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The appraisal model of remedial and enrichment activities integrated with the independent curriculum in vocational field

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ABSTRACT

Implementing remedial and enrichment strategies followed by modeling the weight of the appraisal is the goal to be achieved in this study. The ASSURE model in this study has been used to develop an appraisal model for remedial and enrichment activities integrated with the independent curriculum in the vocational field. The results showed that the peer tutoring strategy among students could optimize remedial and enrichment outcomes. The students have shown their ability in independent and collaborative learning. In remedial and enrichment activities, groups of enrichment students have been directed to help their friends to be successful in remedial. Students' success in the remedial process is the success of enriching other students and vice versa. Each student has received an appreciation of the value according to his effort. The progress of remedial students is 8% to 82%, with an average of 10%. This progress forms the basis for determining the final score for the remedial, intermediate, and enrichment groups as tutors. The difference between the remedial and enrichment appraisal weights was determined using mathematical model 1. The final score of students who become tutors is determined using the mathematical model 3. The three mathematical models above can calculate remedial, enrichment, and tutor results. The use of this model helps teachers or lecturers to be more objective in giving grades. Lecturers' appraisal of student learning outcomes has been carried out in a transparent, fair, and accountable following the differences in the potential competencies of each student. Students have followed the learning process, the assessment process has been carried out properly, the teacher's documentation is complete, and the teacher is more confident.

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INTRODUCTION

The curriculum contains plans and arrangements regarding objectives, content, and teaching materials and how to use them. The curriculum is used as a guide for learning activities to achieve educational goals (Pratycia et al., 2023). Educational planning begins with analyzing learning outcomes to determine learning objectives within a semester or yearly period. Planning in the independent curriculum is very important because it has an impact on determining learning content, implementing teaching strategies up to the assessment and evaluation stage (Idris et al., 2023). Even the curriculum must facilitate differences in the potential abilities of students. Students must serve according to their respective characteristics in the learning process. This strategy is called differentiated learning (Cope & Kalantzis, 2016).

At the beginning of the Covid-19 pandemic, Indonesia implemented an independent curriculum (Minsih et al., 2023). This curriculum was first implemented by a driver school in the last 3 years to overcome the problem of learning loss and recovering well of learning. This curriculum provides a direction of change so that schools focus more on optimizing student-centered learning, differentiated learning, strengthening the character of the Pancasila student profile, and consistency in the implementation of formative and summative assessments to improve the learning process (Kementerian Pendidikan Kebudayaan Riset dan Teknologi Republik Indonesia, 2022). The pattern of implementation of differentiated learning begins with a diagnostic assessment by the teacher to students before the start of the learning process. Analysis of the results of the diagnostic assessment provides information to teachers to organize differentiated learning starting from determining learning content, applying teaching strategies to the assessment and evaluation stages.

Appraisal is the process of collecting and processing information to determine learning needs and developmental achievements or learning outcomes of students (Kementerian Pendidikan Kebudayaan Riset dan Teknologi Republik Indonesia, 2022). Formative and summative assessments in the independent curriculum must be integrated into every learning process and carried out consistently (Ali & Khaeruddin, 2012; Budianto, 2011). Summative assessment is carried out by the teacher at the end of each delivery of material or teaching modules. This assessment aims to find out whether the goals set in each teaching module have been completed by each student? If there are several learning objectives that have not been completely achieved by certain students or by several other students, the teacher must facilitate these students through remedial activities (Karyanto, 2022).

When a group of students in one subject must carry out remedial activities, it is possible that there are other groups of students who must be facilitated with enrichment activities. A similar situation like this will also be found at the higher education level which implements independent learning on an independent campus, including in the vocational field. In term of the 2 differences in remedial and enrichment activities, teachers or lecturers are more likely to facilitate remedial for their students who have not yet completed their learning objectives (Ali & Khaeruddin, 2012). While other groups of enrichment students were not given any opportunity to get grades. This difference in treatment will be felt unfairly by each student. This possibility can occur because the teacher does not have time to remedial as well as provide enrichment to other groups of students. Teachers more focus on remedial students than on facilitating the enrichment of other students who are considered to have succeeded in exceeding their learning objectives.

In the concept of mastery learning which was applied in the 2013 curriculum and previously included being refocused in the independent curriculum, teachers more focus on on facilitating the students (Mahlianurrahman & Aprilia, 2022; Oktaviani et al., 2023). The concept of mastery learning in the independent curriculum must be able to facilitate each student to be able to complete learning objectives. If there are still learning objectives in certain modules that have not been completed, then students must be facilitated with remedial. However, the majority of teachers are not comprehensive in carrying out remedial and even tend to repeat the test and give the same score as the minimum completeness criteria (Dhelilik, 2018).

Therefore, to solve this problem what kind of strategy should the teacher implement to make remedial and enrichment effectively? How to determine the weight of the final value of remedial results and enrichment results so that they are objective, fair and accountable? What is the

mathematical model for appraisal of remedial and enrichment outcomes as the principle of learning and assessment in independent curriculum?.

RESEARCH METHOD

The implementation of differentiated and learner-centered learning in the independent Curriculum begins with an assessment diagnostic (Budiono & Hatip, 2023). Diagnostic assessment aims to analyze the characteristics of students. This strategy becomes the basis for the teacher to develop the learning process until finally evaluating how it is achieved. The ASSURE (Analyze Learners, State Standards and Objectives, Select: Strategies, Technology, Media, and Materials, Utilize: Technology, Media, and Materials, Require Learner Participation, Evaluate and Revise) model (Abdelaziz, 2014; Ariefiani et al., 2016; Goode, 2017; Pribadi, 2011) in this study was adapted to develop a model of remedial assessment and enrichment of student learning outcomes integrated with the Independent Curriculum. Paying attention to student characteristics followed by setting learning objectives and choosing teaching strategies, technology, and teaching media that are very appropriate to use this model.

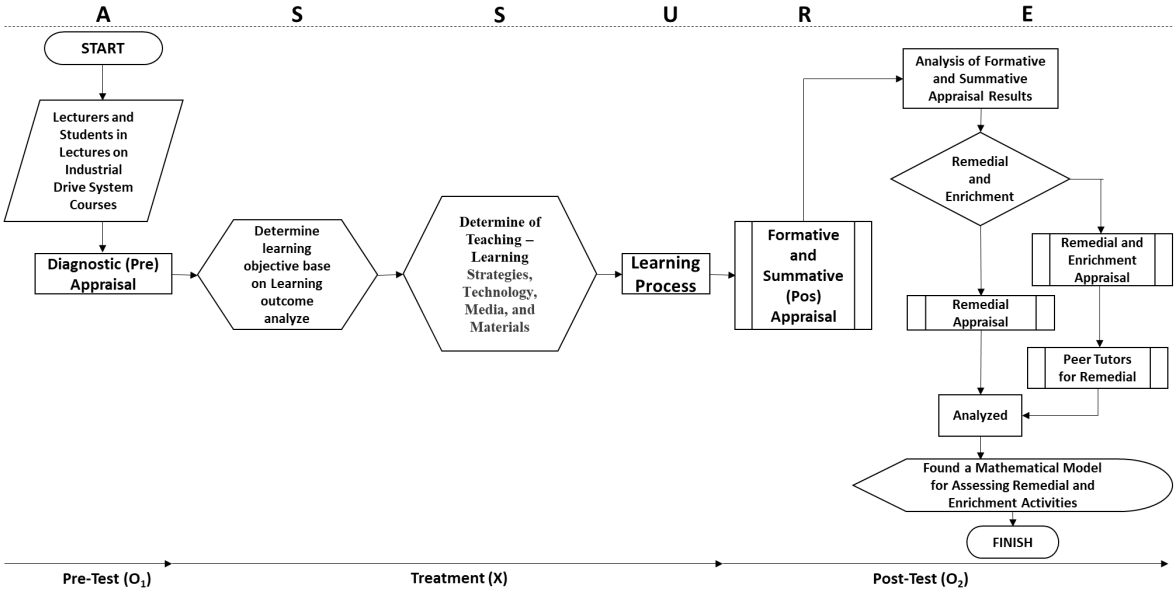

Figure 1. Conceptual Model of Remedial and Enrichment Appraisal

The integrated experiment in the ASSURE model of this study used the pre-experimental method: One Group Pretest – Posttest (Schmidt et al., 2016). Treatment was given only to one class of Sistem Penggerak Industri (SPI) course. The assessment instrument used in this study is a test instrument and practice using a simulator. Pre-test and post-test are given to the same group of students in the course (Bonate, 2000).

Table 1. Pretest – Posttest to Remedial and Enrichment Appraisal in Differentiated Learning of ASSURE Model

One Group Students		
A	SSU	RE
Diagnotic Appraisal as Pre-Test	Implementation strategies, technology, and media in SPI learning process	Formative and Sumative Appraisal to determine Remedial and Enrichment Activities

If there are still students who have not reached the minimum value criteria, then these students are given remedial opportunities (Kao et al., 2012) while other students are assigned as tutors in one activities remedial and enrichment. The results of these activities are then analyzed to find a fair appraisal mathematical model for different student groups. In this study, the term pre-test is referred to as the pre-appraisal and the post-test is referred to as the post-appraisal.

FINDINGS AND DISCUSSION

Findings

In this study, the processed data is the result of assessment of forty students in the Sistem Penggerak Industri (SPI) course. This course is one of the engineering vocational courses in the Electrical Engineering Education Department, Universitas Sultan Ageng Tirtayasa, Banten. In the independent learning and learning campus curriculum system, the focus is that lecturers no activities as actors but tend to activities as facilitators (Forbes, 2013; Yogi Anggraena et al., 2021). The learning process should be more student-centered. Lecturers must be pay attention to the characteristics of students and facilitate these differences.

The implementation of student-centered differentiated learning in this course begins with providing an assessment instrument. Analysis of the results of the assessment is a diagnostic of student learning needs and strategies to be applied by lecturers. One method to find out the differences in student characteristics by giving an initial assessment as a diagnostic appraisal. Analysis of student diagnostic appraisal will provide information to lecturers to choose models, media, technology, and learning materials (Bauman & Tuzhilin, 2018). In this study, forty students in the Sistem Penggerak Industri (SPI) course were given a pre-test to determine the next strategy in learning. The pre-test results for the forty students in the SPI course are shown in Figure 2.

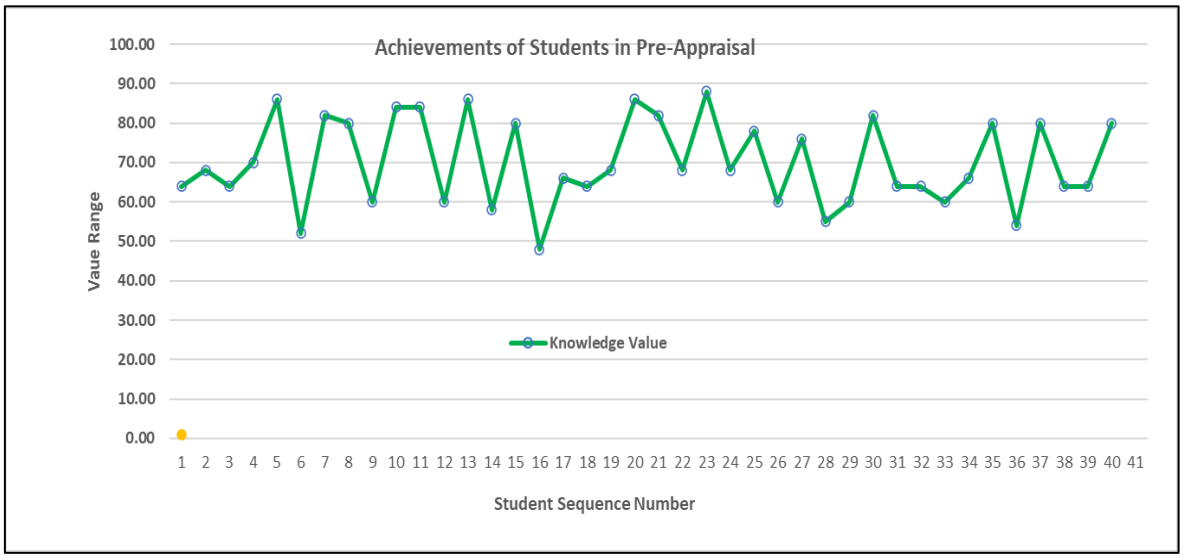

Figure 2. Achievements of Students in Pre-Assessment of SPI Courses

In this study, the forty students were divided into three groups. This grouping is made based on the results of the pre-appraisal by comparing it to the class average score in the SPI course (look at the Figure 3). The class average value is also used as a barrier to provide information to the lecturer in determining the next learning step. Analysis of the results of the initial assessment is a diagnostic to determine student competencies that will be the focus of special services.

It is possible that the differences in student pre-assessment results in the SPI course are caused by differences in educational background. In the SPI course, there are students from SMK, SMA and MA. Students from SMK understand more about electric motor control circuits compared to students from SMA and MA. This is evidenced by the results of their achievements in the pre-

assessment process as shown in Figure 3. Scores below the class average were achieved by seventeen non-vocational school students. However, this difference must be facilitated in different ways so that each learning objective can be completed properly.

