Designing socio discovery learning with interactive multimedia for entrepreneurship education: A mixed method approach

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Abstract: This research is motivated by the necessity for a more effective learning model aimed at enhancing students' communication skills in vocational schools, particularly in the subject of Creative Products and Entrepreneurship (CPE). Currently, the implementation of ICT-based learning remains limited, resulting in an underutilization of technological potential. The objective of this study is to develop a Socio Discovery Learning model that incorporates interactive multimedia to support the improvement of students' communication skills. The research employs a mixed methods design, involving 64 vocational students and two teachers as research subjects. Data were collected through questionnaires, interviews, and classroom observations. Findings from the interviews and observations indicate that teachers face challenges in applying Socio Discovery Learning, primarily due to limited technological facilities and a lack of training in the use of interactive media. Student survey results reveal that 75% of students believe that more interactive ICT-based media would enhance their learning experience, and 80% express a desire for such media to be utilized more frequently in their education. Although Discovery Learning has been implemented, its usage remains suboptimal. Overall, the development of an interactive multimedia-based Socio Discovery Learning model holds significant potential for improving students' communication skills.

1. Introduction

The current demands of global education emphasize the competencies required for the twenty-first century. Students must develop four essential skills: clear communication, collaboration with others, critical thinking and problem-solving, as well as innovation and creativity [1][2]. Communication plays a crucial role in modern learning; therefore, students must be able to articulate their thoughts effectively, both verbally and in writing [3]. In the realm of education, technology and science are continually evolving and being optimized to foster an effective learning environment. A comfortable and engaging learning atmosphere will enable students to concentrate on the subject matter [4].

In the 21st century, the integration of technology and interactive multimedia into educational practices has become paramount for fostering effective learning environments. The rapid advancement of technology necessitates that educators adapt their teaching methodologies to incorporate information and communication technologies (ICT) effectively. This adaptation is crucial as it enhances students' technological competencies, which are essential for navigating the complexities of modern society [5]. Furthermore, technology serves as a vital tool that facilitates various interactive learning processes, allowing for a more engaging and student-centered educational experience [6]. The emphasis on digital literacy, which includes skills such as communication, data analysis, and problem-solving, underscores

the importance of equipping students with the necessary tools to thrive in a digital landscape [7][8]. As educators strive to cultivate 21st-century skills, the role of technology becomes increasingly significant, as it not only supports the acquisition of knowledge but also prepares students for future challenges in a rapidly evolving job market [9]. Moreover, interactive multimedia has transformed traditional pedagogical approaches by promoting collaboration, creativity, and critical thinking among students.

Research showed that smartphone-based interactive multimedia can effectively improve students' critical thinking, creativity, collaboration, and communication skills [10]. These technologies create dynamic learning environments that cater to diverse learning styles and simulate real-world scenarios, particularly beneficial in vocational education [11]. Interactive multimedia courseware has been found to strengthen students' character [12] and increase attention, relevance, confidence, and satisfaction in science learning [13]. The use of multimedia resources, such as interactive e-books and online platforms, encourages active participation and enhances motivation, leading to improved learning outcomes [14]. Research indicates that positive experiences with technology can significantly influence students' perceptions and engagement, thereby fostering a conducive learning environment [15]. Additionally, the incorporation of multimedia in education aligns with the principles of 21st-century learning, which emphasize the necessity of developing skills that are relevant to contemporary society, such as collaboration and innovation. Interactive multimedia technology plays a crucial role in enhancing 21st-century learning and skills development.

The rapid advancement of technology, particularly in the context of Industry 4.0, is significantly impacting vocational education and workplace communication needs. Vocational schools must adapt their curricula to address the increasing demand for digital skills, soft skills, and technical communication abilities [16][17]. The COVID-19 pandemic has accelerated the digital transformation in vocational education, necessitating the use of various online platforms and learning management systems [18]. To meet these evolving needs, vocational schools are exploring innovative approaches such as integrating technoparks and centers of excellence [19]. The changing technological landscape is also affecting work characteristics, leading to increased complexity, mental work, and the need for continuous vocational education and training.

Other than that, the educational landscape in vocational schools has undergone significant changes in response to evolving communication skills and technological demands. As industries increasingly prioritize digital literacy and effective communication, vocational education must adapt its curricula to equip students with these essential competencies [20], the emphasis on communication skills, particularly in teamwork and professional interactions, has become vital as employers seek individuals who can navigate complex social dynamics and contribute effectively within diverse teams [21][22]. Moreover, the incorporation of innovative teaching methods, such as virtual and augmented reality, is reshaping vocational education to meet the demands of the digital economy [23]. These technologies provide immersive learning experiences that enhance students' understanding of practical applications in their fields.

Recent studies highlight significant challenges in vocational education curricula, particularly regarding communication and interpersonal skills development. Research indicates a gap between industry requirements and current vocational training, emphasizing the need for enhanced soft skills alongside technical competencies [24][25]. Studies suggest that integrating critical thinking and active learning strategies can improve communication skills [26]. Employers consistently rank communication, problem-solving, and teamwork as crucial employability skills for graduates [27][28]. To address these challenges, researchers recommend curriculum redesign, increased industry collaboration, and implementation of comprehensive support systems [29]. These findings underscore the urgent need for vocational institutions to adapt their curricula to better prepare students for the evolving demands of Industry 5.0 and enhance their overall employability.

The current vocational school curriculum faces significant challenges in effectively integrating communication skills essential for workforce success. One major issue is the disconnect between

curriculum content and the actual communication demands of the industry. Many programs prioritize technical skills over soft skills, producing graduates who excel in their trades but lack the interpersonal abilities needed to collaborate in diverse workplaces [30]. Additionally, the curriculum often fails to include real-world scenarios that allow students to practice communication, leaving a gap between theoretical knowledge and practical application [31]. This misalignment hinders students' job readiness, as employers increasingly seek candidates with strong teamwork and social interaction skills.

The inconsistent implementation of competency-based education (CBE) further exacerbates this issue, with communication skills being unevenly taught and assessed [32]. Many educators lack the necessary training and resources to effectively teach these skills. Moreover, the rapid evolution of industry standards and communication technologies requires continuous curriculum updates, which institutions often struggle to implement due to bureaucratic challenges and limited funding [33]. To address these challenges, vocational schools must prioritize integrating communication skills into their curricula, ensuring graduates are both technically proficient and equipped with the soft skills needed to thrive in today's collaborative, dynamic work environments [34]. This focus is crucial for improving the employability of vocational graduates and aligning education with industry expectations.

The role of technology in facilitating interactive learning in Vocational High Schools (SMKs) is underscored by several studies. Technology integration in educational settings enhances learning experiences, increases student engagement, and improves learning outcomes [35][36]. Specifically, the flipped classroom model, integrated with digital self-learning and diagnostic systems, has been effective in teaching Network Infrastructure Administration in SMKs, leading to higher test scores and practical skill proficiency [37]. Contradictions or interesting facts emerge when considering the varying degrees of technology integration and its impact. While technology is widely recognized as beneficial for enhancing communication skills and independent learning [38], its effectiveness is contingent upon proper implementation and teacher proficiency [39]. Moreover, the acceptance of technology by educational staff, particularly teachers, is crucial for successful ICT integration, which is influenced by teachers' beliefs and self-efficacy. In summary, technology plays a pivotal role in facilitating interactive learning in SMKs, with studies demonstrating its positive impact on student engagement and educational outcomes. However, the effectiveness of technology in education is dependent on factors such as teacher acceptance, digital competence, and the quality of implementation [40].

