is generally seen as digital natives, born into the digital world and grew up with sophisticated technology, so their dependence on technology has grown significantly. As a result of the increasing use of digital devices, internet users have also increased. Based on data from the Indonesian Internet Service Providers Association (APJII) in 2019-2021, there were 196.71 million people (73.7%) internet users out of a total population of 266.91 million Indonesians. Data shows that internet users have increased from 2018, namely 171.17 million people (64.8%) internet users out of the 264.16 million population of Indonesia. It shows an 8.9% increase in the penetration rate of internet users in 2019-2020 [18].

The rapid development of science and technology also significantly impacts the field of education. Currently, schools and teachers are trying to integrate technology into the curriculum and prepare students for the future, one of which is through learning media [19, 20]. Thematic learning in elementary schools is an integrated form of learning that combines several interrelated subjects into one particular theme [21]. Integrated learning models have been discussed since 1999. There are ten types of integrated learning models [22]. Of these ten models, three models are popularly discussed in Indonesia: the spider web model, the integrated type of thematic learning model, and the thematic learning model—connectedness [23].

The use of learning media that could be more optimal is a problem that needs to be overcome. Experts have developed various strategies to overcome this problem, including learning using digital learning spaces, augmented reality media, game-based learning, and also multimedia learning in elementary schools [9, 14, 24, 25]. One solution that has been implemented and is believed to be able to overcome the problem is using Android-based multimedia. In this multimedia there will be modules that can help students learn according to their age [26]. One appropriate learning model is the flipped classroom. The flipped classroom model is used to prepare students to take part in learning. The flipped classroom model can also increase students' learning motivation [27]. In the traditional model, the teacher delivers the material and then adds to the understanding of the material, so students will do assignments at school and continue at home. However, in flipped classroom learning, which is integrated with Android-based multimedia, students participate in preparing for learning through this media. Besides that, previous research conducted by Chrismawati, et al. [28] and Rindaningsih, et al. [29] revealed that the flipped classroom model could improve student learning outcomes.

Android-based multimedia has uses in various types of communication media and has good color strength and object resolution, varied types of learning, and learning responses; developed the principle of self-evaluation in measuring learning outcomes, which can be used individually or in groups online or offline [30, 31]. Interactive multimedia is one of the digital media that can increase students' motivation, interest, and willingness to learn the desired material. However, the studies are still on specific subjects and refer to something other than the thematic learning that currently exists in elementary school curricula in Indonesia. So far, multimedia learning has been used in learning natural sciences, mathematics, language, and social sciences [32-35]. Therefore, the main aim of this research is to describe the condition of thematic learning media and analyze the need for thematic learning media in depth

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

2. Method

2.1. Research Design

This research uses mixed methods with a mixture of quantitative and qualitative techniques to optimize the interpretation of the data obtained by researchers [36]. Qualitative data uses observation and interview data. This data aims to determine the conditions of thematic learning in elementary schools. Quantitative data uses questionnaires to collect data about the need for thematic learning media in elementary schools. This research uses a sequential mixed methods design that collects qualitative data first at an early stage. Based on the qualitative data, a generalization test was then carried out using quantitative methods, which then interpreted the results of the qualitative research. Data was extracted based on information from respondents using in-depth observation and interviews. The research stages can be seen in the picture below.

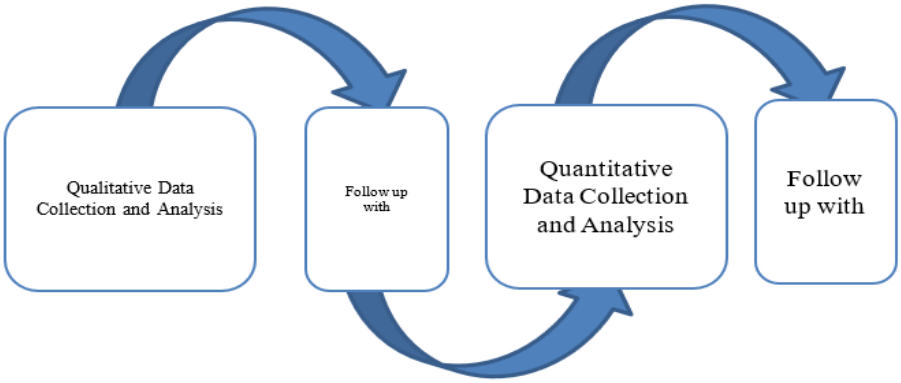

Figure 1.
Sequential exploration design.
Source: Creswell John and Creswell [37].

2.2. Research Participants

The subjects in this study were 35 fifth-grade teachers and 155 fifth-grade elementary school students spread across the Madiun City area, East Java Province, Indonesia. The location of the city of Madiun can be seen in Figure 2. The sampling technique uses random sampling, a method where each unit included in the Sample has the same opportunity to be included [38]. The reason for choosing random sampling was because all respondents had the same opportunity,

namely as fifth-grade elementary school teachers and fifth-grade elementary school students. The number of teacher respondents was 35, divided into 65% female and 35% male respondents. Then, 90% of them had bachelor's degrees, and 10% had master's degrees, aged between 25 and 56 years. Meanwhile, the number of student respondents was 155 with an age range of 10-15 years, and 70% were of the class type. Respondent data can be seen in the table below.

Table 1.
Data on fifth-grade elementary school teacher and student respondents.