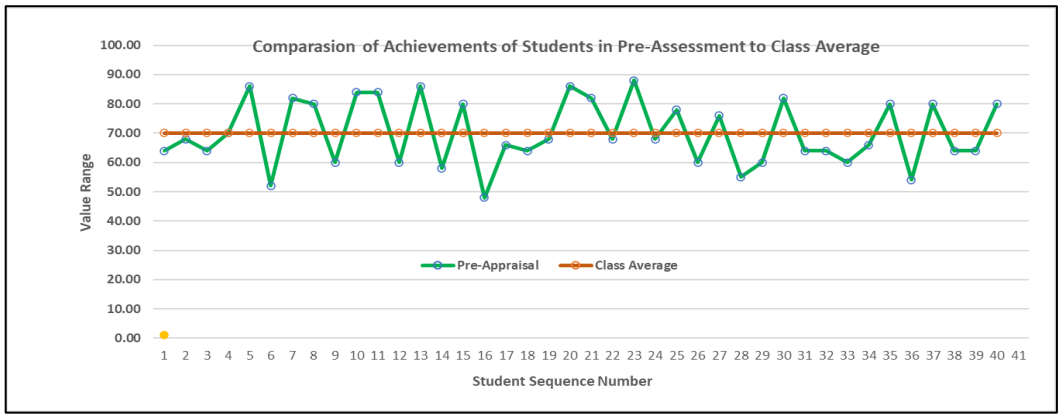

Figure 3. Comparasion of Achievements of Students in Pre-Assessment to Class Average

Referring to the results of the pre-appraisal, the learning process applied in this study uses the flipped classroom learning model (Al-Shabibi & Al-Ayasra, 2019). SPI course lecturers provide lecture materials earlier to be read in advance by each student in their respective homes or before the start of face-to-face lectures. This model equips students to be more active in class discussions. The activeness of the students was shown through asking questions, giving answers, and helping to respond by adding answers to questions submitted by other students.

To increase student competency in the skills aspect, the lecturer provides three different simulators to test a series of programmable logic controller ladders. These three simulators are freely chosen according to the abilities of each student. Control problems can be simulated logically using the simulator. In this case, problem-based learning really supports improving student skills (Noviati, 2022).

Improving student competence in the aspects of knowledge, skills and attitudes is the target of achievement in this study in the SPI course. The combination of flipped classroom learning models, problem-based learning, different simulator-based simulations has been able to increase the competence of the majority of students. The progress of the improvement can be seen through the results of a summative assessment. This point of improvement occurred in the class average in terms of knowledge and skills as shown in Figure 4.

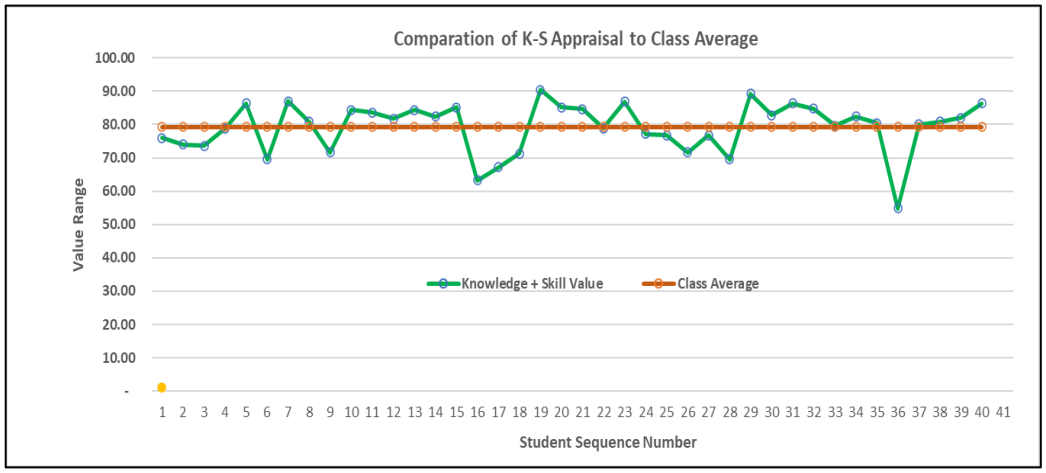

Figure 4. Comparasion of Knowledge and Skill (K-S) Appraisal to Class Average

Comparison of the summative assessment weights of knowledge and skills in SPI courses is made differently. Knowledge summative assessment is given a weight of 40% while skills are weighted 60%. The same assessment techniques and instruments are used in research in the SPI course, but with different content weights. However, the difference in content weight is directed at achieving the same learning objectives. The focus of the results of this study is whether there is an increase in the results of the assessment after the SPI lecture process applies a different strategy?

There is a saying that process or effort will not betray results. so is the case with the efforts and learning processes that have been held in the SPI courses studied have succeeded in increasing student competence. The learning objectives have been well achieved by students in the SPI module on the topic of timer and counter applications as automatic control of 3 sequential motors. Even so, if the results are compared to the class average scores, there are still 17 students who still need to get remedial guidance (look at the Figure 4).

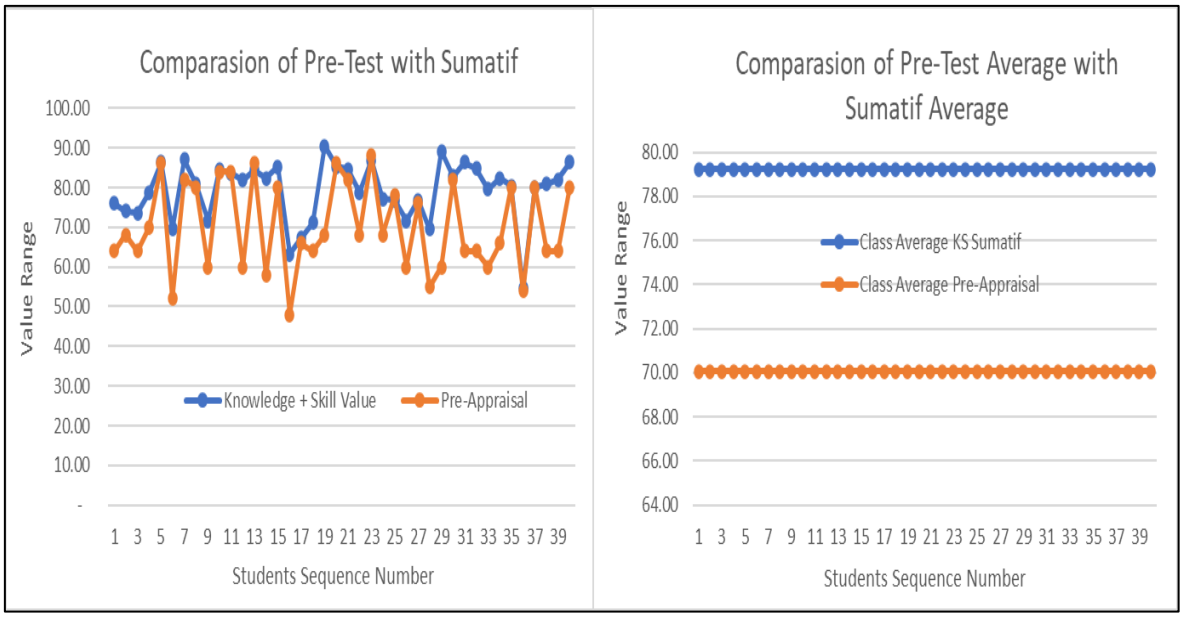

Figure 5. Comparasion of Pre-Appraisal to Sumative Appraisal and Pre-Appraisal Average to Sumatif Appraisal Average

The average pre-appraisal result of 70.08 as a diagnostic assessment increased to 79.22 after students participated in a differentiated learning process (Haniya & Roberts-Lieb, 2017) ending with a summative assessment. However, the increase in the average summative assessment percentage score of 13.04% from the pre-assessment average score still left 17 students who scored below the average (look at the Figure 4 and Figure 5). The seventeen students must be facilitated in order to achieve the learning objectives. The student's failure to reach the summative assessment was analyzed to find out which items were declared incomplete.

In this study, 3 groups of students were distinguished, namely the group of students who received scores below the average were referred to as the remedial group. The second group is students who get scores above the average. The third group is students who get scores much higher than the average and are willing to become tutors. Students who are willing to become tutors are assigned by the lecturer to guide their friends from the remedial group. Assignment to some students who become tutors is a strategy to implement enrichment for these students.

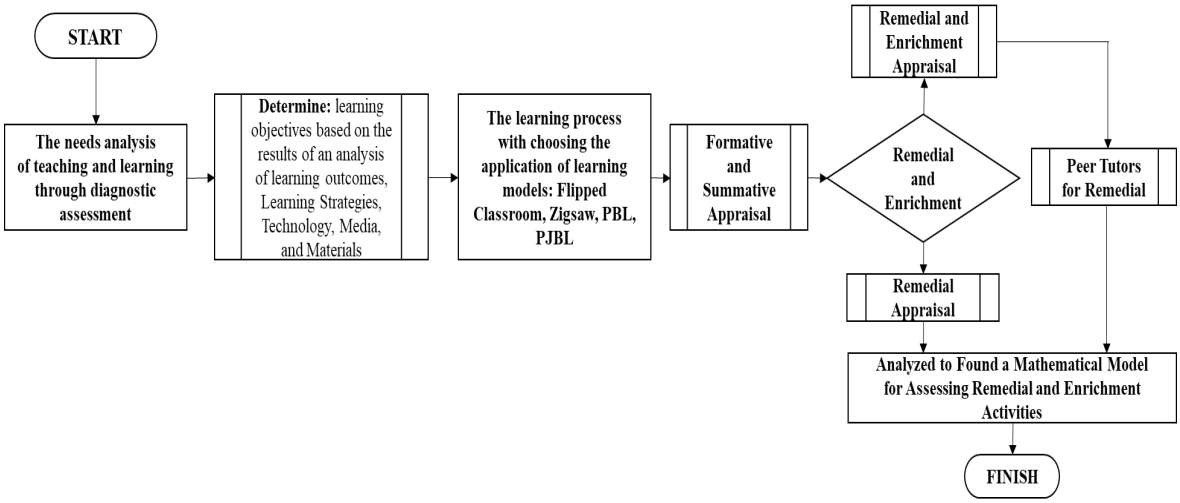

Figure 6. Final Appraisal Model of Remedial and Enrichment Activities Integrated in Independent Curriculum

Tutors teach, guide, and train remedial group preparations to successfully complete learning objectives that are still failing (Phillips, 1967; Villiger et al., 2019). The success of the student group in remedial activities was compared to the summative average scores they previously participated in. Student success in remedial is the success of the group of students who become tutors. steps of remedial and enrichment activities on the basis of the results of pre and summative appraisal analysis are explained with the Figure 6.

The remedial implementation technique in this study was adjusted to the type and level of difficulty of students, so that the method used was different. Remedial is carried out in the form of individual guidance by a friend who is assigned as a tutor. Remedial by providing group guidance by lecturers and several tutors. Remedial by way of re-learning using, methods, and media guided by tutors. These three types of remedial activities end by providing a final remedial appraisal. The progress of the achievements of the seventeen students in remedial is shown in Figure 7.

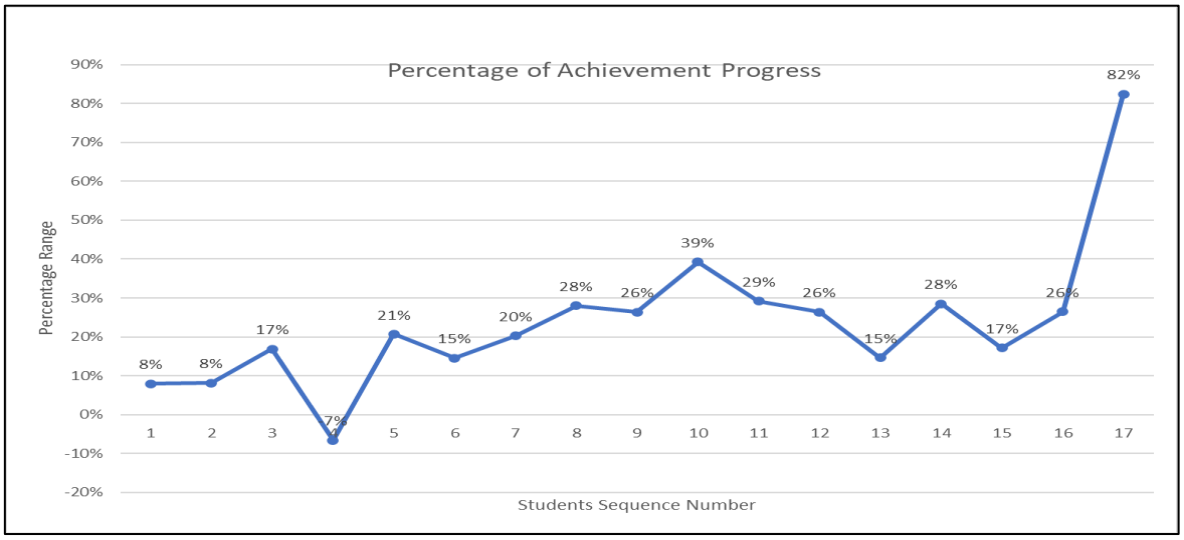

Figure 7. The Percentage of Student Achievement Progress in the Remedial Group

There was one remedial student who experienced a decrease in his remedial results in the SPI course, but the majority of remedial results increased significantly. The increase in remedial

results is in the range of 8% to 82% (see Figure 7). Of course, the success of the remedial student group is the success of their friends who become tutors. Therefore, the Joint effort is an aspect of consideration to be appreciated by giving a fair value. The minimum criteria for completeness determined from the average summative score provide direction whether each student has succeeded in achieving the learning objectives? At the same time, how to appreciate remedial and non-remedial students with fair grades? The answers to these questions were obtained through an analysis of the progress of the achievements of the remedial and enrichment assessment activities as shown in Figure 8.