Developing learning models that align with the needs of vocational school students is crucial for enhancing their educational experience and ensuring their readiness for the workforce. As vocational education increasingly emphasizes practical skills and competencies, it is essential to create curricula that are responsive to industry demands and the specific learning styles of students [41]. This alignment not only fosters engagement and motivation among students but also equips them with the relevant skills needed in their respective fields. For instance, integrating interactive multimedia and technology into the learning process can significantly enhance students' understanding and retention of complex concepts, making learning more relevant and applicable to real-world scenarios [42]. Furthermore, the incorporation of project-based learning and hands-on training opportunities allows students to develop critical thinking and problem-solving skills, which are highly valued by employers [43]. Moreover, the importance of adaptability in vocational education cannot be overstated, as the rapid pace of technological advancement necessitates continuous updates to educational content and teaching methods [29]. By fostering a learning environment that prioritizes collaboration between schools and industries, vocational programs can ensure that students are not only acquiring technical skills but also developing essential soft skills, such as communication and teamwork [44][45]. This holistic approach to vocational education prepares students to navigate the complexities of the modern job market, ultimately enhancing their employability and career prospects. Therefore, the development of tailored learning models that address the unique needs of vocational school students is vital for cultivating a skilled workforce capable of meeting the challenges of today's economy.

The development of communication skills has become a key area of focus in educational research, especially as the demand for effective communication grows in today's globalized world. Various

innovative approaches have been explored to meet this need. Discovery Learning, for example, has proven effective in enhancing both mathematical reasoning and communication [46], while integrating socio-scientific issues through the Jigsaw model has successfully improved chemistry literacy and communication abilities [47]. Similarly, digital storytelling combined with metacognitive strategies has shown great potential for enhancing student communication skills [48]. These findings emphasize the importance of social and collaborative learning in developing communication skills, especially in fields like healthcare, where methods such as simulations and experiential learning have demonstrated significant benefits.

Discovery learning also plays a crucial role in fostering critical thinking and social skills, which are essential for character development [49]. In technical education, modified reciprocal teaching has been found to improve communication among engineering students [50], and a sociocultural approach has been proposed to enhance communication training for educators [51]. These findings collectively suggest that pairing social interaction with effective instructional methods is key to cultivating strong communication skills.

Recent studies have further highlighted the role of interactive multimedia in advancing communication skills, especially in the context of 21st-century competencies. For instance, smartphone-based multimedia tools have significantly enhanced students' communication abilities [51], and applications have been useful in developing professional English communication skills [48]. Additionally, interactive multimedia eBooks have been shown to improve clinical competencies, including communication techniques [52], and multimedia-enriched classrooms have positively impacted students' presentation and speaking abilities [53]. Courses that integrate multimedia to build character and communication skills have also been developed, further showcasing the potential of this approach.

By implementing a Socio Discovery Learning model that integrates interactive multimedia, we can offer an innovative and comprehensive solution to boost communication skills. This model combines social, cognitive, and technological elements in an engaging and relevant way, making it highly effective for students across various educational levels. It addresses not only the cognitive aspects of communication but also the social dynamics crucial for success in today's interconnected world.

In vocational high schools (SMK), communication skills are essential for preparing students to confidently enter the workforce. However, traditional teaching methods, still common in many schools, often fail to provide the necessary support for developing these skills. The heavy reliance on lectures and one-way assignments emphasizes theory over active engagement, critical thinking, and collaboration. As a result, students become passive learners, missing valuable opportunities to practice and enhance their communication skills [54][55]s. The limited use of interactive media or project-based learning further disconnects the learning experience from the real-world demands of today's jobs, where strong communication is crucial. Although research has long emphasized the importance of communication skills in the workplace, particularly for SMK graduates, there remains a gap in understanding how to effectively teach these skills in vocational education. While digital tools and interactive multimedia are making their way into classrooms, their implementation in SMK settings is often inconsistent and lacks clear strategy [56][57]. Many teachers have yet to fully utilize these technologies to create interactive, collaborative learning environments.

By thoughtfully integrating technology, this model not only makes learning more engaging but also enables students to practice communication in real-life work scenarios. It helps bridge the gap between workforce demands and current teaching practices, providing a hands-on, relevant way to develop essential communication skills for their careers. This study explores the need to develop a Social Discovery Learning model that incorporates interactive multimedia to enhance communication skills in vocational high school (SMK) students. It seeks to understand the needs of both students and teachers in improving communication while identifying the challenges in implementing more engaging teaching methods. By addressing these goals, the research aims to close the gap between traditional teaching methods and the modern demand for stronger communication skills. The interactive multimedia

elements are expected to create a dynamic learning environment where students can practice communication in real-world contexts. Additionally, this study aims to provide valuable insights on effectively integrating technology into vocational classrooms, ensuring that both students and teachers are equipped with the tools needed for a more interactive and enriching educational experience.

2. Literature Review

2.1. Research Related to Socio Discovery Learning

The implementation of Socio Discovery Learning, which is closely related to social constructivist learning theory, has been investigated in various educational contexts. As discussed by [58], who examined the application of constructivist learning theory in undergraduate education, emphasizing the importance of authentic, active, and student-centered learning facilitated through social negotiation, particularly in the context of empirical research or studies. Similarly, [59] highlighted the widespread use of social constructivist learning theory in professional education, which utilizes sociocultural collaboration to address challenges in both practical assignments and theoretical frameworks.

Furthermore, several studies have investigated the implementation of Socio Discovery Learning across various educational contexts, specifically highlighting its effectiveness in enhancing student engagement and learning outcomes. For instance, one study aimed to explore the application of the Discovery Learning model in mathematics education, which revealed a significant improvement in students' mathematical communication skills, both orally and in writing [60]. Similarly, in other subjects, the development of a model necessitates a needs analysis. [61], in their research findings, emphasize the importance of fostering student independence and active learning to combat passive learning habits that can lead to poor academic results, serving as a foundational aspect for the development of the Socio Discovery Learning model. Additionally, the application of the Discovery Learning model based on edutainment in physics education not only engages students but also successfully makes complex material more accessible and enjoyable [62]. Collectively, these studies underscore the significance of adapting teaching models to meet the diverse needs of students.

In addition to the aforementioned findings, the primary outcomes from various studies demonstrate the efficacy of the Social Discovery Learning model in enhancing students' communication and collaboration skills across diverse educational contexts. Similarly, research highlights that the Discovery Learning model not only improves students' understanding of reduction-oxidation reactions but also significantly enhances their oral and written communication skills, indicating the model's effectiveness in promoting a collaborative learning environment [63].

Furthermore, it has been reported that the Video-Assisted Discovery Learning model positively influences the communication skills of junior high school students, highlighting the significance of active engagement in the learning process to foster effective communication [64]. Additionally, the incorporation of socio-scientific issues within the Discovery Learning framework has been noted to enhance students' critical and collaborative thinking abilities as they participate in discussions and problem-solving activities related to real-world contexts [65]. Collectively, these findings underscore the potential of the Socio Discovery Learning model not only to improve academic performance but also to cultivate students' communication and collaboration skills in addressing the challenges of the 21st century.

2.2. Research on Interactive Multimedia and Communication Skills Improvement

In recent years, the use of technology in education, particularly in vocational schools, has become increasingly common. Studies have consistently highlighted the positive impact of integrating technology into vocational education, especially in developing 21st-century skills such as communication, critical thinking, and collaboration [11][66]. For instance, Learning Factories 4.0 have successfully promoted technical competencies, although their influence on digital skills has been less significant [67]. Similarly, mixed reality technologies like HoloLens have been found to enhance student motivation and learning in various vocational fields [68]. Despite these advancements, the

rapid development of technology demands continuous vocational education and training to keep pace with dynamic workforce requirements [69]. Overall, students have responded positively to technology-supported learning, especially when it enhances their professional and communication skills.

Empirical research further reinforces the benefits of technology in vocational education, particularly in improving communication and collaboration. For example, [42] demonstrated that the integration of technology in vocational education provides students with direct exposure to industry practices, helping them better understand real-world applications and improving their communication skills within their fields. Additionally, [70] stressed the importance of equipping pre-service teachers with strong technological skills, as this is crucial for fostering effective communication and collaboration in classrooms. Furthermore, the utilization of mobile technology in vocational settings, showed that mobile devices not only support formal learning but also promote informal learning opportunities through collaborative interactions between students and industry professionals [71]. This integration of technology not only enriches the educational experience but also cultivates essential soft skills, such as teamwork and effective communication, which are vital for success in the modern workforce. Overall, these findings underscore the importance of leveraging technology in vocational education to enhance both technical competencies and interpersonal skills among students.