Types of Respondents	Total Respondents	Gender	Age	Academic Background	Teaching Experince (years)
		Female (23)	25 - 34 (15)	Bachelor (31)	0 – 8 (14)
		Male (12)	35 - 44 (12)	Masters (4)	9 – 17 (11)
			44 - 55 (6)		18 – 26 (5)
Teacher	35		above 55 (2)		above 26 (3)
		Female (110)	10 (32)		
		Male (45)	11 (108)		
Student	155		12 (15)	-	-

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

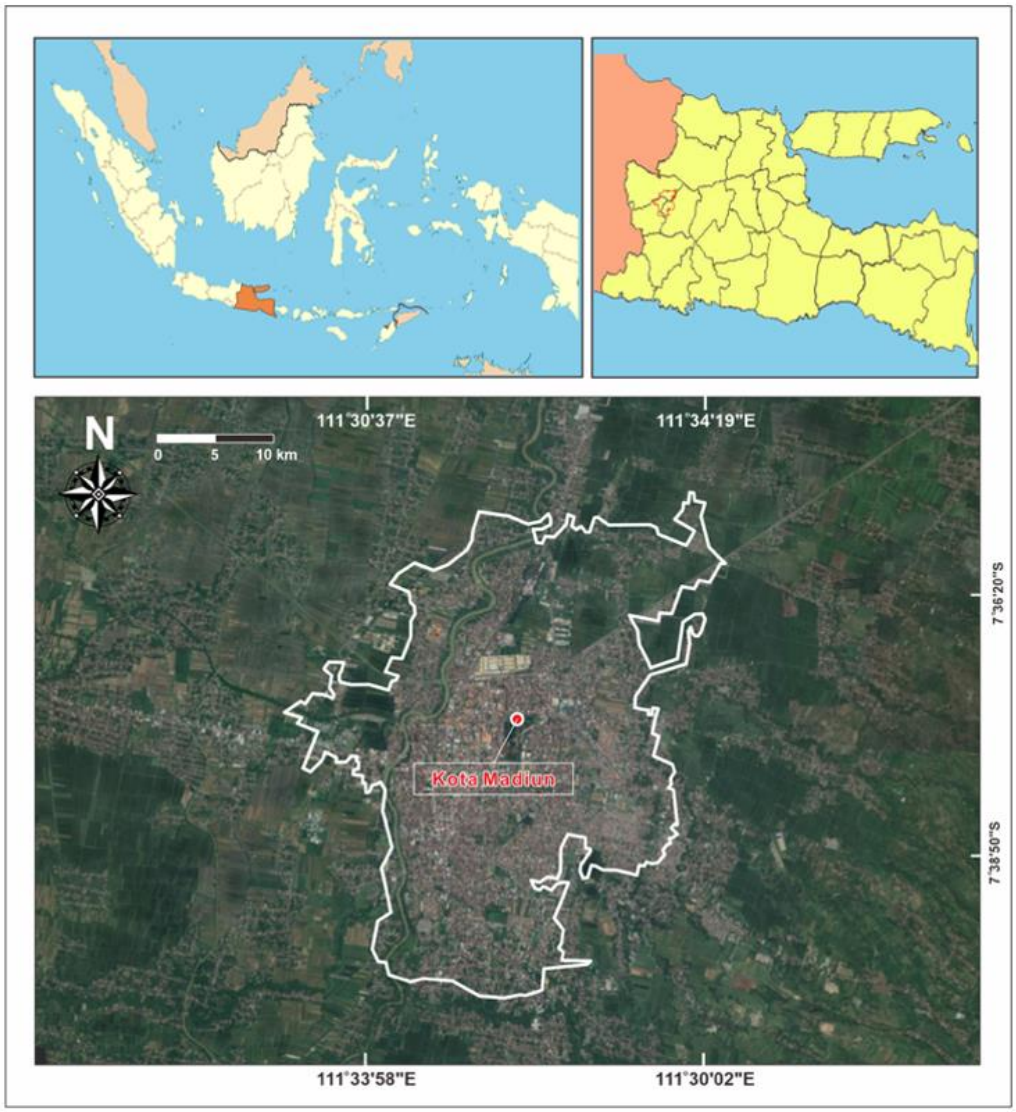

Figure 2.
Map of Madiun City.

2.3. Research Instruments

The instruments in this research are observation guidelines, interview guidelines, and questionnaires. Observations are carried out by direct observation to obtain information about (1) The conditions of teaching and learning activities; (2) The behavior of students and teachers; (3) Interactions between teachers and students in the learning process. Observation guidelines can be seen in the Table 2.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

Table 2.
Guidelines for observing the learning of the student

Category	Indicator
Media suitability with learning needs	The media used is by the learning objectives.
	The media used is by the scope of the learning material.
	The media used is based on the abilities and characteristics of students.
	The media shows learning activities based on the needs of the learning materials.
Use of learning media	The media used is easy to get and use
	The media used can include the learning process.
	Media can be used for a relatively long time.
Teacher response	Teachers can use media easily
	The media used is adequate for conveying material to students.
	Teachers can master the learning material through the media used
Student response	Students can use media easily
	Students can understand the material quickly.
	The media used can generate student learning motivation.

Interviews are used to obtain information about the condition of thematic learning media and the need for in-depth learning media. Interviews were conducted using a semi-structured interview with 10 fifth-grade elementary school teachers spread across the Madiun City area. Semi-structured interviews use an interview guide to gather the required information. Interview guidelines for teachers can be seen in Table 3. Another instrument used is a questionnaire that aims to obtain information from students and teachers about the conditions and needs of digital-based learning media in interactive multimedia. The questionnaire used is intended for fifth-grade students and teachers.

Table 3.
The guidelines for interviewing teachers.