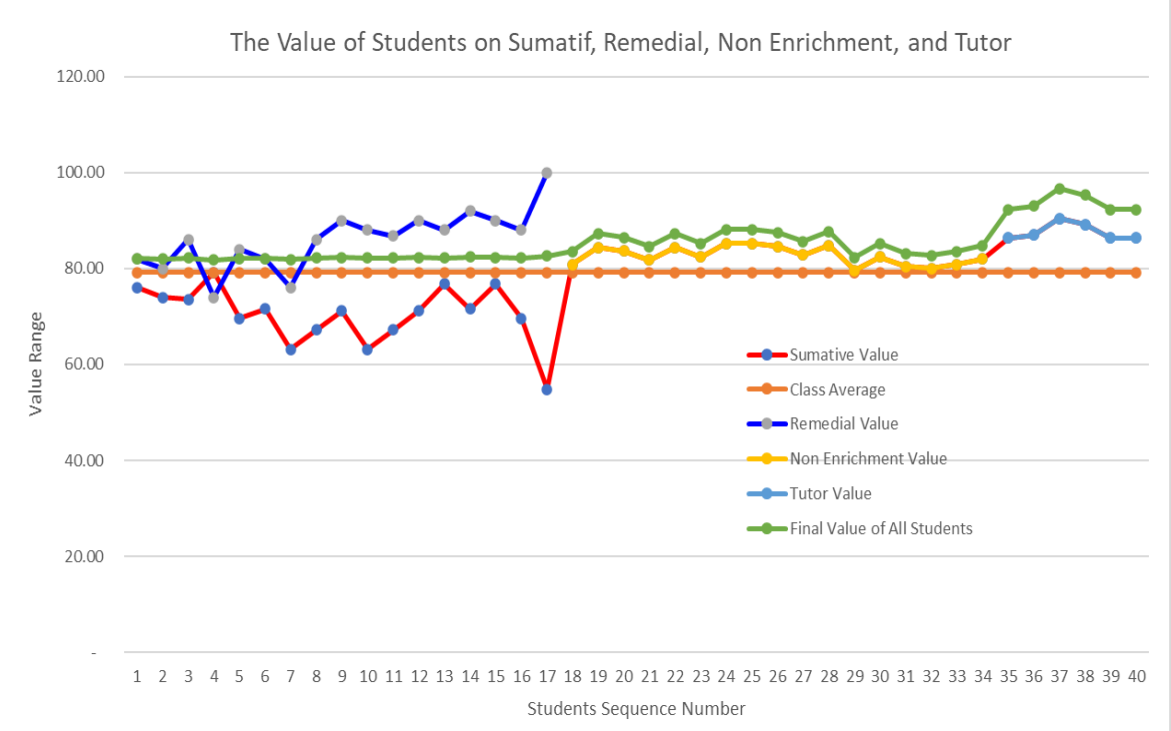

Figure 8. Value Comparasion of Students on Sumatif, Remedial, Non-Enrichment, and Tutor to Class Average

On the basis of the achievement of remedial and enrichment results, teachers or lecturers no longer need to worry about assessing remedial students. Remedial students will get grades, as well as enrichment students and students who become tutors. The value appreciation given to the three groups of students is calculated using the following mathematical model 1.

$$N_{A-R} = N_{cm} + N_R \, x \, (\frac{\sum \%R_a}{n_{stu} \, \text{x} \, n_c})/100 \quad (1)$$

N_{A-R} : Final Score of Remedial Student
N_{cm} : Score of Class Average
N_R : Value of Remedial
$\%R_a$: Achievement percentage of Remedial Value
n_{stu} : Number of students in groups/classes
n_C : Number of Differentiated Clusters/Classes

The second group is students who have tried from the start to get scores above the minimum criteria. They get an appreciation of value above their friends who are remedial. Giving value appreciation to this group of students is calculated by the following mathematical model 2.

$$N_{A-nE} = N_a + N_a\, x\, (\frac{\sum \%R_a}{n_{stu}\, \mathrm{x}\, n_c})/100 \quad (2)$$

N_{A-nE} : Final Score of Enrichment Student
N_a : Pre-Achievement Value
$\%R_a$: Achievement percentage of Remedial Value
n_{stu} : Number of students in groups/classes
n_C : Number of Differentiated Clusters/Classes

While the third group is students who are assigned to be tutors. These students teach and mentor other students who are remedial. The success of remedial students in increasing their remedial scores is the success of tutors. Therefore, tutor students get value appreciation using the following mathematical model 3.

$$N_{AT} = N_a + N_a\, x \left(\frac{\frac{\sum \%R_a}{n_{stu}\, \mathrm{x}\, n_c}}{100} \right) x2 \quad (3)$$

N_{AT} : Final Score of the Group of Students who Become Tutors
N_a : Pre-Achievement Value
$\%R_a$: Achievement percentage of Remedial Value
n_{stu} : Number of students in groups/classes
n_C : Number of Differentiated Clusters/Classes

In the end all student groups: remedial, enrichment, and enrichment as tutors will get value appreciation. Different scores were obtained by them according to each initial effort and the progress of the achievements in the group. The acquisition of value appreciation with different increases is shown again briefly in Figure 9.

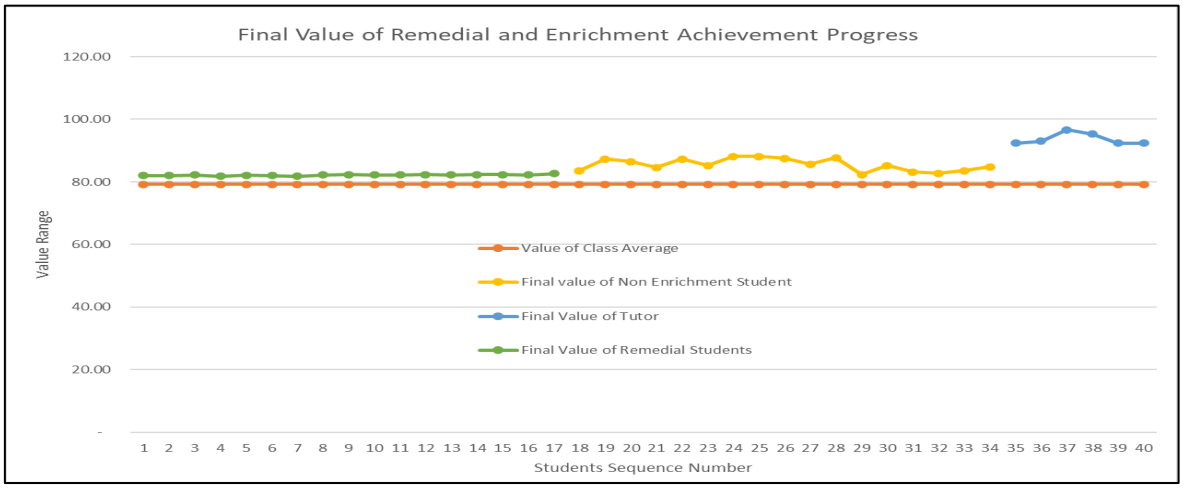

Figure 9. Final Value of Remedial and Enrichment Achievement Progress

In the graph of Figure 9, it can be seen that the three mathematical models can be used to assess remedial, enrichment, and tutor students. The mean summative value is used as a benchmark to see the ability of each student in completing the learning objectives in each teaching module. In the end the lecturers or teachers can give grades in a fair, transparent, and accountable manner. This is in accordance with the direction of change in the independent curriculum, independent learning

independent campus (MBKM), i.e new paradigm learning, differentiated learning, learner-centered learning, and comprehensive, collaborative, and integrated assessment.

Discussion

The first step of research is to analyze the needs of the learning process, especially in terms of student needs. Students who contract SPI courses are required to pass one of the previous courses, namely algorithms and programming. Before the lecture begins, the lecturer provides an assessment instrument to diagnose students' initial abilities. Diagnostic assessment (analyze learners) is very important to explore the characteristics and needs of students in learning (Ariefiani et al., 2016; Goode, 2017; Pribadi, 2011). The characteristics and needs of students really guide lecturers in preparing learning objectives, choosing teaching strategies, applying technology and learning media (Burgstahler & Cory, 2010).

Assessment at the beginning of learning is intended to determine the readiness of students to learn teaching material and achieve the planned learning objectives. This assessment is included in the formative assessment category because it is aimed at the needs of teachers in designing learning (Kementerian Pendidikan Kebudayaan Riset dan Teknologi Republik Indonesia, 2022). Different needs and characteristics of students must be facilitated in different ways. Facilitation should be more focused on helping students improve their competence so that each learning objective can be completed properly.

After the lecturer knows the characteristics and learning needs of students based on the results of the diagnostic assessment, the next step is to choose a learning model. The learning model applied in SPI lectures is the flipped classroom learning model, problem-based learning, and project-based learning. In this study the application of the flipped classroom learning model (Al-Shabibi & Al-Ayasra, 2019) guides students to study more SPI material first at home according to the assignments given by the lecturer.

This model is also used by lecturers to facilitate students who are not present in face-to-face lectures in class. Lecturers must prepare learning materials in print, audio or video form that can be studied by these students. In addition, the application of problem-based learning models in SPI lectures is directed at increasing student competence (Agustina et al., 2022) in the skills aspect. Students will be given several examples of control problems that must be practiced or simulated with the help of a simulator. In several examples, student groups were assigned to simulate several examples of control circuit projects using several types of simulators. Another effort to realize an independent curriculum is by implementing project-based learning (Afriana et al., 2016; Condliffe et al., 2017; Goodman & Weare, 2010). In this model students are given group assignments so that they are trained in planning and creating project frameworks, making schedules, monitoring implementation, testing and giving assessments, and evaluating the results of their work.

The end of the process of one SPI lecture module is closed with a summative assessment activity. Summative assessment (Kementerian Pendidikan Kebudayaan Riset dan Teknologi Republik Indonesia, 2022) is carried out to assess the achievement of each learning objective as a basis for determining whether students still have to study again or can continue to the next module. The summative assessment on the aspects of knowledge and skills of forty students (see figure 4) shows that a number of seventeen students were stated to have not completed the learning objectives of sequential circuit modules using PLC timers and simulators. The seventeen students must be remedied.

In this study, the summative results showed that there were twentythree non-remedial students or commonly called enrichment student groups. These two different student groups, in the end, must get an appreciation of the value according to their respective efforts. Several students from the enrichment group were assigned to be tutors to teach and guide the remedial group of students so they could complete the next reassessment. The treatment model for enrichment student groups in this study aims to ensure that collaborative learning that is carried out simultaneously and integratively does not give rise to new remedial groups. This is because if an enrichment student is given a different assignment and the weight is higher, he must be assessed again to ensure his success in enrichment. However, if several students are assigned as tutors, they will get many benefits.

Student-centered learning, differentiated learning, collaborative learning, and improving 21st century skills (Noor & Wangid, 2019) will be achieved by implementing this strategy.

Remedial achievement progress in the range of 8% to 82% with an average of 10.03% is a good improvement. The average summative score of 79.22 encourages students to be even more active in completing their studies by collaborating as integrated tutors in remedial activities. The success of students exceeding the summative class average is a joint success in the implementation of learning.

The application of peer tutoring strategies in remedial guides students to learn independently, communicatively, creatively, and able to work together. It is this kind of practice that is expected by the independent learning curriculum concept of an independent campus (Direktorat Jendral Perguruan Tinggi Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2020) in Indonesia. For lecturers or teachers, the application of the peer tutoring strategy in remedial activities will give confidence in assessing and appreciating the different efforts of each student. Under different conditions, lecturers or teachers can appreciate remedial activities as well as enrichment using mathematics model 1 for remedial students, mathematics model 2 for non-tutor enrichment students, and mathematics model 3 for tutor students. The use of these three mathematical models encourages lecturers or teachers to assess objectively, comprehensively, transparently, fairly and accountably (Budiono & Hatip, 2023; Karyanto, 2022; Yogi Anggraena et al., 2021) according to the principles of assessment.