Previous research has indicated that Socio Discovery Learning is effective in enhancing communication skills; however, its application has been primarily confined to formal educational settings such as secondary schools and higher education institutions. This limitation is evident in the insufficient exploration of its use within vocational education contexts, such as in vocational high schools (SMK), where the demand for communication skills pertinent to the workforce is crucial. Furthermore, while the incorporation of interactive multimedia has been shown to enrich the learning experience, there remains a gap in research that specifically integrates this technology into social discovery-based learning models in vocational high schools.

This research endeavors to address the aforementioned gap by developing a Socio Discovery Learning model based on interactive multimedia that is more relevant to the needs of vocational high schools (SMK). The proposed model is expected to overcome the limitations of previous research by offering a solution that not only enhances students' communication skills but also effectively integrates technology to support learning that is more responsive to industry requirements and 21st-century challenges.

3. Method

3.1. Research Design

This research employs a mixed methods approach to collect comprehensive data, combining qualitative and quantitative methodologies [72]. This approach enables researchers to obtain generalizations through quantitative data while simultaneously gaining in-depth insights through qualitative data. The mixed methods approach was selected due to its capacity to provide a more holistic understanding of the phenomenon under investigation, particularly in the context of identifying needs for creating an effective learning model to facilitate education in vocational high schools.

3.2. Research Subjects and Data Collection Techniques

The research subjects for quantitative data collection comprised 64 vocational high school students selected through random sampling techniques [73]. Data collection was conducted using a needs analysis questionnaire, adapted from the studies of [74] and [75], and tailored to align with the objectives of this research. In contrast, the qualitative data will involve subjects selected through purposive sampling [76], in accordance with the specific needs and aims of this study. Two teachers specializing in Creative Product Entrepreneurship (PKK) will serve as the primary informants for this research. The selection of qualitative subjects aims to explore diverse perspectives and provide a deeper understanding of students' experiences in the learning process. The qualitative data collection techniques will utilize interviews and observations, employing instruments such as interview guidelines

and observation sheets. Instrument grids utilized in this mixed methods study will be presented in Tables 1, 2, and 3.

Table 1.
Learning observation instruments.

No	Indicator	Item
1.	Giving motivation	3
2.	Use of media during the learning process	4
3.	Ability to manage learning	2
4.	Providing feedback on student activities	1
5.	Types of use of learning models	3

Source: [74]

Table 2.
Identification instrument with teachers (Interview).

No	Indicator	Item
1.	Use of learning strategies	3
2.	Use of learning media	3
3.	Facilities available at school	2
4.	Achievement of learning outcomes/Student achievement	2

Source: [77]

Table 3.
Needs analysis questionnaire instrument (Students).

| No	Indicator	Item
1.	Creative entrepreneurship products (PKK) learning process	3
2.	Use of ICT-based learning media	2
3.	Students' needs and views of ICT-based learning media	2

Source: [74]

3.3. Data Validity Checking Techniques

To ensure the validity of the data, this study employs data source triangulation and methodological triangulation. Data source triangulation involves gathering information from multiple sources, such as teachers and students, followed by cross-checking to verify the consistency of the information [78]. Meanwhile, methodological triangulation is achieved by utilizing various data collection techniques as applied in this research, aiming to obtain a more comprehensive understanding [79].

3.4. Data Analysis Techniques

The quantitative data obtained will be analyzed descriptively, utilizing simple statistical methods to illustrate general trends and patterns in the research findings [80]. Concurrently, the qualitative data will be analyzed using the interactive analysis approach proposed by Miles & Huberman [81], which involves categorizing data into themes and subthemes in accordance with the research objectives. The results of the qualitative data analysis will be presented in a descriptive narrative format, supported by percentages that mutually reinforce the identified themes and subthemes. Figure 1 illustrates the qualitative data analysis process.
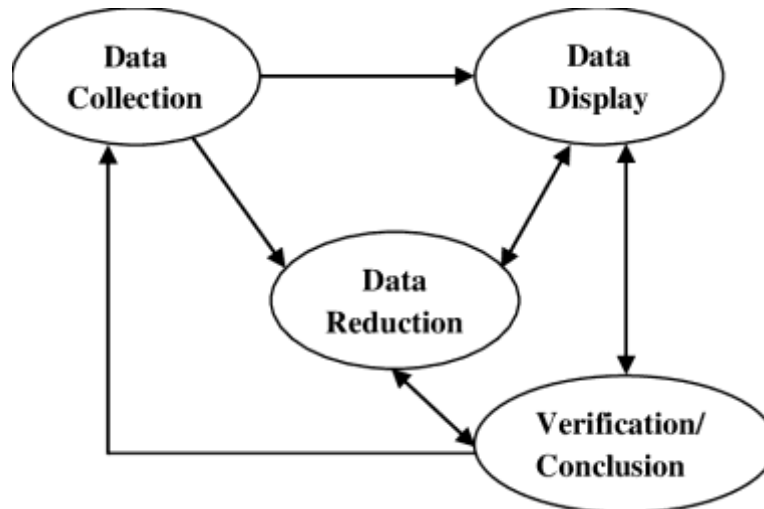
Figure 1.
Data analysis techniques.

4. Results

4.1. Results of Observations on Creative Products and Entrepreneurship Learning

The observations were conducted twice with two different teachers, aiming to assess the implementation of the learning model in the context of Creative Products and Entrepreneurship education at vocational schools. The focus of the observation included aspects such as motivation delivery, media utilization, classroom management skills, feedback provision, and the learning models employed. In the first observation, Teacher A employed a Discovery Learning approach; however, its implementation was not fully effective. Although Teacher A attempted to motivate students by presenting examples of successful entrepreneurs at the beginning of the lesson, this motivation did not persist throughout the learning process. A significant number of students appeared passive following the introductory phase, indicating that the initial motivation was insufficient to foster active engagement during the entire session. Regarding media usage, Teacher A relied on short videos and PowerPoint presentations, yet the media employed lacked interactivity. These resources primarily served as tools for information delivery rather than as means to facilitate student engagement. Classroom management was relatively effective, but challenges arose in time management, particularly during group discussions, where some groups received inadequate guidance. The feedback provided was also not optimal; Teacher A's feedback tended to be general and superficial, failing to encourage students to engage in critical thinking or to further explore their creative ideas. The Discovery Learning model applied was overly structured, leaving students with limited opportunities to independently discover or design their ideas.

In the second observation, Teacher B implemented a traditional approach, predominantly utilizing lectures and open class discussions. The motivation provided was limited to instructions and reminders about the importance of entrepreneurial skills for the workforce; however, this motivation lacked relevance to the immediate learning context faced by the students. Students tended to listen, but their participation was limited, indicating that the provided motivation had not successfully activated full student engagement. Teacher B employed PowerPoint presentations with text-heavy content, which did not adequately assist students in visually comprehending the concept of creative products. The use of this medium insufficiently supported student involvement in the learning process. In classroom management, Teacher B appeared more focused on explaining the material rather than allocating time for student interaction. Consequently, the class became less dynamic and more unidirectional. Teacher B provided minimal feedback to students during the discussion process, and the feedback given was primarily corrective in nature. There was an absence of in-depth discussions or open-ended questions

that would encourage students to develop their ideas. The learning model employed remained lecture-based, with limited application of Discovery Learning, which did not provide sufficient opportunity for students to explore independently or collaborate in groups.

Based on observational data, several aspects have drawn the researchers' attention, particularly regarding the utilization of instructional media and teaching materials. It is noteworthy that digital technologies such as smartphones, laptops, and computers have not been optimally employed to support the ongoing learning process. The introduction of innovative ICT-based teaching materials in an interactive multimedia format, integrated with the socio-discovery learning model, could serve as an alternative that may be utilized during the learning process, with the aim of facilitating students in acquiring the competencies they require for the 21st century.