Variable	Indicator	Number
The condition of the media used for thematic learning	Conditions of thematic learning media	1.3
	Media easy to use	2
	Media suitability with learning needs	4.5
	Media suitability with student characteristics	6
	Media effectiveness in learning	7
	The ability of the media to foster student motivation	8
The need for digital-based media in the form of interactive multimedia in thematic learning	Digital-based media needs	9.10
	Interactive multimedia needs	11.12
	Desire to use interactive multimedia	13.14
	Ability to use digital-based media	15

2.4. Data Analysis

Qualitative data is analyzed using descriptive qualitative by analyzing and summarizing data collected from observation and interview activities to provide an overview of the conditions and situations in the field. Data obtained from the questionnaire was analyzed quantitatively. Each answer to the questionnaire gets a score according to the Likert scale [39]. The highest answer is given a score of four (4) by choosing the answer "strongly agree," a score of three (3) by choosing the answer "agree," a score of two (2) by choosing the answer "do not agree," and a score of one (1) by choosing the answer "do not agree." The total percentage of answers is categorized into five categories Arikunto [38] which can be seen in the table below:

Table 4.
Percentage of response categories of questionnaire.

Category	Percentage	Description
1	< 54%	Very Low
2	55%-59%	Low
3	60%-75%	Currently
4	76%-85%	High
5	86%-100%	Very High

3. Findings and Discussion

3.1. Thematic Learning Conditions: Observations and Interviews

The results of this research are qualitative data about thematic learning conditions obtained from observations and interviews. Researchers made direct observations about the conditions of thematic learning in elementary schools using observation guidelines and conducted interviews with teachers. Thematic learning is divided into several categories: suitability of the media to learning needs, practicality of the learning media, teacher response, and student response.

3.2. Suitability of Media to Thematic Learning Needs

Observation activities were conducted at five schools, and interviews with five elementary school teachers. Learning is carried out offline in class. The teacher uses learning resources in the form of a student handbook, which each student owns. The media used by the teacher is a PowerPoint presentation containing pictures, while for learning materials, the teacher only uses student books. Some teachers also use videos from YouTube as learning media. Media in PowerPoint is displayed in front of the class and seen by all students. There is no interaction between the media and students; there is only interaction between teachers and students. The teacher only operates the media via a laptop held by the teacher. The media is not based on elementary school students' learning objectives and characteristics. Learning is carried out using the direct learning method.

3.3. The practicality of Learning Media

The learning media used are power points and learning videos. Powerpoint media contains learning material in the form of text and images. The teacher took the images presented in PowerPoint from Google and then combined them with text and video. The PowerPoints teachers use must be equipped with the features found in Microsoft Office. These features can make PowerPoints even more enjoyable for elementary school students. The power points made by teachers have yet to provide innovations that impact students' success in learning because students cannot understand the material optimally. PowerPoint media can be used for a long time and is easy to use. Apart from PowerPoint media, the teacher also includes media in learning videos. This video is shown in class by the teacher. The teacher took the video on YouTube, whose theme has been adjusted. Video media is easy to use and can be used for a long time.

3.4. Teacher Response

Learning using PowerPoint and video media can be used by teachers both in offline and online learning. Teachers can create PowerPoint media easily using a computer. Apart from making media easy with the features available in Microsoft Office, its use by teachers is also easy, so teachers have no problems using it. Even though some teachers need help understanding the features of making PowerPoint, they understand the standards for using PowerPoint as a learning medium.

The teacher uses a projector screen to show PowerPoint and video media in front of the class. During the media broadcast, the teacher explained to the students interspersed with questions and answers. Students view the material in PowerPoint presentations and videos while listening to and

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

answering questions from the teacher. By using digital-based learning media, students can easily understand learning material so that this media is used effectively in learning.

3.5. Student Response

Powerpoint and video media can be used by students both at school and at home. Teachers provide this media to students through class groups so that they can study it at home with their parents. At school, the media is operated by the teacher by showing it in front of the class, but at home, the media can also be operated easily by students via smartphone or computer. Digital-based media that students can efficiently operate helps them understand learning material well because students not only read but also view audio-visual media. Students' diverse learning needs require text, audio, and visual media that can help them understand the learning material.

3.6. The Need for Interactive Multimedia in Thematic Learning

Based on data from observations and interviews, a survey was then carried out to determine the needs of teachers and students regarding the need for digital-based learning media, incredibly interactive multimedia. The research results are quantitative data from questionnaires given to 35 teachers and 155 fifth-grade students. The needs survey covers aspects of the (a) implementation of learning, (b) learning media needs, and (b) the use of technology in learning. The survey results can be seen in Table 5 and Table 6.

Table 5.
Results of the Teacher Needs Survey.

Aspect	Question Items	Aspect Code	Response (%)			
			Strongly agree	Agree	Disagree	Strongly agree
Implementation of Learning	Desire to implement models. innovative learning methods	A.1	58.14	42.86	-	-
	The importance of student-centered learning	A.2	88.57	11.43	-	-
	The importance of arousing children's learning motivation in the learning process. for example. by using exciting media.	A.3	37.14	48.57	11.43	2.86
Learning Media Needs	Desire to use interactive multimedia in learning	B.1	42.86	45.71	11.43	-
	Digital-based media (such as interactive multimedia) is more effective and efficient than conventional media.	B.2	34.29	57.14	5.71	2.86
	Digital-based media (such as interactive multimedia) are needed to support constructivist learning.	B.3	42.86	48.57	8.57	-
Utilization of Technology in Learning	Learning needs to utilize technology because students are classified as digital natives.	C.1	60.00	40.00	-	-
	Important teachers can operate and utilize technology	C.2	37.14	62.86	-	-
	The desire to learn technology in order to implement it in learning	C.3	37.14	54.29	5.71	2.86