CONCLUSION

The application of the peer tutoring strategy between students is very effective in remedial students who fail to complete the previous learning objectives. The lecturer selects several enrichment students and assigns them as tutors. The success of students in remedial activities is the success of other students who become tutors. Remedial students and every other student get a final grade appreciation based on their respective achievements.

The teachers or lecturers can appreciate remedial students with final grades using the following mathematical model:

$$N_{A-R} = N_{cm} + N_R \, x \, (\frac{\sum \%R_a}{n_{stu} \, \mathrm{x} \, n_c})/100$$

The Final Grade for students who become tutors is calculated using the following mathematical model:

$$N_{AT} = N_a + N_a \, x \left(\frac{\frac{\sum \%R_a}{n_{stu} \, \mathrm{x} \, n_c}}{100} \right) x2$$

The final grades for the other students are calculated using the following mathematical model:

$$N_{A-nE} = N_a + N_a \, x \, (\frac{\sum \%R_a}{n_{stu} \, \mathrm{x} \, n_c})/100$$

Remedial activities as well as enrichment and assigning students to be tutors can facilitate an active and student-centered learning process. The use of the mathematical model above can assist lecturers in evaluating learning outcomes in a transparent, fair and accountable manner. The effectiveness of applying the mathematical model must be tested further in subsequent research with a wider sample size.

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Employability skills and self-perception of diploma 3 graduates in the world of work

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ABSTRACT

This study aims to determine the world's perception of Diploma 3 graduates regarding work skills. The research used a questionnaire survey method on Diploma 3 graduates who had worked for 2-5 years. Measurement of work aspects includes individual qualities, basic skills, interpersonal skills, thinking skills, resource management, systems and technology, and information skills. The instrument's validity in each aspect ranges from 0.416 to 0.683, with a reliability of 0.882. The research technique used simple random sampling with 109 respondents in this study. The results of the study stated that the self-perception of graduates are (1) an individual quality score of 85.5 with a very high interpretation; (2) basic skills get a score of 81.8 with a high interpretation; (3) an interpersonal score of 84.8 with a very high interpretation; (4) thinking skills get a score of 83.1 with a very high interpretation; (5) resource management obtained a score of 88.6 with a very high interpretation; (6) systems and technology got a score of 92.4 with a very high interpretation, and (7) information skills got a score of 85.1 with a very high interpretation. Thus, the average worldwide employment of Diploma 3 graduates is 85.9, with a high interpretation. This finding implies that the higher graduates' employability skills, the higher their self-perception at work.

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INTRODUCTION

Vocational education has unique characteristics, so it requires special handling as well. These characteristics include education and training oriented towards preparing students to work in specific fields as assistant technicians, technicians, or supervisors in the industry. The Diploma 3 program is part of vocational education; of course, it pays attention to the needs and situations of the industrial world of work to meet the demands of a dynamic and rapidly growing job market. In the industrial era, the demands for skills in the field of work, the world of work, and industry demand employability skills that prospective workers must possess to the characteristics of the current work climate. Several studies on employability skills have been carried out by Australian trade and

industry associations involving several industries, and private and government institutions, including the Ministry of Education, Science, and Training (DEST). The results of the study identified two essential things, namely (1) the determining factors in facing the changing world of work; and (2) employability skills for the future (Mcleish, 2002).

The first study's results identify six essential things that impact a worker's skills demands: customer-based service, the role of technology, warehousing, and financial requirements, learning and training approaches, emphasis on innovation, and project-based work improvement. While the results of the second study indicate a change in the demands of the world of work on the skills possessed by workers, the world of work emphasizes employability skills. The demands on the employability skills of new workers or prospective workers by the business world and industry in Malaysia can be sorted as follows, have communication skills, interpersonal skills, can use of computers, can work in teams, can work alone, leadership potential, logical thinking analysis, and self-motivated, honest, and highly committed (Bakar & Hanafi, 2007).

Employability skills as a kind of non-technical ability that every single person who works in the industrial field should acquire as it is vital as technical skills (Ju et al., 2012). Employers are generally looking for graduates who possess employability skills, especially communication and interpersonal skills, skills in problem-solving, and the ability to adapt to all kinds of situations in the workplace. Employability skills are essential because every job requires initiative, flexibility, and a person's ability to handle different tasks. Employability skills mean that the skills possessed by a person in the workforce do not have to be specific but should be more service-oriented and, more importantly, have high social skills.

Chan's et al., (2018) research shows that employers' perceptions of the essential work skills in the manufacturing industry are communication skills. The independent variables chosen were gender, company size, and the type of manufacturing sector. In contrast, the dependent variable was the manufacturing industry's perception of essential work skills. The results show no significant difference in the perception of critical work skills in the manufacturing industry according to the sex of the entrepreneur and the type of manufacturing sector. However, there is a significant difference in company size (Chan et al., 2018).

From research with Australian employers, the Australian Chamber of Commerce and Industry (ACCI) and Business Council Australia (BCA) provide a report on a set of job skills relevant to the Australian industry for the future. The Employability Skills Framework establishes eight skill groupings to describe and define employability Skills. The eight skill groupings are (1) communication skills that contribute to productive and harmonious relationships among employees and customers; (2) teamwork skills that contribute to productive work relationships and outcomes; 3) problem-solving skills that contribute to productive results; (4) corporate initiatives and skills that contribute to innovative results; (5) planning and organizational skills that contribute to long-term and short-term strategic planning; (6) self-management skills that contribute to employee satisfaction and growth; (7) learning skills that contribute in employee and company operations and outcomes; and (8) technology skills that contribute to the effective execution of tasks (Cates et al., 2008).

Lankard (1990) identified five skills that are needed in the world of work and must be possessed by a worker to work and achieve success, namely basic academic skills consisting of communication skills, mathematics, and science. Meanwhile, to enter the world of work, skills that are appropriate to the job (occupational skills) are needed. However, according to him, these four skills contain risks and are critical to improving careers because they do not guarantee success in work. Based on the results of his study, Lankard (1990) said that employers believe that employability skills-skills that can make a person survive and keep up with changes in the workplace - are critical.

Employability skills are ranked fifth, and workers must adapt quickly to various work situations.The Secretary's Commission on Achieving Necessary Skills (SCANS) conducted a study to identify and describe the skills needed in the workplace (employability skills) to improve the performance of workers to be more effective. Initially, SCANS found seven functional skills, namely skills that are important for a worker: resource management, information management, social interaction, systems behaviour and performance, human and technology interaction, and affective skills (Kane et al., 1990). Then, based on an in-depth review and verification, SCANS created two

groups of skills education graduates need to possess, namely foundation skills and workplace competencies, as shown in Table 1.

Table 1. Employability Skills by SCANS

No.	Aspect	Indicator
1	Foundation Skills	Basic skills, thinking skills, personal qualities
2	Workplace Competencies	Resources, interpersonal, information, systems, technology

Rasul et al. (2014) pointed out that employers emphasize different job skill levels. Employers need employees with strong interpersonal skills such as communication skills, problem-solving skills, teamwork, and entrepreneurial skills related to the context of the work environment. Employers also suggest that project-oriented and work-process-oriented are the best methods for imparting these skills (Rasul et al., 2014). However, Sing's findings suggest no significant difference in the relationship between job skills and employer gender. That leads to the conclusion by the authors that the work skills of graduates are almost the same for groups of men and women (Singh & Singh, 2017).

A study conducted by Buntat (2004) has identified five essential elements needed by entrepreneurs in the industry: (1) Have honesty, integrity, and personality ethics; (2) Cooperate with other parties; (3) Make use of technology, instruments, and information systems effectively; (4) Decision making; and (5) Time management. The research results by Husain show that employers value the importance of work skills at a high level (Husain et al., 2010). Self-perception is a person's view of himself or any mental or physical attributes that make up the self; such views may involve true self-knowledge or varying degrees of distortion (APA Dictionary of Psychology). The application of self-efficacy theory to vocational behavior was first suggested by Betz and Hackett (1981). Briefly, as originally proposed by Bandura expected self-efficacy refers to a person's beliefs regarding his ability to successfully perform a given task or behavior (Dittmer, 1977).

The self-concept theory concerns individuals' perceptions of themselves, such as their self-knowledge and attitudes or emotions related to themselves (Greenwald & Farnham, 2000). Self-efficacy relates to the belief that one can deal with the expected actions. Betz and Klein (1995) state that self-efficacy results from a person's cognitive processes in the form of decisions. The individual's belief or expectation is how he estimates his ability to carry out a task or an action needed to get the desired result (Betz & Klein, 1995). In the study Basito et.al stated that there was a relationship between self-efficacy and students' higher-order thinking skills as evidenced by the t-value greater than t-table of 2.395 > 1.671 (Basito et al., 2018).

Measurement of work aspects includes; individual qualities, basic skills, interpersonal, thinking skills, resource management, systems and technology, and utilization of information. Interpersonal skills are required to work well with others, such as peers, subordinates, and superiors, or understand and sympathize with their needs (Rocco, 2000). Teamwork is defined as the ability to function well in various situations, be a disciplined team, work effectively with others, show flexibility, power, and adaptability, and understand and contribute to the goals of an organization (Cates et al., 2008). In the contemporary workplace, teams, committees, and working groups are elements for making deals and contributing to the success of every routine assignment, initiative, and project (Dunne & Rawlins, 2000).

Furthermore, information, communication, and Technological skills are defined as those skills and competencies facilitating the use of computers and related information on technology to meet the personal, educational, and workforce needs of a target market (Chidike et al., 2020). Plus, Casner-Lotto and Barrington described information, communication, and technology skills as the ability to select and practice applicable technologies to obtain given tasks complete successfully and apply computational skills for troubleshooting (Barrington et al., 2006).

In Indonesia, the Diploma 3 program is part of vocational education. Vocational education defined by Wenrich and Wenrich (1974) that vocational education might be described as specialized education organized to prepare the learner for entrance into a particular occupation or family of

disciplines or to upgrade employed workers. In this sense, vocational education is carried out to train someone to become a worker in various fields of work. Cantor (1991) says that vocational education has an understanding as education that has programs related to work and aims to provide students with skills that are by the demands of the world of work.

Currently, vocational education is needed to develop knowledge and skills that can help a worker become more flexible and sensitive to the needs of the labour market, especially to face competition in the era of globalization. The objectives of vocational education are broader and related to the individual expectations of students, namely: (1) permit the harmonious development of personality and character, and foster spiritual and human values, the capacity for understanding, judgment, critical thinking and self-expressing; (2) prepare the individual for lifelong learning by developing the necessary mental tools, technical and entrepreneurial skills and attitudes; (3) develop capacities for decision-making and the qualities necessary for active and intelligent participation, teamwork and leadership at work and in the community as a whole; (4) enable an individual to cope with the rapid advances in information and communication technology (Shirley, 2015).

The Presidential Regulation of the Republic of Indonesia No. 8 of 2012 concerning the Indonesian National Qualifications Framework (KKNI) stated, "Diploma 3 graduates are at least equivalent to level 5". Competencies of Graduates of the D3 Catering Program graduate qualifications are intermediate experts equivalent to KKNI level 5. The level 5 qualification level has the following graduate competencies: (1) Able to complete a wide range of work, choose the appropriate method from a variety of already or not standardized options by analyzing data, and show performance with measurable quality and quantity; (2) Mastering the theoretical concepts of specific fields of knowledge in general and able to formulate procedural problem solving; (3) Able to manage working groups and compose written reports comprehensively; (4) Responsible for own work and can be given responsibility for the achievement of group work results (Direktorat Jendral Pembelajaran dan Kemahasiswaan Republik Indonesia, 2015).

Vocational education graduates must have various skills needed in work and industry because the nature of education prepares graduates to work. For this reason, vocational education should prepare graduates with various appropriate skills, both technical skills according to certain areas of expertise and non-technical skills, for their readiness to work and survive in their jobs. In addition to the demands for basic skills and technical skills in the field of expertise they are engaged in, the world of work and industry requires non-technical abilities and skills or so-called employability skills for prospective workers to the characteristics of the current work climate.

Therefore, vocational education graduates who work in the industry and have various abilities and high skills, including employability skills according to work demands, are expected to contribute more to work efficiency and production quality. Efficient work results with quality production results will positively impact industrial growth and implications for industrial performance and competitiveness. Based on various theoretical studies on employability skills, this study measured employability skills, including individual quality, basic, interpersonal, thinking, resource management, system and technology, and information skills.

RESEARCH METHOD

This study used a descriptive research design with a quantitative approach. This study aims to determine the world's perception of diploma 3 graduates regarding work skills. Quantitative data for this study were obtained through questionnaires adapted from the (Husain et al., 2010). Research with this survey method aims to explain and simplify various conditions, situations, or variables using data. The respondent data are 109 graduates of the Diploma 3 program from various majors. This study analyzed 109 valid responses to achieve the research objectives, with 37 men and 72 women. Another attribute is the working period with an active period of 2 - 5 years and position at work with a choice of work position as the owner has a particular place and ordinary staff. Respondents completed the employability skills questionnaire with indicators of individual quality, basic skills, interpersonal skills, thinking skills, resource management, systems and technology, and information skills. This study analyzed 109 valid responses with descriptions as shown in Table 2.