4.2. Challenges for Teachers in Implementing Creative Entrepreneurship Product Learning

Interviews were conducted with two teachers who instruct Creative Products and Entrepreneurship at a vocational school to gain insights into the implementation of teaching strategies, the use of media, the facilities available at the school, and the academic achievements of students. Overall, the discussions with both educators revealed several similarities in their approaches to teaching and the challenges they encounter. In terms of teaching strategies, both teachers continue to employ traditional lecture-based methods, despite some efforts to incorporate Discovery Learning. Unfortunately, the implementation of Discovery Learning has not yet reached its full potential. Both Teacher A and Teacher B indicated that a lack of training and time constraints hinder their ability to fully optimize this strategy. Students tend to be passive when the teaching methods do not include collaborative activities or projects that promote active engagement. Regarding media usage, both teachers rely on more traditional tools, such as PowerPoint presentations and short videos, which primarily serve as information delivery mechanisms rather than interactive learning aids. Both educators recognize that the use of more interactive media, such as ICT-based multimedia, could enhance the learning experience for students. However, they noted that the facilities available at the school do not fully support the optimal use of this technology.

Regarding school facilities, both educators noted limitations in access to technological devices such as computers and stable internet connectivity. Although basic hardware like projectors was available, technical constraints frequently impeded their efforts to more deeply integrate technology into the learning process. These limitations reduced their capacity to fully utilize technology in support of more collaborative and interactive learning. Concerning learning outcomes, both educators expressed that students were moderately successful in comprehending fundamental entrepreneurship concepts. However, communication and collaboration skills, particularly in presenting creative ideas, still required improvement. Educators A and B concurred that a more project-based and collaborative learning model could assist students in developing their communication skills more effectively.

Overall, the interviews conducted with both educators revealed that despite the implementation of various teaching strategies and learning media, there exists an urgent need to incorporate more innovative ICT-based interactive media into the educational process. Learning models such as Project-Based Learning or Blended Learning, when supported by interactive media, could effectively address existing challenges and enhance students' communication skills and engagement. The application of technology, including computer-based simulations and multimedia modules, is anticipated to serve as a viable solution for equipping students with relevant skills for the 21st century.

4.3. Students' Views on the Implementation of Learning and the Need for Supporting Media

A questionnaire was distributed to 64 students enrolled in the Creative Products and Entrepreneurship (CPE) course at a vocational high school. This instrument was developed to assess students' perceptions regarding the learning process in CPE, the utilization of ICT-based learning media, and their needs and perspectives on technology-based media. The results of the analyzed questionnaire are presented in Table 4.

Table 4.
Results of the student needs identification questionnaire.

Indicator	Question items	Yes (n/%)	No (n/%)
Creative entrepreneurship product learning process	Does PKK learning help you understand the concept of entrepreneurship?	45 (70%)	19 (30%)
	Does PKK learning involve you in practical activities?	38 (60%)	26 (40%)
	Is PKK material relevant to your entrepreneurial interests?	42 (65%)	22 (35%)
Use of ICT-based learning media	Do teachers often use ICT-based media in learning?	26 (40%)	38 (60%)
	Does ICT media help you understand PKK material better?	32 (50%)	32 (50%)
Students' needs and views on ICT	Do you feel that more interactive ICT-based media will help you learn better?	48 (75%)	16 (25%)
	Do you want more ICT media used during PKK learning?	51 (80%)	13 (20%)

The results of a survey completed by 64 students indicate that while a significant majority (70%) believe that the Creative Product and Entrepreneurship (CPE) course aids in their understanding of entrepreneurial concepts, only 60% reported active participation in practical activities during the learning process. Furthermore, the utilization of ICT-based media in the educational framework is perceived as suboptimal, with merely 40% of students stating that their teachers frequently employ ICT tools, and half of the respondents (50%) feeling that such media have not fully enhanced their comprehension of the subject matter. Nevertheless, the survey also reveals that a substantial majority (75%) of students feel that more interactive ICT-based media would greatly facilitate their learning, and 80% express a desire for increased usage of these tools in CPE instruction. This data underscores an urgent need for innovative interactive ICT media that transcends mere presentation aids and is integrated with collaborative and discovery-based learning models, such as Socio Discovery Learning. The implementation of interactive media aligned with these pedagogical approaches is anticipated to foster active student engagement, promote the development of communication and collaboration skills, and render the learning process more pertinent to the demands of the 21st century.

Based on the results of interviews, observations, and student questionnaires, it is evident that ICT-based interactive media are essential for supporting the enhancement of students' communication skills. The current utilization of predominantly passive media, such as PowerPoint presentations and brief videos, has not been optimal in fostering active student engagement. Both students and teachers have indicated a need for more dynamic interactive media, which are anticipated to increase student participation and facilitate the development of improved communication skills. Consequently, the development of ICT-based interactive media integrated with learning models such as Socio Discovery Learning presents a potential solution to support more effective communication skills in this digital era.

5. Discussion

Based on observations, interviews with teachers, and student questionnaires, this research indicates that the implementation of Socio Discovery Learning has not yet been optimal in enhancing students' communication skills. Observations reveal that although teachers have attempted to apply this learning model, limitations in the use of interactive media and student engagement remain primary obstacles. Interview results with teachers also disclose that the employed learning strategies insufficiently maximize the potential of Socio Discovery Learning, particularly in aspects of collaboration and inter-student interaction. Questionnaire results corroborate these findings, wherein the majority of students perceive that the ICT-based media utilized in learning are not yet interactive and do not fully support

the development of their communication skills. Students also indicate a need for more innovative and collaborative media to enable more active involvement in the learning process. This suggests that the implementation of Socio Discovery Learning could be more effective if integrated with ICT-based interactive media capable of supporting active communication and collaboration among students. This aligns with the findings of [82], where the study successfully integrated interactive media with a problem-based learning model, resulting in improved student science process skills.

In this research, several challenges were identified in the implementation of Socio Discovery Learning and the utilization of ICT-based interactive media. Based on interview results and observations, educators encountered difficulties in effectively applying this learning model. One of the primary challenges was the lack of specialized training regarding Socio Discovery Learning and the use of interactive media that could support collaborative learning processes. Educators perceived that although this model possesses significant potential, limitations in knowledge and skills for integrating ICT-based interactive media hindered its application in the classroom. Furthermore, limitations in technological facilities also presented a significant obstacle. The schools participating in this research were not fully equipped with devices supporting the use of ICT-based media, such as stable internet connections and adequate computer equipment. This aligns with several findings stating that facilities play a key role in the successful integration of technology implementation [83][84]. These constraints resulted in less interactive learning, and students were less engaged in activities that develop communication skills. This impacted the effectiveness of the Socio Discovery Learning model, where the full potential of this model could not be optimally utilized in enhancing students' communication skills.

Based on the analysis presented, the challenges associated with the implementation of Socio Discovery Learning and the use of interactive media based on ICT can be addressed through enhanced specialized training for teachers and improvements in technological infrastructure within schools. It is essential for educators to receive appropriate training to effectively integrate ICT-based interactive media into collaborative learning environments, thereby better supporting students' communication skills. Furthermore, the enhancement of facilities, such as reliable internet connectivity and adequate computer resources, is crucial to facilitate a more interactive learning process that actively engages students. Through collaboration among schools, government entities, and technology providers, it is anticipated that these challenges can be overcome, allowing for the more effective utilization of the full potential of Socio Discovery Learning in the future.

The role of ICT-based interactive media in vocational education is pivotal for enhancing student engagement and developing essential communication skills. Research indicates that the integration of interactive media, such as videos, simulations, and collaborative platforms, fosters a more engaging learning environment, enabling students to actively participate in their education [85][86]. For instance, found that teachers' ICT skills significantly influence the effective integration of technology in vocational classrooms, which in turn enhances students' ability to communicate and collaborate effectively [87]). Furthermore, the use of ICT tools encourages peer interaction and teamwork, as students often work together on projects that require them to share ideas and feedback, thereby improving their communication skills [88]. Additionally, the findings from suggest that the utilization of ICT-based media, such as video presentations, aids in delivering content more dynamically and promotes students' ability to articulate their thoughts and collaborate with their peers [89]. Overall, the incorporation of ICT-based interactive media in vocational education enriches the learning experience and equips students with the necessary communication skills to thrive in the workforce.