Based on the teacher needs survey, 58.14% of teachers strongly agreed, and 42.86 agreed to implement innovative learning models and methods. 88.57% of teachers strongly agreed, and 11.43% agreed about the importance of student-centered learning. Meanwhile, 37.14% of teachers strongly agreed, and 48.57% agreed about the importance of raising children's learning motivation in the learning process, such as using exciting media. Then, regarding learning media needs, 42.86% of teachers strongly agree, and 45.71% agree to use interactive multimedia in learning. 34.29% of teachers

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

strongly agree, and 57.14% think interactive multimedia is more effective and efficient than conventional media. 42.86% of teachers strongly agree, and 48.57% agree that interactive multimedia is needed to support constructivist learning. Then, regarding using technology in learning, 60% of teachers strongly agree, and 40% agree that learning needs to utilize technology because students are classified as digital natives. 37.14% of teachers strongly agree, and 62.86% agree that it is essential for teachers to have the ability to operate and utilize technology.

Furthermore, 37.14% of teachers strongly agreed, and 54.29% of teachers agreed to learn technology so they could implement it in learning. Apart from surveys with teachers, researchers also conducted surveys with students, which yielded the following results.

Table 6.
Results of the Student Needs Survey.

Question Items	Response Description	Response (%)
Learning conducted by the teacher in class	Explain/ lecture	35.48
	Ask me and my friends to discuss	50.32
	Others (assigning assignments. teaching using pictures/ videos/ animations)	14.19
The desired media in learning	Book	17.2
	Picture	22.58
	Interactive Multimedia (a combination of text. images. videos)	60.00
Interactive Multimedia makes it easier to understand the material	Yes	87.74
	No	12.26
Interactive Multimedia makes you more enthusiastic and does not get bored quickly.	Yes	90.97
	No	9.03
Responses if a teacher uses interactive multimedia in learning	Strongly agree	48.39
	Agree	44.52
	Disagree	5.81
	Strongly disagree	1.29
The desire to study subject matter using a cellphone or laptop	Want	86.45
	Do not want	13.55
Using a smartphone for study	Already	54.84
	Not yet	45.16
Smartphone ownership	Already	85.16
	Not yet	14.84
Laptop ownership/laptop borrowed from school	Already	100
	Not yet	0
Parental permission to use a smartphone or laptop for study	Parents allow	87.10
	Parents do not allow	12.90

Based on a survey of student needs, 50.32% of students answered that learning was carried out through discussion. Meanwhile, 60% of students want learning media in the form of interactive multimedia, a combination of text, video, images, and audio, making it easier for them to understand the material. Students also answered that learning by using interactive multimedia makes them more enthusiastic, and they do not get bored of learning quickly. 48.39% of students strongly agree, and 44.52% agree if teachers use multimedia in learning. Students want to learn to use smartphones or laptops, and they already have their own smartphones. Meanwhile, students have also received laptop loans from the city government to be used in the learning process. Parents also support their children in using smartphones or laptops for learning.

3.7. Flipped Classroom Learning Framework by Integrating Android-Based Multimedia

The flipped classroom learning steps used in this research use steps from Bishop & Verleger, (2013), which consist of:

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

3.7.1. Phase 0

Students study independently at home or outside the classroom before classroom learning is carried out based on instructions given by the teacher. They are integrating learning with interactive multimedia. Students can read modules and view learning videos available on Android-based interactive multimedia. Students can set their learning speed and learn through their styles and techniques to pause, repeat, and speed up the material.

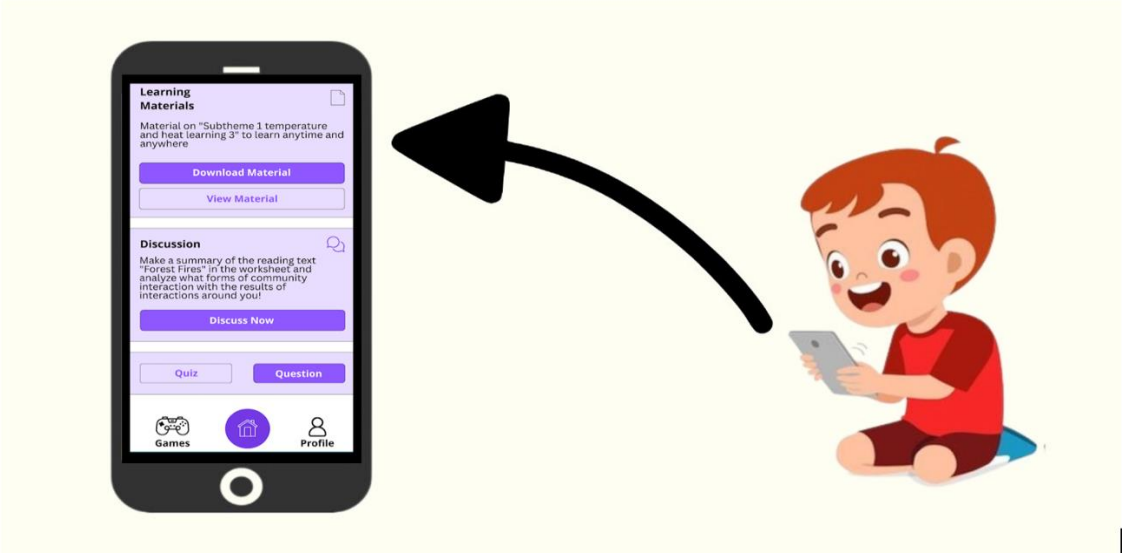

Figure 3.
Phase 0.