Table 2. Graduate Working Time

Number of Graduates	Years of Work
99 graduates	2-2.9 years
5 graduates	3-3.9 years
1 graduates	4-4.9 years
4 graduates	more than 5 years

Content chose questions or statements to measure respondents' perceptions of employability skills with indicators of individual quality, basic skills, interpersonal skills, thinking skills, resource management, systems and technology, and information skills. Table 3 describes the questions and statements selected from the employability skills instrument.

Table 3. Employability Skills Questionnaire

No.	Indicators	Ability	Item
1	Individual Quality	Have an honest nature, have a commitment to work, responsible, have a social attitude / sensitive to social conditions, care about work safety, high self-confidence, manage yourself, work without supervision	P1, P2, P3, P4, P5, P6*, P7, P8
2	Basic Skills	Read the manual, listen to the conversation in the discussion, expressing opinion/talking, counting fast, writing activity reports	P9, P10, P11*, P12, P13
3	Interpersonal Skills	Serve customers, working with different cultures, teaching friends/colleagues, active as a group member (inclusion), lead the group, negotiating with customers	P14, P15, P16, P17, P18, P19
4	Thinking Skills	Creative and innovative thinking, solve the problem properly, have strong reasoning, seeing with the mind's eye (stereo map), make decisions, knowing how to learn	P20, P21, P22, P23, P24, P25
5	Resource Management	Manage time, manage facilities, facilities and infrastructure managing risk, managing human resources in the work environment, manage funds	P26, P27, P28, P29, P30
6	Systems And Technology	Understanding the system, using technology and work equipment, maintaining technology and work equipment, choosing the right technology	P31, P32, P33, P34
7	Information Skills	Assess information, using information and communication technology, delivering the right information	P35, P36, P37

Questionnaires conducted validity analysis to measure the instrument's validity in each aspect and reliability testing using Cronbach's alpha. With a total of 109 respondents with a significance level of 5%, rtable of 0.1882 was obtained. Of the 37 statement items, there were 2 invalid items, namely items number P6 and number P11. The reliability result obtained was a value of 0.910 which stated that the instrument had consistency requirements as a measuring tool. Variable tendency category conversions can be seen in Table 4.

Table 4. Variable Trend Category

Rating Category	Value Range	Percentage (%)
Very High	5	81-100%
High	4	61-80%
Moderate	3	41-60%
Not high enough	2	21-40%
Low	1	0-20%

FINDINGS AND DISCUSSION

Overall, in the analysis of the impact of the independent variables on participation in assessing self-perception of employability skills, the results show that most of the coefficients are significant, with p-values lower than 0.05. Analysis of participatory answers on each aspect of employability skills is presented in Figure 1.

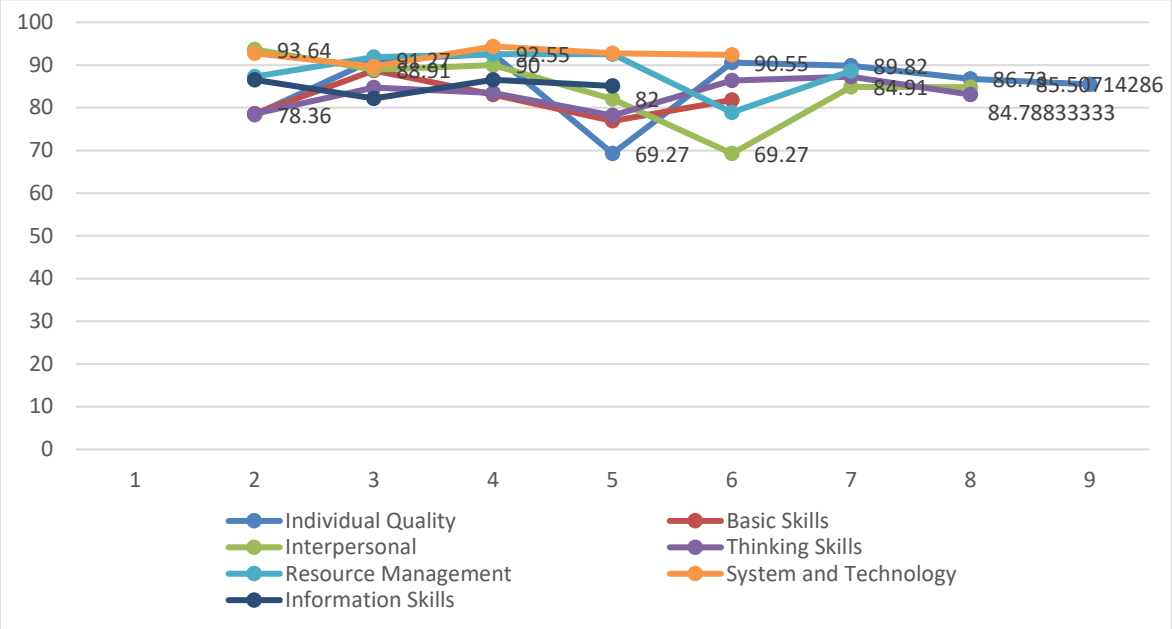

Figure 1. Percentage Level of Each Aspect of Employability Skills

Figure 1 shows the results for each aspect of employability skills. An explanation of the score can be seen in Figure 2. Individual quality indicators include honesty, commitment to work, responsibility, social/sensitivity to social conditions, concern about work safety, high self-confidence, self-management, and work without supervision. Of the eight abilities, only one was declared invalid, namely high self-confidence, with a validity value of 0.1512 <0.1882. So that high self-confidence granules are not used. Basic skills include reading manuals, listening to conversations in discussions, expressing opinions/speaking, counting fast, and writing activity reports. Based on the calculation of the validity of the ability to express opinions/speak, it was declared invalid with a value of 0.0521 < 0.1882, so it was excluded from the instrument.

Interpersonal skills include the ability to serve customers, work with different cultures, teach friends/colleagues, be active as a group member (inclusion), lead a group, and negotiate with customers. All six abilities meet the validity requirements, so the interpersonal skills indicator still contains six abilities. Thinking skills include thinking creatively and innovatively, solving problems well, having strong reasoning, seeing with the inner eye (stereo map), making decisions, and learning. All ability statements from indicators of thinking skills are valid so that they are used in the instrument. The resource management indicator contains the ability to manage time, facilities, infrastructure, risks, human resources in the work environment, and funds. This indicator consists of five questions.

Table 5. Employability Skills Indicator Values and Averages

No.	Indicators	Ability	Score	Average
1	Individual Quality	Have an honest nature	78,36	85,5
		Have a commitment to work	91,27	
		Responsible	92,55	
		Have a social attitude / sensitive to social conditions	69,27	
		Care about work safety	90,55	
		Manage yourself	89,82	
		Work without supervision	86,73	
2	Basic Skills	Read the manual	78,55	81,8
		Listen to the conversation in the discussion,	88,73	
		Counting fast	83,09	
		Writing activity reports	76,91	
3	Interpersonal Skills	Serve customers	93,64	84,8
		Working with different cultures	88,91	
		Teaching friends/colleagues	90,00	
		Active as a group member (inclusion)	82,00	
		Lead the group	69,27	
		Negotiating with customers	84,91	
4	Thinking Skills	Creative and innovative thinking	78,55	83,1
		Solve the problem properly	84,73	
		Have strong reasoning	83,45	
		Seeing with the mind's eye	78,18	
		Make Decisions	86,36	
		Knowing how to learn	87,27	
5	Resource Management	Manage time	87,27	88,6
		Manage facilities	91,82	
		Facilities and infrastructure managing risk	92,55	
		Managing human resources in the work environment	92,55	
		Manage funds	78,91	
6	Systems And Technology	Understanding the system	92,73	92,4
		Using technology and work equipment	89,64	
		Maintaining technology and work equipment Choosing the right technology	94,36 92,73	
7	Information Skills	Assess information	86,55	85,1
		Using information and communication technology	82,18	
		Delivering the right information	92,73	

Interpersonal skills include the ability to serve customers, work with different cultures, teach friends/colleagues, be active as a group member (inclusion), lead a group, and negotiate with customers. All six abilities meet the validity requirements, so the interpersonal skills indicator still contains six abilities. Thinking skills include thinking creatively and innovatively, solving problems well, having strong reasoning, seeing with the inner eye (stereo map), making decisions, and learning. All ability statements from indicators of thinking skills are valid so that they are used in the instrument. The resource management indicator contains the ability to manage time, facilities, infrastructure, risks, human resources in the work environment, and funds. This indicator consists of five questions.

System and technology contain four abilities with four valid questions: understanding the system, using work technology and equipment, maintaining work technology and equipment, and choosing the right technology. Information skills include assessing information, using information and communication technology, and conveying the right information. This indicator consists of three questions: the ability to assess information, use information and communication technology, and convey the right information.

Based on Table 5, the statement of having a social attitude/sensitivity to social conditions and leading the group has the lowest score of 69.27. This low factor is probably caused by learning patterns that have yet to be maximized in developing students' work abilities. Employers/industries, besides demanding extraordinary expertise in certain fields of work, also expect workers to have academic skills and other skills, including essential skills in reading, writing, and arithmetic; communication skills, oral and written; problem-solving skills; ability to work; reasoning skills; leadership skills; computer skill; interpersonal skills; learning skills (learning-how-to-learn); and teamwork skills.

Employers value the importance of job skills at a high level. The employers show that all employers place the eligibility skills that all graduates must have in order to be able to compete in the global market. Authority from Educational institutions must improve the workability of their students either through professional channels, development of lecturers, curriculum, and co-curriculum (Husain et al., 2010). Employers need employees with strong interpersonal skills such as communication skills, problems solving skills, teamwork, and entrepreneurial skills related to the context of the work environment. Employers also suggest that project-oriented and work-process-oriented are the best methods for imparting these skills (Rasul et al., 2014).

Jaafar et al. (2018) research shows that the relationship between work skills and career choice is high, with an ETA of 0.742, which proves that the variable has a strong correlation. In conclusion, employability skills affect students in such a way that they tend to choose careers based on the courses they take. Chan's et al., (2018) research provides key insights that will enable future employees to better understand job demands in today's manufacturing industry and for employees to develop their job skills before preparing to enter the job market.

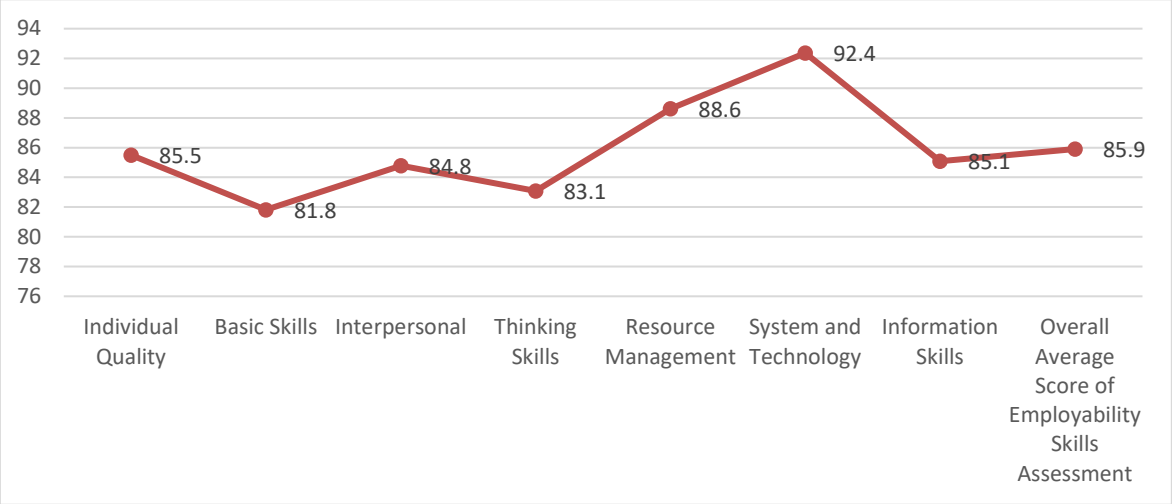

Figure 2. Average Overall Self-Perception of Employability Skills

The percentage related to self-perception and system and technology offers the highest magnitude (92,4%). The lowest self-perception of employability skills related to basic skills was 81,8%. Overall aspects of employability skills have presented in Figure 2. This study states that the highest perception of graduates on employability skills in the world of work is the use of systems and technology.

The system and technology aspect occupies the highest rating because the three diploma graduates in this study belong to the millennial generation category, which is very attached to technology in everyday life. The high perception of diploma 3 graduates is in line with the research results on the assessment of the work skills industry, which can be identified through indicators of managerial ability and personality/personality with 87.1 with a very high interpretation (Febriana et al., 2018).

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CONCLUSION

This study found that the self-perception of graduates of the Diploma 3 program regarding work skills was very high, with a score of 85.9 in the range of 5 (percentage 81 - 100%). The highest average self-perceptions of graduates are systems and technology, resource management, individual quality, information skills, interpersonal skills, thinking skills, and basic skills. The lowest self-perception of work skills on basic skills is 81.8%. Therefore, basic skills need to be improved, and several indicators of basic skills need to be looked for strategies. Furthermore, it is necessary to integrate aspects of Employability skills into the curriculum and learning tools. Thus, it is hoped that graduates of the diploma three program will have a high self-perception of their ability to work in the world of work.