Integrating interactive media effectively within a Socio Discovery Learning-based model can significantly enhance student engagement and collaborative learning experiences. One approach involves utilizing Android-based interactive learning media, which can be integrated with guided inquiry learning models to promote active participation and contextual understanding among students [90]. This integration allows learners to explore concepts through interactive simulations and multimedia resources, fostering a deeper connection to the subject matter. Additionally, the use of social media platforms can facilitate collaborative writing projects and structured debates, enabling students to

express their opinions and engage in meaningful dialogue with peers [91]. Furthermore, emphasize the importance of incorporating various ICT tools, such as blogs and video content, to complement traditional learning materials, thereby creating a more dynamic and interactive learning environment. By leveraging game-based interactive media, educators can create enjoyable and effective learning experiences that motivate students to participate actively and develop their communication skills [92]. Overall, the effective integration of interactive media within a Socio Discovery Learning framework not only enhances student engagement but also cultivates essential skills necessary for collaboration and effective communication in diverse educational contexts.

The integration of media with learning models in vocational high schools (VHS) has a significant impact on learning outcomes, particularly in developing 21st-century skills such as communication and collaboration. Research by emphasizes that production-based learning, when combined with interactive media, enhances students' technical competencies and fosters essential soft skills that are highly valued in the workforce, including effective communication and teamwork [93]. Similarly, highlight the necessity of adapting educational practices to meet the demands of the 21st century, where mastering soft skills is increasingly important for students to thrive in a competitive environment [94]. Moreover, the findings of indicate that the application of technology and innovative learning models significantly contributes to creating a dynamic learning environment, which is crucial for developing students' communication abilities and collaborative skills [95]. This alignment of interactive media with pedagogical strategies enriches the learning experience and prepares students to navigate the complexities of modern workplaces, where effective communication and collaboration are essential for success.

The findings of this research carry significant implications for teaching in vocational high schools, particularly in the subjects of Creative Products and Entrepreneurship. The results indicate that the implementation of Socio Discovery Learning and ICT-based interactive media has the potential to enhance students' communication skills; however, challenges remain in its execution. Consequently, strategic measures are necessary to strengthen the integration of technology in vocational education. The role of educators is crucial in facilitating a more collaborative and technology-driven learning environment. Teachers are expected to adapt to the use of ICT-based interactive media to promote active student engagement. Thus, instructional models such as Socio Discovery Learning can be optimized through the integration of interactive multimedia, thereby creating a learning process that is aligned with the demands of the 21st century and the workforce.

This research has several limitations that warrant acknowledgment. A primary constraint is the limited time frame for conducting the study, which restricted the duration of Socio Discovery Learning implementation and in-depth data collection. Furthermore, the sample utilized in this research was confined to select schools within a specific region, potentially affecting the generalizability of results to broader contexts, such as other geographical areas or different educational levels.

Overall, the findings of this study indicate that ICT-based interactive media have not been extensively developed or utilized by educators to support learning activities, particularly in the Creative Products and Entrepreneurship subject in vocational high schools. Consequently, the development of ICT-based interactive learning media presents a significant opportunity for application and utilization in the learning process. It is anticipated that through the optimization of ICT-based media usage, students' communication skills, which constitute a crucial competency in 21st-century learning, can be enhanced. Relevant research outcomes and discussions also demonstrate that innovation and development of ICT-based interactive media are highly necessary in the context of more collaborative learning. These media may encompass various components, including text, images, instructional videos, and practice exercises designed to support student learning activities. Thus, ICT-based interactive media are expected not only to increase student engagement in the learning process but also to directly contribute to the improvement of communication skills required in the professional world and daily life.

6. Conclusion

Through this research, it was discovered that the ongoing learning process remains suboptimal, particularly in the implementation of Socio Discovery Learning and the utilization of ICT-based interactive media. Educators demonstrate limited use of technology-based media, predominantly employing simple presentation formats, which inadequately facilitate active student engagement. This indicates that the potential of ICT media in supporting students' communication skills has not been fully realized. The findings of this study also reveal that ICT-based interactive media, when integrated with more collaborative learning models such as Socio Discovery Learning, can positively impact the development of students' communication skills.

Therefore, it is recommended that educators receive further training in utilizing technology-based interactive media, as well as strengthening technological infrastructure in schools to support the learning process. Additionally, further research is necessary to develop more innovative ICT-based learning media that can be adapted to learning models that encourage active student involvement and the development of 21st-century skills. Consequently, the use of ICT is expected to contribute not only to academic achievement but also to the development of communication and collaboration skills relevant to the professional world.

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References

[1]   N. E. Feyza and S. Y. Seyda, "21st Century Skills and Learning Environments: ELT Students Perceptions," *Educ. Res. Rev.*, vol. 18, no. 6, 2023, doi: 10.5897/err2023.4332.

[2]   M. F. Oluwagbohunmi and R. A. Alonge, "21st Century Skills and Its Applicability to Social Studies," *Asian J. Educ. Soc. Stud.*, vol. 41, no. 3, 2023, doi: 10.9734/ajess/2023/v41i3896.

[3]   P. Piriyasurawong, "Active learning using ARCS motivation on social cloud model to enhance communication skills in foreign language," *TEM J.*, vol. 8, no. 1, pp. 290–297, 2019, doi: 10.18421/TEM81-40.

[4]   R. S. Shieh, "The impact of Technology-Enabled Active Learning (TEAL) implementation on student learning and teachers' teaching in a high school context," *Comput. Educ.*, vol. 59, no. 2, pp. 206–214, Sep. 2012, doi: 10.1016/j.compedu.2012.01.016.

[5]   Ö. T. Öztürk, "Examination of 21st Century Skills and Technological Competences of Students of Fine Arts Faculty," *Int. J. Educ. Math. Sci. Technol.*, vol. 11, no. 1, 2023, doi: 10.46328/ijemst.2931.

[6]   Yurniwati and E. Utomo, "The synthesis of qualitative evidence-based learning by design model to improve TPACK of prospective mathematics teacher," in *Journal of Physics: Conference Series*, 2022, vol. 2157, no. 1. doi: 10.1088/1742-6596/2157/1/012044.

[7]   H. Salam, "Stem Education: Its Effects on the Quality of Teachers and Students in the 21st Century," 2023. doi: 10.2991/978-2-38476-020-6_4.

[8]   C. M. Tang and L. Y. Chaw, "Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment?.," *Electron. J. E-learning*, vol. 14, no. 1, pp. 54–65, 2016.

[9]   S. Imran, S. Shaheen, H. Waseem, and A. Ali, "Transformation of 21st Century Science Skills: Perceptions of Secondary School Teachers," *Qlantic J. Soc. Sci. Humanit.*, vol. 4, no. 3, 2023, doi: 10.55737/qjssh.819252525.

[10]   F. Mufit, Y. Hendriyani, Usmeldi, M. Dhanil, and M. R. Tanjung, "The Effectiveness of Smartphone-Based Interactive Multimedia Integrated Cognitive Conflict Models to Improve 21st-Century Skills," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 11, 2023, doi: 10.18178/ijiet.2023.13.11.1991.

[11]   S. Wu, "Application of multimedia technology to innovative vocational education on learning satisfaction in China," *PLoS One*, vol. 19, no. 2 February, 2024, doi: 10.1371/journal.pone.0298861.

[12]   A. N. S. I. Septiani, "Development of Interactive Multimedia Learning Courseware to Strengthen Students' Character," *Eur. J. Educ. Res.*, vol. 9, no. 3, pp. 1267–1279, Jul. 2020, doi: 10.12973/eu-jer.9.3.1267.

[13]   Herianto and I. Wilujeng, "Increasing the attention, relevance, confidence and satisfaction (Arcs) of students through interactive science learning multimedia," *Res. Learn. Technol.*, vol. 29, 2021, doi: 10.25304/rlt.v29.2383.

[14]   A. Harjono, G. Gunawan, R. Adawiyah, and L. Herayanti, "An interactive e-book for physics to improve students' conceptual mastery," *Int. J. Emerg. Technol. Learn.*, vol. 15, no. 5, pp. 40–49, 2020, doi: 10.3991/IJET.V15I05.10967.