3.7.2. Phase 1

Students come to class to carry out teaching and learning activities and do related assignments. Students interact directly with friends or teachers. Students are divided into groups randomly. Next, the teacher gives students assignments related to the material they have studied at home and gives them a pre-test at the start of the lesson. These assignments and questions are available in multimedia, which students can access at school.

Figure 4.
Phase 1.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

3.7.3. Phase 2

Students work on projects and simulations with other students and the teacher in the classroom. Students hold discussions with their groups to carry out group assignments and apply the understanding they have learned previously. The teacher becomes a facilitator in the class, guiding student discussions and working on group worksheets. There is interaction between students and students and students and teachers.

Figure 5.
Phase 2.

3.7.3. Phase 3

This phase aims to measure students' understanding in class at the end of the lesson material. Each student works on evaluation questions prepared in interactive learning multimedia. In this phase, the teacher acts as a facilitator.

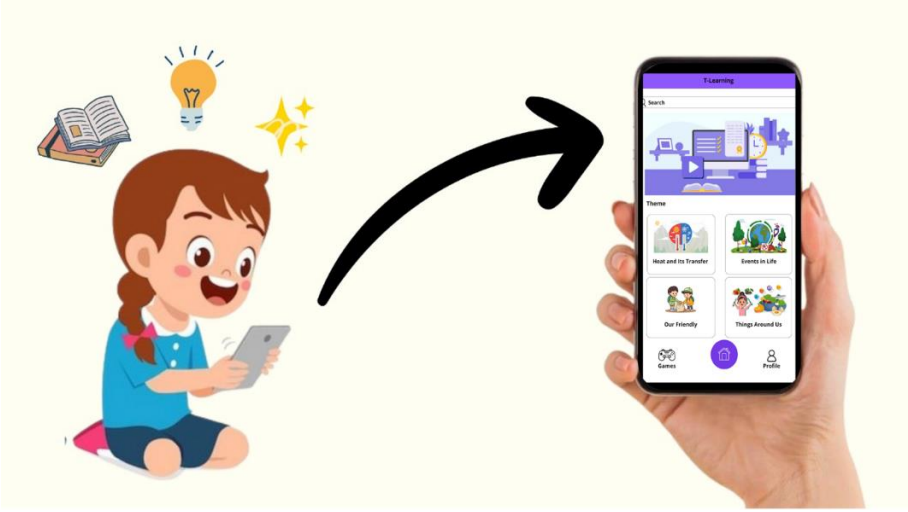

Figure 6.
Phase 3.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

4. Discussion

Digital technology-based learning is an integral part of a child's education process. Technology-based learning can be implemented by using digital learning media as a means for students to learn [19, 20]. Digital media promises convenience to its users by being easy to operate and accessible wherever students are [40, 41]. Elementary school students are digital natives who have been close to technology since childhood [42]. Today's elementary school students have good digital skills and quickly adapt to digital media. Based on research conducted by Baek, et al. [43] technology is a medium for improving classroom teaching. Using technology in learning can provide students with the broadest possible access and opportunities to build knowledge by independently accessing existing learning resources. Digital literacy is often discussed as a new phenomenon, depending on media or technological affordances; this identifies how new technologies have changed existing literacy in society [44]. With digital media that suits the characteristics of elementary school students, it will raise students' motivation to learn.

As time goes by, there are various kinds of digital media that teachers and parents can use to facilitate student learning. The use of digital media and the implementation of learning using the internet has become a characteristic feature of education in this century, so schools must improve students' digital skills. Interactive multimedia is one of the digital media that can be used. Elementary school is one of the educational institutions that is very fundamental in preparing quality human resources. Teachers should create a positive learning climate so that data provides students with provisions to prepare quality human resources to face future challenges. Integrative thematic learning in elementary schools is a learning approach that integrates various competencies in various subjects into various themes. This integration consists of two things, namely (1) integration between attitudes, skills, and knowledge in the learning process and (2) integration of various related basic concepts that are studied thoroughly [45]. In this way, learning provides students complete meaning, reflected in the theme [46]. So integrative thematic learning is very suitable for elementary school students.

Implementing integrative thematic learning requires innovation in the form of media implementing learning to make it more interesting, effective, and meaningful. Al-Rahmi, et al. [47] revealed that learning problems occur, one of which is the need for teachers to use more learning media, which is caused by the limited learning media owned by schools. Teachers need to use more learning media to impact students' less-than-optimal grasp of lesson material, which results in learning not running optimally. The material packaging for thematic learning needs to be made attractive, high quality, and technology-based to optimize learning. Thematic learning requires child-centered skill competencies, which involve student activity in the learning process and form complete competencies in terms of attitudes, knowledge, and skills. Based on the problems and importance of thematic learning in the era of globalization and technology above, this is an urgent need and challenge for elementary/MI teachers. Teachers are required to provide knowledge and skills and be able to carry out thematic learning innovations that can be applied to elementary/MI students. Teachers need to know the principles of thematic learning well so they do not just teach the material but also develop students' potential.