ACKNOWLEDGEMENTS

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Essential competences contribution of the S2-PTE course in Universitas Negeri Yogyakarta to work competence

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ABSTRACT

This study aims to determine the essential competencies contribution of each vocational course and engineering course in the curriculum to the competence needs of education, training, and engineering work in the electrical power competencies. The research was carried out using a goal-oriented evaluation approach. The object of this research is to the essential competencies of the electrical engineering education Master Program's courses at Universitas Negeri Yogyakarta, including engineering and vocational education courses. Data collection used a questionnaire, then analyzed descriptively. Furthermore, it was presented in the form of categorical data and graphs. The research results show that each essential competence contributes 70.0% to electrical education and training jobs. Referring to the Indonesian National Work Competency Standards, each essential competency contributes more than 66.7%. Thus it can be concluded that the essential competencies of the electrical engineering education Master Program's courses in Universitas Negeri Yogyakarta have contributed to the electricity sector jobs.

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INTRODUCTION

Indonesian workers are not ready to face the ASEAN Economic Community (AEC). According to Rieke Dyah Pitaloka in Sudarno (2016), the reason why Indonesian workers are not ready to face MEA is due to a lack of skills. Goldrick-Rab (2010) revealed that the key factors for student accomplishment success in following this practice and its acceptance in the business world and industry will lead to increased success. The enthusiasm to follow the practice and do the practice requires teamwork, actively accepting suggestions from superiors is essential in industrial practice. Bentley (2012) stated that in the current era of science and technology, the existence of educational institutions is increasingly being felt as an urgent need in responding to various challenges and current demands for change. This can be achieved if educational activities are carried out responsibly and with quality. Competence is something that cannot be separated from education and teaching activities (Hamdani & Krismadinata, 2017). The quality in question lies in the design and

management of the educational process which is based on the concepts of growth, development and renewal (Morgan, 2007). The process of providing education must be managed professionally.

The qualities, skills and understandings a university community agrees its students should develop during their time with the institution (Meda & Swart, 2017). Competencies has an important role in the human resource process, because in general competence concerns a person's basic abilities in doing a job (Adam et al., 2021). The fulfillment of competencies according to the needs of the business and industrial world carried out by educational institutions is largely determined by human resources and the adequacy of infrastructure that supports the formation of graduate competencies (Sugandi et al., 2022). This condition needs to be of concern to tertiary institutions in implementing learning programs so that they pay attention to skills competency needs in the labor market, in Indonesia, especially according to the Indonesian National Qualifications Framework (KKNI).

KKNI cannot be separated from the determination of the National Higher Education Standards (SNPT). According to the Ministry of Education and Culture of the Republic of Indonesia (2013), the level of higher education that is applied in the KKNI starts from qualification level 3 to qualification level 9. KKNI has a very broad dimension in the process of forming human resources qualified, competent and empowered competitive. This standard can be used reference in development curriculum, syllabus and modules competency based training (Hadi, 2018). In the Appendix to Presidential Decree No. 8 of 2012 also states that at level 8 which is equivalent to graduates of applied masters, masters, or specialist one have a description of the qualifications at that level.

Description Level 8 of the KKNI is being able to develop knowledge, technology, or art in their scientific fields through research, solving science, technology, or arts problems in their scientific fields through inter or multidisciplinary approaches, and managing research and development that is beneficial to society and knowledge, and able to gain national and international recognition. Referring to the Indonesian National Work Competency Standards (SKKNI), the electricity sector is divided into three sub-sectors, namely: the electric power transmission sector, the electricity distribution sector, and the electricity utilization installation sector. SKKNI is expected to be a benchmark for tertiary institutions to determine the competences that students must provide, so it is hoped that after studying at university students will have competences that can compete in the world of work (Abdelaziz, 2014).

Postgraduate Program in Universitas Negeri Yogyakarta, which organizes master and doctoral's programs, has opened 33 master programs and 8 doctoral programs. Master of Electrical Engineering Education is one of the new study programs that opened in the 2015/2016 academic year. Master of Electrical Engineering Education Study Program (S-2 PTE), is a study program that was officially opened based on the Decree of the Minister of Education and Culture of the Republic of Indonesia. As a consequence, learning programs that are designed need to pay attention to issues of relevance to the demands of the labor market.

S-2 PTE is designed to produce professional educators in electrical engineering vocational learning, as well as a continuation of studies for bachelor degree (S1) in electrical engineering education, electrical engineering, or cognates. S-2 PTE is increasingly demanded so that the graduates produced have competence skills that are relevant to the needs of the job market both at home and abroad, so the S-2 PTE curriculum was developed oriented to the Indonesian National Qualifications Framework (KKNI), it is hoped that graduates will be able to adapt to the demands accordance with the qualifications of the labor market.

The electrical engineering curriculum is designed to provide comprehensive expertise for students and prospective students so that they have competency skills after fulfilling the basic competencies for all fields of electrical engineering (Santika & Mukhaiyar, 2020). The competence standards for graduates of the master of electrical engineering education study program are: (1) Have pedagogical and andragogical abilities to plan, implement, and evaluate learning electrical engineering skills in vocational education and training; (2) Master electrical engineering skills to plan, implement and evaluate programs within the scope of vocational education and training work; (3) Able to plan, organize scientific activities and manage research within the scope of learning which is his responsibility and national institutions; (4) Able to make managerial decisions in the field of electrical engineering vocational education and training based on scientific methods in institutional

tasks that become responsibilities institutionally and between national institutions; and (5) having commitment, loyalty, integrity, honesty and discipline to carry out managerial tasks assigned on an institutional and inter-agency scale (Universitas Negeri Yogyakarta, 2019).

In order to prepare for employment needs, the competence standards for graduates of the master of electrical engineering education study program are: (1) Having pedagogical and andragogical abilities to plan, implement, and evaluate learning electrical engineering skills in vocational education and training; (2) Mastering electrical engineering skills to plan, carry out and evaluate programs within the scope of work of vocational education and training; (3) Able to plan, organize scientific activities and manage research within the scope of learning which is his responsibility and institutional nationally; (4) Able to make managerial decisions in the field of electrical engineering vocational education and training based on the method scientific in institutional tasks which are institutionally and inter-national institutions' responsibilities; and (5) Having commitment, loyalty, integrity, honesty, and discipline to carry out managerial tasks imposed on an institutional and inter-institutional scale (Universitas Negeri Yogyakarta, 2019).

RESEARCH METHOD

This research was carried out using the goal-oriented program evaluation model developed by Tyler (1976). This goal-oriented approach was first introduced by Tyler (1976) as a new standard for educational evaluation. Previously, to evaluate the field of education, a test was conducted using reference criteria. Tyler used a more complex methodology to relate student achievement results to the desired learning outcomes. Tyler formulated the evaluation of learning outcomes from learning objectives based on the taxonomy of learning objectives developed by Bloom and Krathwohl (Fauzobihi et al., 2022). Currently, evaluation in education is greatly paid attention when the quality of education and the improvement that needs to be made to educational programs are the main concern of the whole educational system (Anh, 2018).

This approach collects information from stakeholders consisting of (1) SMK leaders (Head of Study Programs, Deputy Principal), (2) Education and Training Leaders (BLK and BLPT), (3) Polytechnic/Academic Leaders (Head of Study Progtram), (4) Associations Indonesian Electrical Professionals (APEI), (5) Association of Indonesian Electrical Contractors (AKLI), and (6) Professional Certification Institute for Work in a State of Voltage (LSP Gema PDKB). Information from these stakeholders is used to evaluate the contribution of course content in the master of electrical engineering education to the needs of education and training in the field of electrical engineering and jobs in the electricity sector. The steps of Tayler's goal-oriented evaluation model as quoted by Marsh (1978) are explained in Figure 1.

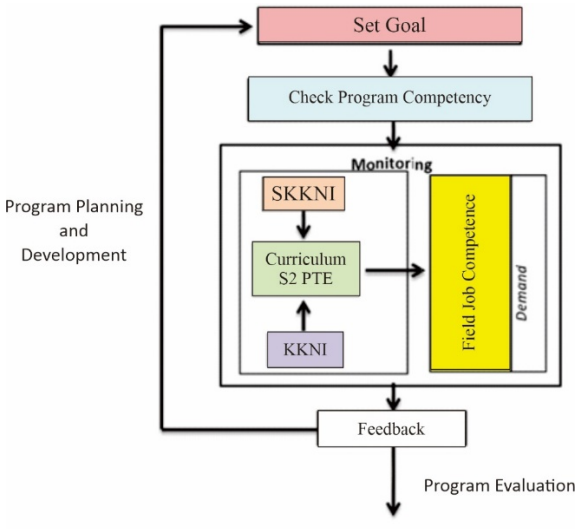

Figure 1. Steps of Taylor's Goal Oriented Evaluation Method

There are two types of locations when viewed from data collection. The two types of locations are (1) vocational education and training institutions; and (2) association institutions or certification institutions. Vocational education and training institutions consist of a vocational high school group, vocational schools/academies and polytechnics, and 10 vocational training centers. Data collection for the second type of location are in 3 association institutions or electricity certification institutions.

The object of this study is a essential competence of each course in the S2-PTE Study Program's Curriculum, which includes groups of vocational courses and expertise towards the demands of work competence in the field of electrical engineering education and training, as well as the field of electricity work based on SKKNI. Furthermore, research subjects and data sources were from: (1) heads of study programs/departments/fields from the vocational high school group, vocational schools/ academies/ polytechnics, and job training centers as many as 10 people, and (2) heads/managers of association institutions/electricity certification institutions as many as 3 people. So, a total of 13 research subjects. Collection methods and tools can be explained in Table 1.

Table 1. Research Data Collection

Data Types	Data Source	Instrument	Number of Respondent
Expertise and Vocational Education	Head of the Vocational High School Study Program Head of Electrical Engineering Training Center Head of Electrical Engineering Study Program (Vocational/Academic)	Questionnaire	10
Electricity Competence vs SKKNI	Head of APEI (Asosiasi Profesionalis Elektrikal Indonedia) Head of AKLI (Asosiasi Kontraktor Listrik Indonesia) Head of LSP Gema PDKB Semarang	Questionnaire	3

The summary of the questionnaire grid for each type of course group data and the number of essential competence items is shown in Table 2.

Table 2. Summary of the Questionnaire Grid

No.	Courses	Electricity Engineering Group Based on SKKNI			
		Number of Basic Competency Items (CI)	Number of Items CI Transmission	Number of Items CI Distribution	Total Item CI Electrical Installation
1	Electrical Power System	7	21 (2)	38 (1)	18 (3)
2	Energy Management	10	-	-	22 (1)
3	Electric Power Automation System	10	18 (4)	13 (3)	20 (3)
4	Protection System	5	21 (2)	39 (1)	9 (3)
5	Utilization of Electrical Energy	6	-	-	23
6	Management of Vocational Education and Training	6	-	-	-
7	Curriculum Development for Vocational Training and Education	8	-	-	-
8	Vocational Learning Model	7	-	-	-
9	Evaluation of Vocational Learning	7	-	-	-

The data analysis technique used in this study is descriptive analysis by taking the mode value. Descriptive analysis is intended to interpret the description of the data represented by the respondents' answers. Data processing was carried out with the help of SPSS and Excel programs. The results of the research data are presented in graphs and the mode frequency distribution is in the form of a percentage (%). Empirical data is obtained from the number of essential competence items from the two course groups as shown in Table 2. Empirical data were analyzed based on four categories, namely: highly relevant (score 4), relevant (score 3), less relevant (score 2), and irrelevant (score 1).

FINDINGS AND DISCUSSION

Findings

Essential Competences Data for Vocational and Expertise Course Groups

Data obtained from vocational and expertise groups, this data is grouped based on two groups of courses, namely: (1) Groups of expertise courses, which consist of courses: electric power systems, energy management, electric power automation systems, electrical energy utilization protection systems, and utilization of electrical energy; and (2) Vocational course groups, which consist of courses: vocational education and training management, vocational training and education curriculum development, vocational learning models, and vocational learning evaluation. Obtaining data on essential competences from these course can be seen in Table 3.

Table 3. Essential Competences Data for Expertise and Vocational Course Groups

Course Group	Course	Category (%)		
		High Relevant	Relevant	Less Relevant
Expertise	Electrical Power System	70	30	0
	Energy Management	70	20	10
	Electric Power Automation	70	10	20
	Protection System	70	20	10
	Utilization of Electrical Energy	70	30	0
Vocational	Management of Vocational Education and Training	60	40	0
	Development of Vocational Education and Training Curriculum	60	40	0
	Vocational Learning Model	70	30	0
	Evaluation of Vocational Learning	60	40	0

Essential Competences Data for Expertise Group Based on SKKNI

Data obtained from the electricity engineering group based on SKKNI. This data is derived based on groups of expertise course areas, which consist of courses; electric power systems, energy management, electric power automation systems, electrical energy utilization protection systems, and electrical energy utilization in terms of competence units in the SKKNI. Data acquisition on the essential competences of this course group against SKKNI can be seen in Table 4.