[15]   R. Shadiev and X. Wang, "A Review of Research on Technology-Supported Language Learning and 21st Century Skills," *Frontiers in Psychology*, vol. 13. 2022. doi: 10.3389/fpsyg.2022.897689.

[16]   G. Spöttl and L. Windelband, "The 4th industrial revolution–its impact on vocational skills," *J. Educ. Work*, vol. 34, no. 1, 2021, doi: 10.1080/13639080.2020.1858230.

[17]   M. Batsila and P. N. Shrestha, "Business English Needs and Secondary Vocational Business English: The Case of Greek Workplaces," *Bus. Prof. Commun. Q.*, vol. 85, no. 3, 2022, doi: 10.1177/23294906221109190.

[18]   P. Kumar, C. Saxena, and H. Baber, "Learner-content interaction in e-learning- the moderating role of perceived harm of COVID-19 in assessing the satisfaction of learners," *Smart Learn. Environ.*, vol. 8, no. 1, 2021, doi: 10.1186/s40561-021-00149-8.

[19]   N. Usman, A. R. Murniati, U. Irani, R. Mylostyvyi, and I. Siswanto, "TECHNOPARKS AS CATALYST FOR SUSTAINABLE FUTURE INNOVATIVE ECOSYSTEM IN VOCATIONAL SCHOOLS," *J. Ilm. Peuradeun*, vol. 12, no. 1, 2024, doi: 10.26811/peuradeun.v12i1.1042.

[20]   Wagiran, Pardjono, and H. Sofyan, "What industry needs of vocational school graduate competence in the era of industrial revolution 4.0," *Int. J. Adv. Sci. Technol.*, vol. 29, no. 5, pp. 2459–2470, 2020.

[21]   T. Wanyama, "Using industry 4.0 technologies to support teaching and learning," *Int. J. Eng. Educ.*, vol. 33, no. 2, pp. 693–702, 2017, [Online]. Available: https://www.ijee.ie/latestissues/Vol33-2A/19_ijee3396ns.pdf

[22]   I. Alshbili and A. A. Elamer, "The vocational skills gap in accounting education curricula: Empirical evidence from the UK," *Int. J. Manag. Educ.*, vol. 14, no. 3, 2020, doi: 10.1504/ijmie.2020.10026560.

[23]   J. Jang, Y. Ko, W. S. Shin, and I. Han, "Augmented Reality and Virtual Reality for Learning: An Examination Using an Extended Technology Acceptance Model," *IEEE Access*, vol. 9, pp. 6798–6809, 2021, doi: 10.1109/ACCESS.2020.3048708.

[24]   H. B. Lund and A. Karlsen, "The importance of vocational education institutions in manufacturing regions: adding content to a broad definition of regional innovation systems," *Ind. Innov.*, vol. 27, no. 6, pp. 660–679, 2020, doi: 10.1080/13662716.2019.1616534.

[25]   A. B. N. R. Putra, T. T. Kiong, M. S. Subandi, A. A. Smaragdina, and A. M. Nidhom, "The innovation of TVET based e-training to increase the human resources level for vocational educators in the era of society 5.0," in *AIP Conference Proceedings*, 2023, vol. 2590. doi: 10.1063/5.0107410.

[26]   V. S. Damaianti, Y. Abidin, and R. Rahma, "Higher order thinking skills-based reading literacy assessment instrument: An Indonesian context," *Indones. J. Appl. Linguist.*, vol. 10, no. 2, 2020, doi: 10.17509/ijal.v10i2.28600.

[27]   A. Yesnazar, A. Japbarov, A. Zhorabekova, Z. Kabylbekova, A. Nuralieva, and U. Elmira, "Determination of primary school children's speech skills in interdisciplinary communication in learning environments," *World J. Educ. Technol. Curr. Issues*, vol. 12, no. 4, 2020, doi: 10.18844/wjet.v12i4.5190.

[28]   A. R. Nisa', Asrowi, and T. Murwaningsih, "The effectiveness of value clarification technique (VCT) and problem-based learning (PBL) models on social problem-solving skills viewed from emotional intelligence," *Elem. Educ. Online*, vol. 19, no. 3, 2020, doi: 10.17051/ilkonline.2020.734977.

[29]   S. Soenarto, Sugito, Suyanta, Siswantoyo, and Marwanti, "Vocational and senior high school professional teachers in industry 4.0," *Cakrawala Pendidik.*, vol. 39, no. 3, pp. 655–665, 2020, doi: 10.21831/cp.v39i3.32926.

[30]   I. M. Sudana, D. Apriyani, and S. Nurmasitah, "Revitalization of vocational high school roadmap to encounter the 4.0 industrial revolution," *J. Soc. Sci. Res.*, vol. 5, no. 2, pp. 338–342, 2019, doi: 10.32861/jssr.52.338.342.

[31]   A. Durmus and A. Dağlı, "Integration of Vocational Schools to Industry 4.0 by Updating Curriculum and Programs," *Int. J. Multidiscip. Stud. Innov. Technol.*, vol. 1, no. 1, pp. 1–13, 2017, [Online]. Available: https://dergipark.org.tr/tr/download/article-file/372843

[32]   H. Rosina, V. Virgantina, Y. Ayyash, V. Dwiyanti, and S. Boonsong, "Vocational Education Curriculum: Between Vocational Education and Industrial Needs," *ASEAN J. Sci. Eng. Educ.*, vol. 1, no. 2, pp. 105–110, 2021, doi: 10.17509/ajsee.v1i2.33400.

[33]   E. Suncaka, "Leadership and Management of the Multicultural Education Curriculum at Senior High School," *Scaffolding J. Pendidik. Islam dan Multikulturalisme*, vol. 5, no. 1, 2023, doi: 10.37680/scaffolding.v5i1.2370.

[34]   T. Wulaningrum and S. Hadi, "Soft skills profile of vocational school students in Yogyakarta City for entering the industrial world," *J. Pendidik. Vokasi*, vol. 9, no. 3, 2019, doi: 10.21831/jpv.v9i3.24944.

[35]   M. T. Husein, K. Koesmawan, and G. Ahmad, "Design And Implementation of Field Work Practices (PKL) With The Work Integrated Learning (WIL) Model At Health Vocational School (SMK) in Tangerang City," *Asian Soc. Work J.*, vol. 7, no. 5, 2022, doi: 10.47405/aswj.v7i5.228.

[36]   Roemintoyo and M. K. Budiarto, "Project-based Learning Model to Support 21st Century Learning: Case Studies in Vocational High Schools," *J. Educ. Res. Eval.*, vol. 7, no. 4, 2023, doi: 10.23887/jere.v7i4.63806.

[37]   R. Ramadhani and Y. Fitri, "A Project-based learning into flipped classroom for ePUB3 electronic mathematics learning module (eMLM)-based on course design and implementation," *Univers. J. Educ. Res.*, vol. 8, no. 7, pp. 3119–3135, 2020, doi: 10.13189/ujer.2020.080740.

[38]   C. Nicolaou, M. Matsiola, and G. Kalliris, "Technology-Enhanced Learning and Teaching Methodologies through Audiovisual Media," *Educ. Sci.*, vol. 9, no. 3, p. 196, Jul. 2019, doi: 10.3390/educsci9030196.

[39]   Ramadiani, Azainil, A. N. Hidayanto, D. M. Khairina, and M. L. Jundillah, "Teacher and student readiness using e-learning and m-learning," *Bull. Electr. Eng. Informatics*, vol. 9, no. 3, pp. 1176–1182, 2020, doi: 10.11591/eei.v9i3.2006.

[40]   A. Kuatbekov, E. Vershitskaya, I. Kosareva, and V. Ananishnev, "E-Learning as a basis for the development of media

competences in students," *J. Inf. Sci.*, vol. 49, no. 4, 2023, doi: 10.1177/01655515211040656.

[41] S. Şeker, Z. Bülbül, and S. Erdinler, "Opinions of Forest Industrial Engineering and Vocational School of Forestry Students on Online Computer Aided Design Learning," *Düzce Üniversitesi Bilim ve Teknol. Derg.*, vol. 10, no. 3, pp. 1079–1090, 2022, doi: 10.29130/dubited.985281.