This interactive multimedia combines various media elements, including audio, graphics, text, animation, etc., into one synergistic unit to produce many uses and can be used individually by students. Because it can be used individually, students can use this multimedia to study from home. Interactive media has uses in various types of communication media; has good color strength and object resolution, varied learning types, and learning responses; developed the principle of self-evaluation in measuring learning outcomes, which can be used individually or in groups online or offline [30]. Interactive multimedia is very suitable for elementary school-age students because, through this computer-controlled teaching delivery system, students hear sounds, see videos/images, and read text and can also provide active responses to the media. It can attract students' attention to learning resources and improve the quality of learning [48, 49].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

Digital-based interactive multimedia can effectively support students' independent learning activities wherever they are and can be accessed by students at any time [50]. Through experimental tests, student learning outcomes in classes that use interactive multimedia are better compared to classes that use video scribe and PowerPoint-based media. In line with this opinion, research conducted by Gan, et al. [51] revealed that learning with the use of digital-based interactive media at the level has been recognized as an essential tool for improving student learning individually and collaboratively with peers. Positive attitudes were also shown by students through the results of filling out questionnaires [52, 53]. Interactive multimedia can help and involve students in seeking and gaining much knowledge to complete assignments or problems given to students. Web-based interactive multimedia can also provide motivation, and by using interactive multimedia, you can carry out authentic evaluations on students. Appropriate design and development of interactive media by applying specific models can make learning effective and beneficial for students. Research by Liu, et al. [54] proves that interactive media can motivate students to study complex electrocardiogram material more efficiently and positively impact learning motivation, independent learning, and student learning achievement. The design and development of digital-based media are based on learning models; learning multimedia, material descriptions, and feedback tests are integrated. With this combination of designs, it contributes to improving student learning achievement.

Learning using a flipped classroom that is integrated with interactive multimedia can attract students' attention because it is student-centered; besides that, it can also activate students learning [39, 44, 55]. The flipped classroom model is used to prepare students to take part in learning. The flipped classroom model can also increase students' learning motivation [27]. In the traditional model, the teacher delivers the material and then adds to the understanding of the material, so students will do assignments at school and continue at home. However, in flipped classroom learning, students prepare learning through a medium and access that media. Besides that, previous research conducted by Chrismawati, et al. [28] and Rindaningsih, et al. [29] revealed that the flipped classroom model could improve student learning outcomes.

5. Conclusion

Thematic learning in elementary schools has implemented digital-based learning using PowerPoint media and learning videos. The rapid development of science and technology significantly impacts education, especially in implementing learning. Elementary students who are digital natives quickly adapt to technological developments connected to the internet. Flipped classroom learning by integrating multimedia is one solution that can be used to implement technology-based learning that can attract students' interest in learning. Learning using multimedia can provide a variety of media forms in the form of text, images, video, and audio. Flipped classroom learning integrated with multimedia consists of phases 0, 1, 2, and 3; each phase has its steps.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Acknowledgment:

The article was prepared thanks to the support of the Universitas Negeri Malang and Universitas PGRI Madiun

References

[1] M. A. Alsubaie, "Distance education and the social literacy of elementary school students during the COVID-19 pandemic," *Heliyon*, vol. 8, no. 7, p. e09811, 2022. https://doi.org/10.1016/j.heliyon.2022.e09811

[2] J. Shim, "Investigating the effectiveness of introducing virtual reality to elementary school students' moral education," *Computers & Education: X Reality*, vol. 2, p. 100010, 2023. https://doi.org/10.1016/j.cexr.2023.100010

[3] S. Isha and B. Wibawarta, "The impact of the COVID-19 pandemic on elementary school education in Japan," *International Journal of Educational Research Open*, vol. 4, p. 100239, 2023. https://doi.org/10.1016/j.ijedro.2023.100239

[4] S.-i. Bessho, H. Noguchi, A. Kawamura, R. Tanaka, and K. Ushijima, "Evaluating remedial education in elementary schools: Administrative data from a municipality in Japan," *Japan and the World Economy*, vol. 50, pp. 36-46, 2019. https://doi.org/10.1016/j.japwor.2019.04.003

[5] K. Kim and K. Kwon, "Exploring the AI competencies of elementary school teachers in South Korea," *Computers and Education: Artificial Intelligence*, vol. 4, p. 100137, 2023. https://doi.org/10.1016/j.caeai.2023.100137

[6] N. Horoz *et al.*, "Children's behavioral and emotional problems and peer relationships across elementary school: Associations with individual-and school-level parental education," *Journal of school psychology*, vol. 93, pp. 119-137, 2022. https://doi.org/10.1016/j.jsp.2022.06.005

[7] Y. Zen, "Gender differences in occurrence of behavioral and emotional problems at the lower grades of elementary school: Association with developmental and behavioral characteristics at 5 years," *Brain Dev*, vol. 41, no. 9, pp. 760–768, 2019. https://doi.org/10.1016/j.braindev.2019.06.001

[8] M. Rojas *et al.*, "Assessing collaborative problem-solving skills among elementary school students," *Computers & Education*, vol. 175, p. 104313, 2021. https://doi.org/10.1016/j.compedu.2021.104313

[9] S.-Y. Huang, Y.-H. Kuo, and H.-C. Chen, "Applying digital escape rooms infused with science teaching in elementary school: Learning performance, learning motivation, and problem-solving ability," *Thinking Skills and Creativity*, vol. 37, p. 100681, 2020. https://doi.org/10.1016/j.tsc.2020.100681

[10] S. Vuk, "Development of creativity in elementary school," *Journal of Creativity*, vol. 33, no. 2, p. 100055, 2023. https://doi.org/10.1016/j.yjoc.2023.100055

[11] J. A. Greene, B. Y. Seung, and D. Z. Copeland, "Measuring critical components of digital literacy and their relationships with learning," *Computers & Education*, vol. 76, pp. 55-69, 2014. https://doi.org/10.1016/j.compedu.2014.03.008

[12] A. Y. Lee and J. T. Hancock, "Developing digital resilience: An educational intervention improves elementary students' response to digital challenges," *Computers and Education Open*, vol. 5, p. 100144, 2023. https://doi.org/10.1016/j.caeo.2023.100144