Table 4. Essential Competence Data for Expertise Course Groups with SKKNI

No.	Course	Relevancy Level of SKKNI (%)								
		Transmission			Distribution			Utilization of Electrical Installation		
1	Electrical Power System	0	100	0	33	67	0	0	100	0
2	Energy Management	0	0	0	0	0	0	33	67	0
3	Electric Power Automation	67	33	0	33	67	0	33	67	0
4	Protection System	33	67	0	33	33	33	33	67	0
5	Utilization of Electrical Energy	0	0	0	0	0	0	33	67	0

Discussion

Essential Competences for Vocational and Expertise Course Groups

Research data related to the contribution of essential competences in the expertise course groups can be illustrated in Figure 2. Overall, Figure 2 can be explained that all essential competences in the skill course groups contribute by an average percentage of 70% which is included in the "Highly Relevant" category. Yet there are two courses that have essential competences that are "Less Relevant" by 10%, namely the energy management and protection systems course, and essential competences that are "Less Relevant" by 20% in the electric power automation system course.

Based on the data in Figure 2, those can be stated that some of the expertise course groups essential competences (70.0%) in the S2-PTE study program are be able to contribute to jobs in the field of electrical engineering education and training.

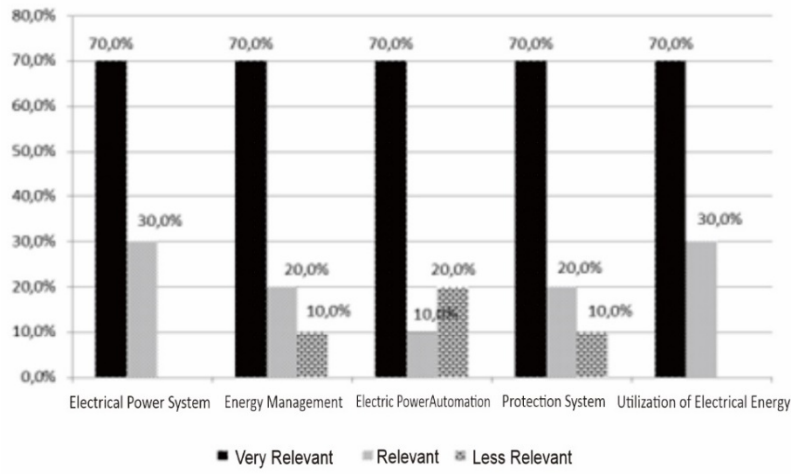

Figure 2. Contribution of Expertise Course Groups

Research data related to the contribution of essential competences in the vocational course group can be illustrated in Figure 3. Overall in the Figure 3, those explains that all essential competences in the vocational course groups contribute by an average percentage of 62.5% which is included in the "Very Relevant" category and an average of 37.5 which is included in the "Relevant" category. These mean that all the essential competences in the vocational course groups have a contribution to job in the field of electrical engineering education and training.

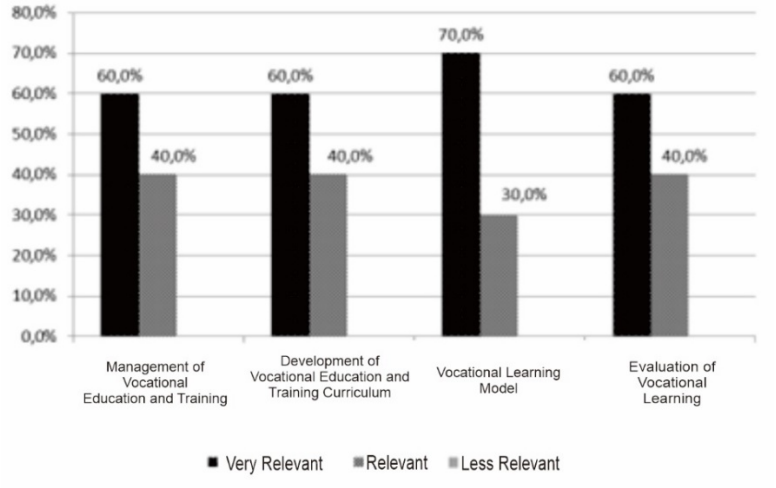

Figure 3. Contribution of Vocational Course Groups

Essential Competences for Expertise Course Groups Based on SKKNI

There are five courses included in this group, namely: electric power systems, energy management, electric power automation systems, protection systems, and electrical energy utilization. The electric power system course has 7 essential competences, and it is related to the competences in the SKKNI subfields of transmission, distribution and utilization of electrical installations with 21, 38, and 18 competences respectively. The energy management course has 10 essential competences, and it is related to competences in the SKKNI installation subfield of 22 competences.

The electric power automation system course has 10 essential competences, and it is related to the competences in the SKKNI subfields of transmission, distribution and utilization of electrical installations with 18, 13, and 20 competences respectively. The protection systems course has 5 essential competences and it is related to the competences in the SKKNI subfields of transmission, distribution, and utilization of electrical installations with 21, 39, and 9 competences respectively. The electrical energy utilization course has 6 essential competences and it is related to competences in the SKKNI subfield of installation utilization as many as 23 competences.

Research data related to the contribution of the electric power system's essential competences with SKKNI can be illustrated in Figure 4. Figure 4 explain that the essential competences of this course have contributed to the competences of transmission, distribution, and utilization of electrical installations in SKKNI respectively: 100% in the “Relevant” category, 66.7% in the more than “Relevant” category, and 100% in the “Relevant” category. Based on the Figure 4, the data can be stated that the essential competences in the electric power system course have relevance to electricity work based on the competences in SKKNI.

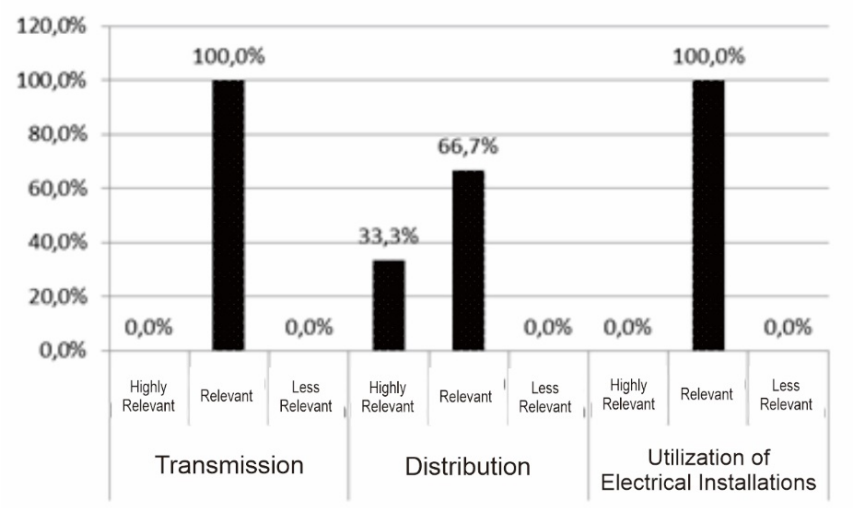

Figure 4. Contribution of the Electric Power System in SKKNI

Research data related to the contribution of the energy management's essential competences with SKKNI can be illustrated in Figure 5. In SKKNI this course is only related to the subfield of electricity installation utilization. Referring Figure 5, the data can be explained that the essential competence of this course has a contribution to the competence of utilizing electrical installations in SKKNI by 66.7%, so this is categorized as more than "Relevant". Based on Figure 5 can be stated that the essential competences in the energy management course have relevance to electricity work based on the competences in SKKNI.

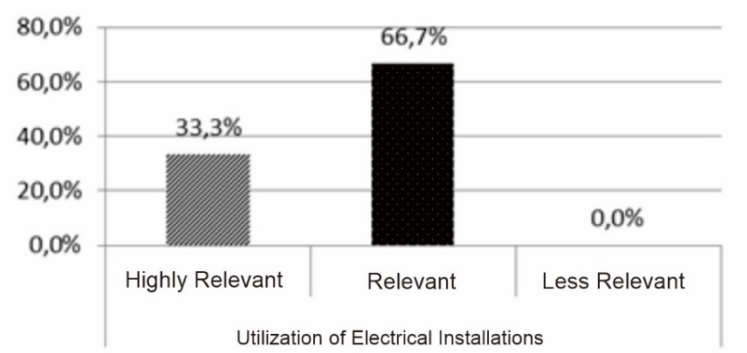

Figure 5. Contribution of Energy Management in SKKNI

Research data related to the contribution of the electric power automation system's essential competences with SKKNI can be illustrated in Figure 6. Refer to Figure 6, the data can be explained that the essential competences of this course have contributed to the competences of transmission, distribution and utilization of electrical installations in SKKNI respectively: 66, 7% in the "Highly Relevant" category, 66.7% in the more than "Relevant" category, and 66.7% in the more than "Relevant" category. Referring from Figure 6, it can be stated that the essential competences in the electric power automation system course have relevance to electricity work based on the competences in SKKNI.

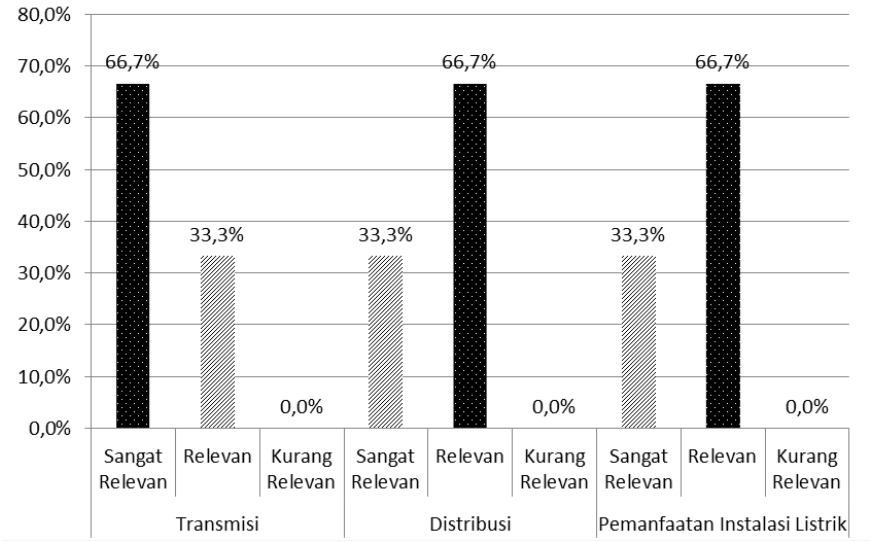

Figure 6. Contribution of the Electric Power Automation System in SKKNI

Research data related to the contribution of the protection system's essential competences with SKKNI can be illustrated in Figure 7. Based on Figure 7, the essential competences of this course have contributions to the competences of transmission, distribution, and utilization of electrical installations in SKKNI respectively: 66.7% are in the more than "Relevant" category, 66.7% are in the more than "Relevant" category, 33.3% are in the "Less Relevant" category, and 66.7% are in the more than "Relevant" category. Based on Figure 7, some of the expertise course groups in the S2-PTE study program can contribute to jobs in the field of electrical engineering education and training.

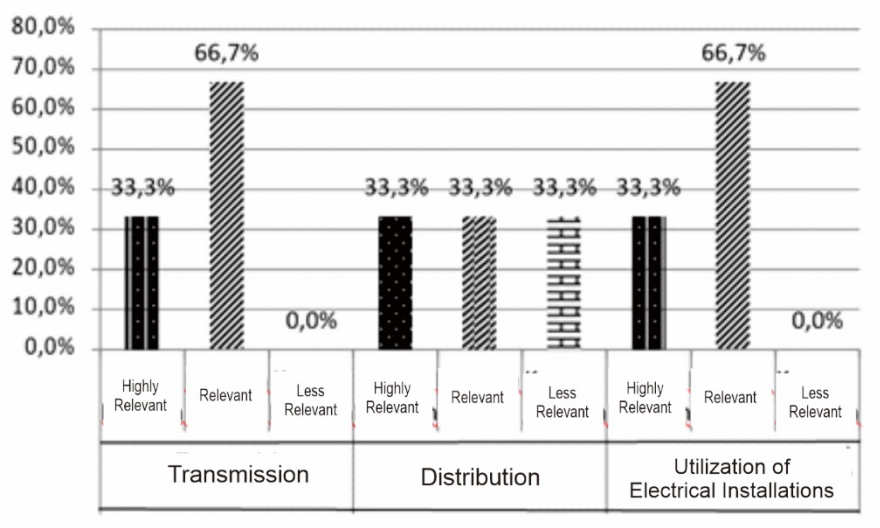

Figure 7. Protection System Contribution in SKKNI

Research data related to the contribution of the energy management's essential competences with SKKNI can be illustrated in Figure 8. Based on Figure 8, the data can be explained that the essential competence of this course has a contribution to the competence of utilizing electrical installations in SKKNI by 66.7% in the category of more than "Relevant".