[42] C. H. A. Dirgatama, P. Ningharjanti, C. D. S. Indrawati, and A. W. Wirawan, "Utilization of Interactive Multimedia Android-Based Archiving Towards Learning Independence," *Econ. Educ. Anal. J.*, vol. 10, no. 3, 2021, doi: 10.15294/eeaj.v10i3.50437.

[43] J. Feng and H. Hou, "STEM in vocational education and training: The future direction," *STEM Educ. Rev.*, vol. 1, 2023, doi: 10.54844/stemer.2023.0431.

[44] C. Thianthai and K. Sutamchai, "Skills That Matter: Qualitative Study Focusing on the Transfer of Training Through the Experience of Thai Vocational Students," *Front. Educ.*, vol. 7, 2022, doi: 10.3389/feduc.2022.897808.

[45] A. Lytvyn *et al.*, "Informatization of technical vocational schools: Theoretical foundations and practical approaches," *Educ. Inf. Technol.*, vol. 25, no. 1, pp. 583–609, 2020, doi: 10.1007/s10639-019-09966-4.

[46] T. L. Yuniawati and F. J. Purba, "Discovery Learning Model to Optimize Students' Critical Thinking Skills on Hydrocarbon Material," *J. Pendidik. Kim.*, 2021, doi: 10.24114/jpkim.v13i3.30208.

[47] A. R. Subiyantari, S. Muslim, and E. Rahmadyanti, "Effectiveness of Jigsaw Cooperative Learning Models In Lessons of the Basics of Building Construction on Students Learning 'Outcomes Viewed From Critical Thinking Skills," *Int. J. Educ. Vocat. Stud.*, vol. 1, no. 7, 2019, doi: 10.29103/ijevs.v1i7.1653.

[48] K. Chaisriya, S. Kaeophanuek, and L. Gilbert, "The effects of integrating digital storytelling with metacognition strategies (DSTMC) learning model to enhance communication abilities," *Contemp. Educ. Technol.*, vol. 15, no. 2, 2023, doi: 10.30935/cedtech/12986.

[49] Hariyanto, M. Amin, S. Mahanal, and F. Rohman, "ANALYZING THE CONTRIBUTION OF CRITICAL THINKING SKILLS AND SOCIAL SKILLS ON STUDENTS' CHARACTER BY APPLYING DISCOVERY LEARNING MODELS," *Int. J. Educ. Pract.*, vol. 10, no. 1, 2022, doi: 10.18488/61.v10i1.2907.

[50] D. M. Kadam and S. Y. Sawant, "Modified reciprocal teaching: Cooperative learning technique for enhancing communication skills of first year engineering students," *J. Eng. Educ. Transform.*, vol. 33, no. Special Issue, 2020, doi: 10.16920/jeet/2020/v33i0/150111.

[51] M. T. Hora, R. J. Benbow, and C. Lee, "A sociocultural approach to communication instruction: How insights from communication teaching practices can inform faculty development programs," *J. Learn. Sci.*, vol. 30, no. 4–5, 2021, doi: 10.1080/10508406.2021.1936533.

[52] N. R. Dewi, L. Magfiroh, S. Nurkhalisa, and I. Dwijayanti, "The development of contextual-based science digital storytelling teaching materials to improve students' critical thinking on classification theme," *J. Turkish Sci. Educ.*, vol. 16, no. 3, pp. 364–378, 2019, doi: 10.12973/tused.10288a.

[53] T. W. Khusniyah and A. Muhtadi, "DEVELOPING ARABIC LANGUAGE LEARNING MULTIMEDIA," *J. Kependidikan Penelit. Inov. Pembelajaran*, vol. 2, no. 2, pp. 247–261, 2018, doi: 10.21831/jk.v2i2.18856.

[54] A. Rochmawati and S. Ridlo, "Analysis of 21 st Century Skills of Student on Implementation Project Based Learning and Problem Posing Models in Science Learning," *J. Prim. Educ.*, vol. 9, no. 1, pp. 58–67, 2020, doi: doi.org/10.15294/jpe.v9i1.28753.

[55] B. I. Makki, M. U. Javaid, and S. Bano, "Level of Work Readiness Skills, Career Self-Efficacy and Career Exploration of Engineering Students," *NFC-IEFR J. Eng. Sci. Res.*, vol. 4, no. 1, pp. 91–96, 2016, doi: 10.24081/nijesr.2016.1.0017.

[56] M. Han and S. Niu, "Effect of Computer Multimedia Assisted Word Annotation on Incidental Vocabulary Acquisition of English Reading," *Int. J. Emerg. Technol. Learn.*, vol. 14, no. 13, p. 21, Jul. 2019, doi: 10.3991/ijet.v14i13.10705.

[57] A. Syawaludin, G. Gunarhadi, and P. Rintayati, "Development of Augmented Reality-Based Interactive Multimedia to Improve Critical Thinking Skills in Science Learning," *Int. J. Instr.*, vol. 12, no. 4, pp. 331–344, Oct. 2019, doi: 10.29333/iji.2019.12421a.

[58] I. Thoib, "Critical Collaboration-Oriented Constructivist Learning Model Development to Improve Social and Spiritual Skills," *J. Southwest Jiaotong Univ.*, vol. 56, no. 3, pp. 436–445, 2021, doi: 10.35741/issn.0258-2724.56.3.37.

[59] Z. Hafizi, "Evaluasi Konstruktivisme Sosial Sebagai Pendekatan Pendidikan Karakter di Era Digital," *J. Ilm. Edukatif*, vol. 9, no. 2, 2023, doi: 10.37567/jie.v9i2.2519.

[60] H. S. Widodo, M. Taufik, and R. D. Susanti, "Application of Discovery Learning Model in Mathematics Learning to Determine Students' Mathematical Communication Ability," *Math. Educ. J.*, vol. 5, no. 1, 2021, doi: 10.22219/mej.v5i1.16008.

[61] R. F. Rumsariadi, S. Y. Sari, H. Hufri, and W. S. Dewi, "Needs Analysis of Discovery Learning Model in Physics Learning for Students," *Phys. Learn. Educ.*, vol. 1, no. 3, 2023, doi: 10.24036/ple.v1i3.58.

[62] W. T. Winarti, H. Yuliani, M. Rohmadi, and N. Septiana, "Pembelajaran Fisika Menggunakan Model Discovery Learning Berbasis Edutainment," *J. Ilm. Pendidik. Fis.*, vol. 5, no. 1, 2021, doi: 10.20527/jipf.v5i1.2789.

[63] Q. Mardhatillah, J. Copriady, and D. Futra, "Enhancing Students' Oral and Written Communication Skills through Discovery Learning Model: A Study on Reduction-Oxidation Reactions," *Hydrog. J. Kependidikan Kim.*, vol. 11, no. 1, 2023, doi: 10.33394/hjkk.v11i1.5592.

[64]   D. Prasetyowati, . R., and . K., "The Effect of Video-assisted Discovery Learning Model on Junior High School Students' Mathematical Communication," *KnE Soc. Sci.*, 2022, doi: 10.18502/kss.v7i14.11969.

[65]   E. Purwaningsih, S. P. Sari, A. M. Sari, and A. Suryadi, "The effect of stem-pjbl and discovery learning on improving students' problem-solving skills of the impulse and momentum topic," *J. Pendidik. IPA Indones.*, vol. 9, no. 4, 2020, doi: 10.15294/jpii.v9i4.26432.

[66]   M. K. Budiarto, G. Gunarhadi, and A. Rahman, "Technology in education through mobile learning application (MLA) and its impact on learning outcomes: Literature review," *J. Educ. Learn.*, vol. 18, no. 2, pp. 413–420, 2024, doi: 10.11591/edulearn.v18i2.20976.

[67]   D. Ifenthaler, "Determining the effectiveness of prompts for self-regulated learning in problem-solving scenarios," *Educ. Technol. Soc.*, vol. 15, no. 1, 2012.