[13] A. Kor and A. Shoshani, "Moderating the impact of the COVID-19 pandemic on children's and adolescents' substance use, digital media use, and mental health: A randomized positive psychology addiction prevention program," *Addictive Behaviors*, vol. 141, p. 107660, 2023. https://doi.org/10.1016/j.addbeh.2023.107660

[14] Y.-c. Yeh, H.-L. Chang, and S.-Y. Chen, "Mindful learning: A mediator of mastery experience during digital creativity game-based learning among elementary school students," *Computers & Education*, vol. 132, pp. 63-75, 2019. https://doi.org/10.1016/j.compedu.2019.01.001

[15] S. Wang, A. Wilson, R. Jesson, Y. Liu, and S. Meiklejohn-Whiu, "Opportunities to learn literacy in digital classrooms in New Zealand primary schools: Does class achievement level make a difference?," *Teaching and Teacher Education*, vol. 130, p. 104171, 2023. https://doi.org/10.1016/j.tate.2023.104171

[16] T. Knaus, "Emotions in Media Education: How media based emotions enrich classroom teaching and learning," *Social Sciences & Humanities Open*, vol. 8, no. 1, p. 100504, 2023. https://doi.org/10.1016/j.ssaho.2023.100504

[17] M. Degner, S. Moser, and D. Lewalter, "Digital media in institutional informal learning places: A systematic literature review," *Computers and Education Open*, vol. 3, p. 100068, 2022. https://doi.org/10.1016/j.caeo.2021.100068

[18] Asosiasi Penyelenggara Jasa Internet Indonesia, "Laporan survei internet APJII 2019 – 2020," *Asos. Penyelenggara Jasa Internet Indones*, pp. 1–146, 2020.

[19] L. Pangrazio, A.-L. Godhe, and A. G. L. Ledesma, "What is digital literacy? A comparative review of publications across three language contexts," *E-learning and Digital Media*, vol. 17, no. 6, pp. 442-459, 2020. https://doi.org/10.1177/2042753020946291

[20] P. Zhao, H. Kynäshlahti, and S. Sintonen, "A qualitative analysis of the digital literacy of arts education teachers in Chinese junior high and high schools," *Journal of Librarianship and Information Science*, vol. 50, no. 1, pp. 77-87, 2018. https://doi.org/10.1177/0961000616658341

[21] R. Rejeki, M. F. Adnan, and P. S. Siregar, "Utilization of learning media in integrated thematic learning in elementary schools," *J. Basicedu*, vol. 4, no. 2, pp. 337–343, 2020. https://doi.org/10.31004/basicedu.v4i2.351

[22] R. Fogarty and B. M. Pete, "Haw to interate the curricula," print. united states am," Retrieved: http://ir.obihiro.ac.jp/dspace/handle/10322/393. [Accessed 2009.

[23] H. Karli, "Implementation of thematic learning in elementary schools in Indonesia," *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, vol. 2, no. 1, pp. 1–11, 2015.

[24] R. Rusli, D. A. Nalanda, A. D. V. Tarmidi, K. M. Suryaningrum, and R. Yunanda, "Augmented reality for studying hands on the human body for elementary school students," *Procedia Computer Science*, vol. 216, pp. 237-244, 2023. https://doi.org/10.1016/j.procs.2022.12.132

[25] K. Dalacosta, M. Kamariotaki-Paparrigopoulou, J. Palyvos, and N. Spyrellis, "Multimedia application with animated cartoons for teaching science in elementary education," *Computers & Education*, vol. 52, no. 4, pp. 741-748, 2009. https://doi.org/10.1016/j.compedu.2008.11.018

[26] A. Fajarini, B. E. Soetjipto, and F. Hanurawan, "Developing a social studies module by using problem based learning (PBL) with scaffolding for the seventh grade students in a junior high school in Malang, Indonesia," *IOSR Journal of Research & Method in Education*, vol. 6, no. 1, pp. 62-69, 2016. https://doi.org/10.9790/7388-06126269

[27] L. Susanti and D. A. H. Pitra, "Flipped classroom sebagai strategi pembelajaran pada era digital," *Health and Medical Journal*, vol. 1, no. 2, pp. 54-58, 2019.

[28] M. Chrismawati, I. Septiana, and E. Purbiyanti, "Improving learning outcomes through the flipped classroom model assisted by power point and audio visual media in elementary schools," *Edukatif: Jurnal Ilmu Pendidikan*, vol. 3, no. 5, pp. 1928-1934, 2021.

[29] I. Rindaningsih, W. D. Hastuti, and Y. Findawati, "Design of a fun learning environment based on flipped classroom in elementary school," *Proceedings of the ICECRS*, vol. 2, no. 1, pp. 41-47, 2019. https://doi.org/10.21070/picecrs.v2i1.2452

[30] B. Williamson, J. Potter, and R. Eynon, "New research problems and agendas in learning, media and technology: the editors' wishlist," *Taylor & Francis*, vol. 44, no. 2, pp. 87-91, 2019. https://doi.org/10.1080/17439884.2019.1614953

[31] S. Herrlinger, T. N. Höffler, M. Opfermann, and D. Leutner, "When do pictures help learning from expository text? Multimedia and modality effects in primary schools," *Research in Science Education*, vol. 47, pp. 685-704, 2017. https://doi.org/10.1007/s11165-016-9525-y

[32] C. Öksüz, S. Uça, and G. Genç, "Designing multimedia videocases to improve mathematics teaching with technology:"technology integration into mathematics education" project," *Procedia-Social and Behavioral Sciences*, vol. 1, no. 1, pp. 489-494, 2009. https://doi.org/10.1016/j.sbspro.2009.01.089

[33] Y. Akpınar, D. Ardaç, and N. Er-Amuce, "Development and validation of an argumentation based multimedia science learning environment: Preliminary findings," *Procedia-Social and Behavioral Sciences*, vol. 116, pp. 3848-3853, 2014. https://doi.org/10.1016/j.sbspro.2014.01.853

[34] F. Ahmadi, "Increasing elementary school students' interest in reading with the Glenn Doman multimedia-based method," *Jurnal Penelitian Pendidikan*, vol. 27, no. 1, pp. 64–70, 2010.

[35] M. Basori, "Interactive multimedia development based on," *J. Pendidik. Dasar Nusant*, vol. 1, no. 2, pp. 75–87, 2016.

[36] A. J. Onwuegbuzie, R. M. Bustamante, and J. A. Nelson, "Mixed research as a tool for developing quantitative instruments," *Journal of Mixed Methods Research*, vol. 4, no. 1, pp. 56-78, 2010. https://doi.org/10.1177/1558689809355805

[37] W. Creswell John and J. D. Creswell, "Research design: Qualitative, quantitative, and mixed methods approaches," *Los Angeles London New Dehli Singapore: Sage Publications*, 2009.

[38] S. Arikunto, *Research methodology*. Jakarta: PT. Rineka Cipta, 2002.

[39] J. Bishop and M. A. Verleger, "The flipped classroom: A survey of the research," presented at the In 2013 ASEE Annual Conference & Exposition (pp. 23-1200), 2013.

[40] H. Prastiyono, S. Utaya, S. Sumarmi, I. K. Astina, S. Amin, and M. Aliman, "Development of e-learning, mobile apps, character building, and outdoor study (EMCO learning model) to improve geography outcomes in the 21st century," *International Journal of Interactive Mobile Technologies*, vol. 15, no. 7, pp. 107-122, 2021. https://doi.org/10.3991/ijim.v15i07.21553

[41] D. S. Nasuha, "Development of e-learning media based on Edmodo on basic competency of final drive unit maintenance for class XI students of SMK "Panca Hidayat"Tulungagung," Doctoral Dissertation, Universitas Negeri Malang, 2020.

[42] M. Prensky, "Digital natives, digital immigrants part 2: Do they really think differently?," *On the Horizon*, vol. 9, no. 6, pp. 1-6, 2001.

[43] Y. Baek, J. Jung, and B. Kim, "What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample," *Computers & Education*, vol. 50, no. 1, pp. 224-234, 2008. https://doi.org/10.1016/j.compedu.2006.05.002

[44] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *European Physical Education Review*, vol. 26, no. 1, pp. 70-84, 2020.

[45] N. Hidayah, "Pembelajaran tematik integratif di Sekolah Dasar," *Terampil: Jurnal Pendidikan dan Pembelajaran Dasar*, vol. 2, no. 1, pp. 34-49, 2017.

[46] S. Anshori, "Pembelajaran Tematik (Tematik Integrative) Mata Pelajaran IPS Pada Kurikulum 2013," *Jurnal Ilmiah PGSD*, vol. 6, no. 2, pp. 42-53, 2014.

[47] W. M. Al-Rahmi *et al.*, "Integrating technology acceptance model with innovation diffusion theory: An empirical investigation on students' intention to use E-learning systems," *Ieee Access*, vol. 7, pp. 26797-26809, 2019.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610

[48] D. R. Anderson and M. C. Davidson, "Receptive versus interactive video screens: A role for the brain's default mode network in learning from media," *Computers in Human Behavior*, vol. 99, pp. 168-180, 2019.
[49] U. Jamaludin and R. Rachmatullah, *Social studies education learning theory concepts and applications for teachers and students*. Bekasi: CV Nurani, 2018.
[50] B. E. Praheto, M. R. Andayani, and N. E. Wardani, "The effectiveness of interactive multimedia in learning Indonesian language skills in higher education," *Rupkatha J. Interdiscip. Studs. Humanity*, vol. 12, no. 1, pp. 1-11, 2020. https://doi.org/10.21659/rupkatha.v12n1.34
[51] B. Gan, T. Menkhoff, and R. Smith, "Enhancing students' learning process through interactive digital media: New opportunities for collaborative learning," *Computers in Human Behavior*, vol. 51, pp. 652-663, 2015. https://doi.org/10.1016/j.chb.2014.12.048
[52] T. Gopal, S. S. Herron, R. S. Mohn, T. Hartsell, J. M. Jawor, and J. C. Blickenstaff, "Effect of an interactive web-based instruction in the performance of undergraduate anatomy and physiology lab students," *Computers & Education*, vol. 55, no. 2, pp. 500-512, 2010. https://doi.org/10.1016/j.compedu.2010.02.013
[53] C.-S. Koong and C.-Y. Wu, "An interactive item sharing website for creating and conducting on-line testing," *Computers & Education*, vol. 55, no. 1, pp. 131-144, 2010. https://doi.org/10.1016/j.compedu.2009.12.010
[54] Y. Liu, P.-L. Chou, and B.-O. Lee, "Effect of an interactive e-book on nursing students' electrocardiogram-related learning achievement: A quasi-experimental design," *Nurse Education Today*, vol. 90, p. 104427, 2020. https://doi.org/10.1016/j.nedt.2020.104427
[55] D. Oktaria, "Outcomes and challenges of using flipped classroom," *Learning Methods in Medical Education*, vol. 8, pp. 47–54, 2019.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 4: 2610-2624, 2025
DOI: 10.55214/25768484.v9i4.6610