[68]   J. Adams, F. Flavell, and R. Raureti, "Mixed reality results in vocational education: a case study with HoloLens 2," *Res. Learn. Technol.*, vol. 30, 2022, doi: 10.25304/RLT.V30.2803.

[69]   P. Beer and R. H. Mulder, "The effects of technological developments on work and their implications for continuous vocational education and training: A systematic review," *Front. Psychol.*, vol. 11, 2020, doi: 10.3389/fpsyg.2020.00918.

[70]   Halimah and H. N. Syaddad, "Preparing the Preservice Teachers to be the Industrial Revolution Teacher 4.0 Era," 2020. doi: 10.2991/assehr.k.200129.144.

[71]   R. D. Mahande and Jasruddin, "Utilisation study of mobile technology at a vocational high school," *World Trans. Eng. Technol. Educ.*, vol. 15, no. 2, 2017.

[72]   C. A. McKim, "The Value of Mixed Methods Research: A Mixed Methods Study," *J. Mix. Methods Res.*, vol. 11, no. 2, 2017, doi: 10.1177/1558689815607096.

[73]   B. N. Cvetković and D. Stanojević, "Educational needs of teacher for introduction and application of innovative models in educational work to improve teaching," *Int. J. Cogn. Res. Sci. Eng. Educ.*, vol. 5, no. 1, pp. 49–56, 2017, doi: 10.5937/IJCRSEE1701049N.

[74]   H. Ismail and Edi, "Student need analysis of problem-based learning model with blended learning in EFL academic reading," *Int. J. English Lang. Lit. Stud.*, vol. 12, no. 1, 2023, doi: 10.55493/5019.v12i1.4698.

[75]   Widya, D. Maielfi, and Alfiyandri, "Need Analysis for Physics E-Module Based on Creative Problem Solving Integrated 21st Century Skills," in *Journal of Physics: Conference Series*, 2021, vol. 1940, no. 1, p. 1002. doi: 10.1088/1742-6596/1940/1/012110.

[76]   S. Bhangu, F. Provost, and C. Caduff, "Introduction to qualitative research methods," *Perspect. Clin. Res.*, vol. 14, no. 1, pp. 1–19, 2023, doi: 10.4103/picr.picr_253_22.

[77]   Laila Raudatul Fauziah, "Analisis Kebutuhan Pengembangan Media Pembelajaran Interaktif Berbasis Adobe Flash CS6," *AL MURABBI*, vol. 5, no. 2, pp. 1–7, Jun. 2020, doi: 10.35891/amb.v5i2.2135.

[78]   N. K. Denzin, *The Research Act: A Theoretical Introduction to Sociological Methods*. 2017. doi: 10.4324/9781315134543.

[79]   J. W. Cresswell, V. L. Plano-Clark, M. L. Gutmann, and W. E. Hanson, "Advanced mixed methods research designs," *Handb. Mix. Methods Soc. Behav. Res.*, pp. 209–240, 2003, [Online]. Available: http://www.sagepub.com/upm-data/19291_Chapter_7.pdf

[80]   A. Jariah, A. Suriansyah, and Ngadimun, "Implementation of Total Quality Management in School Management: Cross Site Study at SMK Negeri 2 Banjarmasin and SMK Negeri 4 Banjarmasin," *J. K6 Educ. Manag.*, vol. 4, no. 2, 2021, doi: 10.11594/jk6em.04.02.06.

[81]   M. B. Miles, A. M. Huberman, and J. Saldana, *Qualitative Data Analysis A Methods Sourcebook Edition 3*, vol. 30, no. 25. 2016.

[82]   W. Fitriani, A. Abdulah, and A. Mustadi, "The Use Of PBL-Based Interactive Multimedia To Develop Student Science Process Skill," *J. Pendidik. dan Pengajaran*, vol. 54, no. 1, p. 150, 2021, doi: 10.23887/jpp.v54i1.34256.

[83]   N. Zhou, D. E. H. Tigelaar, and W. Admiraal, "Factors influencing the impact of work placement on vocational teachers' school practice," *Educ. Stud.*, 2022, doi: 10.1080/03055698.2022.2069462.

[84]   M. T. Machmud, A. P. Widiyan, and N. R. Ramadhani, "The development and policies of ICT supporting educational technology in Singapore, Thailand, Indonesia, and Myanmar," *Int. J. Eval. Res. Educ.*, vol. 10, no. 1, pp. 78–85, Mar. 2021, doi: 10.11591/ijere.v10i1.20786.

[85]   F. Syahputra and H. Maksum, "The Development of Interactive Multimedia Learning in Information and Communication Technology Subjects," *J. Educ. Res. Eval.*, vol. 4, no. 4, pp. 428–434, 2020, doi: 10.23887/jere.v4i4.29931.

[86]   K. A. A. Rahman *et al.*, "Conceptual Model of Video Learning based on Project-Oriented Problem-Based Learning and Competency-Based Education for Technical and Vocational Education," *J. Tech. Educ. Train.*, vol. 14, no. 1, pp. 38–53, 2022, doi: 10.30880/jtet.2022.14.01.004.

[87]   U. Shah, S. H. Khan, and M. Reynolds, "Insights into variation in teachers' pedagogical relationship with ICT: a phenomenographic exploration in the Pakistani higher education context," *Technol. Pedagog. Educ.*, vol. 29, no. 5, pp. 541–555, 2020, doi: 10.1080/1475939X.2020.1810751.

[88]   I. M. Sutama, I. N. Yasa, I. P. M. Dewantara, and K. Saddhono, "ICT Utilization in Indonesian Language Learning at the Junior High School Level in Buleleng Regency, Bali, Indonesia," *Int. J. Inf. Educ. Technol.*, vol. 12, no. 9, pp. 947–955, 2022, doi: 10.18178/ijiet.2022.12.9.1705.

[89]   A. Prehanto, N. M. Aprily, A. Merliana, and M. Nurhazanah, "Video Pembelajaran Interaktif-Animatif sebagai Media Pembelajaran IPS SD Kelas Tinggi di Masa Pandemi Covid 19," *Indones. J. Prim. Educ.*, vol. 5, no. 1, pp. 32–38, 2021.

[90]   Y. T. Lasfika, H. Widyastono, and ..., "Digitalization Android-based Interactive Learning Media in Geography for High School Students," *J. Educ. ...*, vol. 6, no. 2, pp. 207–216, 2022, [Online]. Available: https://ejournal.undiksha.ac.id/index.php/JET/article/view/44674%0Ahttps://ejournal.undiksha.ac.id/index.php/JET/article/download/44674/22183

[91]   Y. Zhou, "Impacts of Social Media on Language Learning : A Review of Literature," *Proc. 2021 4th Int. Conf. Humanit. Educ. Soc. Sci. (ICHESS 2021)*, vol. 615, no. Ichess, pp. 743–749, 2021.

[92]   M. I. Idris, N. E. Mohd Said, and K. H. Tan, "Game-based learning platform and its effects on present tense mastery: Evidence from an ESL classroom," *Int. J. Learn. Teach. Educ. Res.*, vol. 19, no. 5, pp. 13–26, 2020, doi: 10.26803/ijlter.19.5.2.

[93]   T. T. Kiong *et al.*, "Needs Analysis for Module Development of Communication Skills Based on Learning Styles for Vocational College Students," *J. High. Educ. Theory Pract.*, vol. 22, no. 5, 2022, doi: 10.33423/jhetp.v22i5.5200.

[94]   Y. Indarta, N. Jalinus, R. Abdullah, and A. D. Samala, "21st Century Skills : TVET dan Tantangan Abad 21," *EDUKATIF J. ILMU Pendidik.*, vol. 3, no. 6, pp. 4340–4348, 2021, doi: 10.31004/edukatif.v3i6.1458.

[95]   F. Mutohhari, S. Sutiman, M. Nurtanto, N. Kholifah, and A. Samsudin, "Difficulties in implementing 21st century skills competence in vocational education learning," *Int. J. Eval. Res. Educ.*, vol. 10, no. 4, 2021, doi: 10.11591/ijere.v10i4.22028.