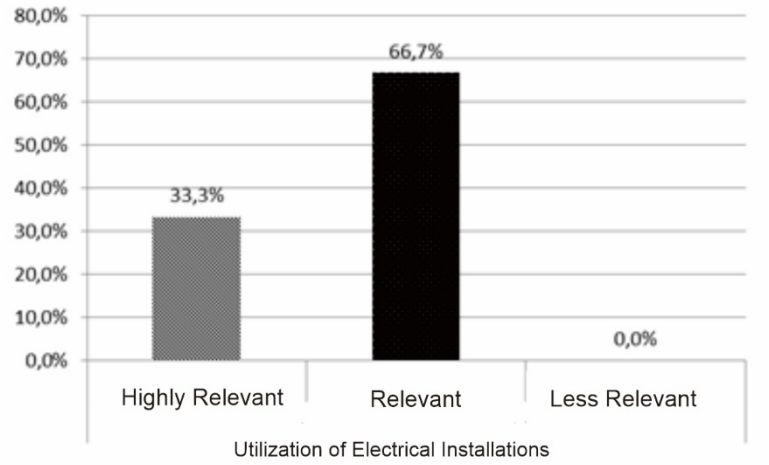

Figure 8. Contribution of Electrical Energy Utilization in SKKNI

The description of the essential competences of the five courses in the course group of expertise above can be concluded that the essential competences in the courses; electric power systems, energy management, power automation systems, protection systems, and electrical energy utilization have a contribution of more than 66.7 % including more than the "Relevant" category, but the protection system course's essential competence in the electrical installation utilization subfield is still being studied further because it is included in the "Less Relevant" category by 33.3%.

CONCLUSION

Based on the analysis and discussion of the study results, it can be concluded as follows. First, all essential competences in the expertise course group have a contribution by 70.0%, each included in the "Very Relevant" category, and all essential competences in the vocational course groups have an average contribution by 62.5% which are included in the "Very Relevant" category, and an average of 37.5% which is included in the “Relevant” category. These mean that all essential

competences in the expertise and vocational course groups in the electrical engineering education Master Program have a contribution to a work in the field of electrical engineering education and training. Second, all courses in the course groups of expertise, which include: electric power systems, energy management, electric power automation systems, protection systems, and electrical energy utilization have contributed more than 66.7%, so they are included in the "Relevant" category. However, the essential competences in the protection system course of the electrical installation utilization subfield still need to be studied further because it is included in the "Less Relevant" category. Thus all the essential competences in the expertise course group of the electrical engineering education study program have a contribution to a work in the electricity sector based on the SKKNI.

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Smart learning model in technical and vocational education training with webcast technology

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ABSTRACT

This research aims to develop an e-learning strategy for the industrial revolution 4.0 era by developing an innovative and adaptable TVET learning model using Webcast technology. This approach highlights the blended learning model developed as a smart learning model featuring a balance between synchronous and asynchronous learning using webcast technology. Research and development method is used in this approach. The model design is done by literature study and focus group discussion with experts and academicians. The model effectiveness trial results were measured with an experimental design (using the one-group pretest-posttest and posttest-only method with nonequivalent groups). The results of developing a smart learning model of TVET webcast technology describe: (1) How the learning rules are used; (2) How to connect with webcasting technology; and (3) What are the stages and steps of the webcasting-based smart learning model? The proposed model approach allows for simultaneous learning interactions in synchronous and asynchronous classes in various locations, thus triggering student engagement in learning activities and enhancing different learning styles, ways of thinking, and problem-solving skills.

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INTRODUCTION

Quality education is seen as important in the current competitive environment of the Industrial Revolution 4.0. According to Triyono (2017), Industrial Revolution 4.0 or the 4th World Industrial Revolution includes social inclusion, human life, robotics, quantum computing, biotechnology, 3D printing, vehicle automation, internet and virtualization and has underlying technological characteristics. Science. System. with global cooperation. This condition applies to professional courses that prepare graduates for professional activities, especially for the role of teacher (Triyono, 2017). In order to improve the quality of education, various studies are conducted. These include the best teaching strategies; effective and efficient (Picard, 2004; Shinn, 1997), the best teaching methods, reflection and reflection (Biesta, 2009; Effiong & Igiri, 2015; Kapi et al., 2017; Lazar, 2015; Navaneedhan, 2010; Westbrook et al., 2013).

To address the issue of quality education, educational strategies that use technology-enabled devices seem to be the right solution. Expanding access to quality education through online learning technology is the best solution. Online learning in Indonesia, known as distance learning or *pendidikan jarak jauh* (PJJ), has now become an integral part of Indonesia's educational landscape

and provides access to education for the community (Mukarromah & Wijayanti, 2021). This situation opens up opportunities and challenges for universities for active distance learning in the 21st century.

To answer the rapid development of the times in the 21st century, learning must be planned in such a way as to achieve 21st-century competencies. According to Kusmawan (2014), classroom characteristics that describe competencies in the 21st century fulfill four characteristics that distinguish it from the previous century, namely: Integrating digital communication into learning, collaboration, critical thinking and creativity, and innovation. The inclusion of digital communication as a key area of 21st-century learning skills provides the basis for the importance of research in this discussion. Issues related to equity and democratization of education and the expansion of access to quality education at all levels of society have long been a concern of the government and are one of the main areas of the National Research Master Plan 2017-2045 and the Strategic Plan of Universitas Negara Padang 2020-2025. The model provided aims to support the realization of the strategic plan and Universitas Negeri Padang, especially as an IT-based learning development subject in the field of educational and educational technology excellence.

Issues related to the expansion of access to quality education to all levels of society through PJJ have been addressed wisely by the government through various legal instruments that have been issued, including Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 109 of 2013 concerning the Implementation of Distance Education in Higher Education, Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System and Government Regulation Number 17 of 2010 concerning Management and Implementation of Education which was later amended by Government Regulation Number 66 of 2010 and Law Number 12 of 2012 concerning Higher Education. Legally based on the Regulation of the Minister of Education and Culture Number 109 of 2013 distance learning aims to provide higher education services to groups of people who cannot attend face-to-face education and expand access and facilitate higher education services in learning.

Thus, it can be interpreted that PJJ is an education system that has the characteristics of open, independent, and complete learning by utilizing ICT and/or other technologies and/or integrating learning in higher education. In its development, the distance education system greatly benefits from the development of media, information, and communication technology that can bridge the need for mass education. Higher education then strengthens the implementation of online learning (synchronous) through the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia No. 51/2018. The rapid development of technology has given rise to a flexible and smart distance education model, and we introduce it as Smart Learning. It is called smart learning because distance education has a learning strategy that is able to open access to education for anyone, anywhere, and anytime by crossing the boundaries of space and time and overcoming various socio-economic barriers.

In order to build various intellectual talents in students, proper smart learning implementation techniques are required, as shown in Figure 1. This strategy should combine online and face-to-face approaches both separately and together, as shown in Figure 1, to enhance the knowledge and skill capacity of students with diverse abilities. 1, to enhance the knowledge and skill capacity of students with diverse abilities. In this study, through 2 scenarios of teaching methods, the learning model is designed to adopt a blended learning model that balances synchronous and asynchronous online face-to-face learning together.

This intelligent learning model can be achieved through modeling the trial use of webcast technology in an intelligent classroom learning environment. The proportion of instruction in each form varies widely and isstrongly influenced by the role of the trainer in facilitating learning. E-learning has developed into a learning process, not limited to a static and independent one-way learning process. The e-learning learning environment indirectly encourages students to learn more actively (Gumilar & Hermawan, 2021). It has undergone a series of studies at Universitas Negeri Padang, particularly at the faculty of engineering. As shown in Figure 2, the electronics engineering department, one of the departments in Faculty of Engineering, Universitas Negeri Padang (FT UNP) as a vocational education institution, already has the supporting devices and environment for smart classrooms (Huda et al., 2019, 2021; Huda & Hayadi, 2017; Novaliendry et al., 2020; Rukun et al., 2019).

Figure 1. Synchronous and Asynchronous Learning Models by AverExpert (Hastings, 2018)

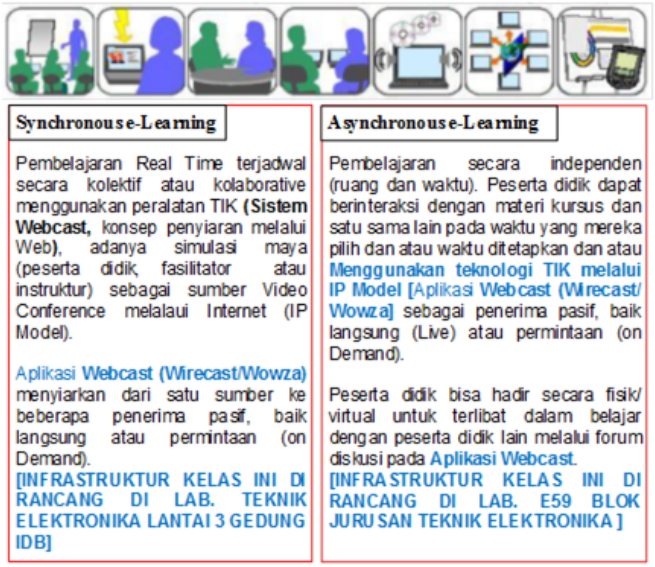

Figure 2. Synchronous (Live) dan Asynchronous (on Demand) Learning

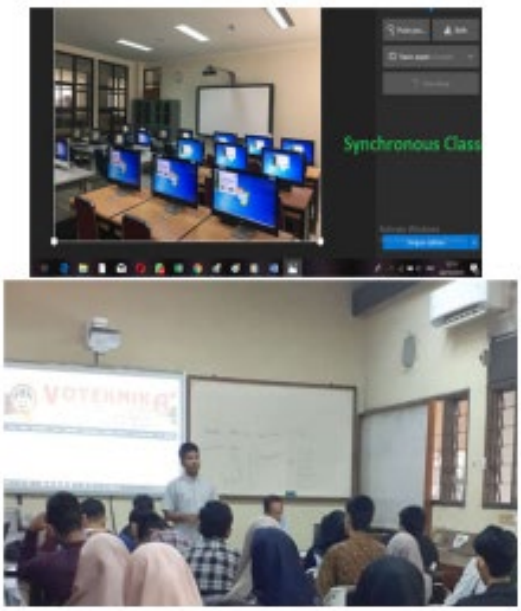

Figure 3. Implementation Webcast Technology in the Department of Electronics FT UNP (Rukun et al., 2019)

This approach highlights a blended learning model developed as an intelligent learning model featuring a balance between synchronous and asynchronous learning by using student smartphone or tablet webcasting technology. The outcomes of the development of the webcast technology TVET intelligent learning model are revealed through the research questions (1) How the learning rules are used; (2) How to connect to webcasting technology; and (3) What are the stages and steps of the webcasting-based intelligent learning model?

The proposed model approach allows for simultaneous learning interactions in synchronous and asynchronous classrooms at various locations, thus triggering student engagement in learning activities and enhancing different learning styles, thinking and problem-solving abilities.

RESEARCH METHOD

This type of research is development research (Educational Research and Development, R&D), with the direction of finding and developing learning models as intelligent learning. In the model trial conducted after revising the model based on the analysis of the limited trial results and feedback, the number of participants involved was 1 lecturer and 45 students (natural work setting in 1 synchronous class and 2 asynchronous classes). This field trial was conducted in a real learning situation by forming a practicum learning class so that developer interaction with related experts was needed.

The measurement of the results of the model effectiveness trial following the experimental design is shown in Figure 4.

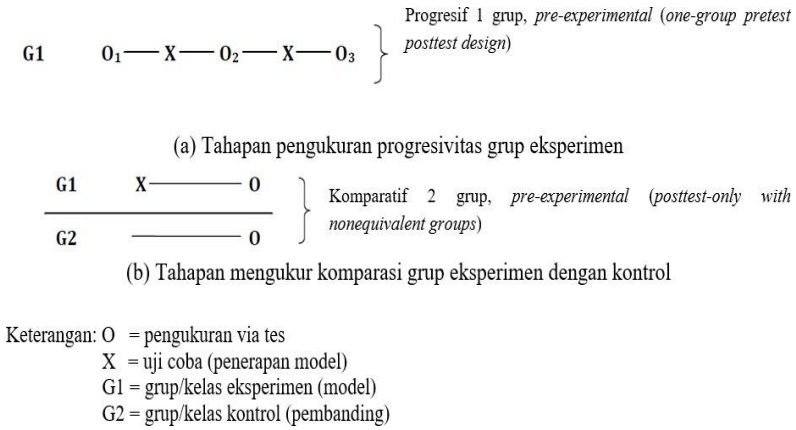

Figure 4. Experimental design for Smart learning development model in TVET with webcast technology (Creswell, 2009)

The concept of smart learning models using webcast technology can be applied to both asynchronous and synchronous classes in different locations. Asynchronous learning allows students to engage with course material at their own pace, while synchronous learning involves learners and instructors being in the same place at the same time. A blended approach that combines both types of learning can be effective in improving the online learning experience.

FINDINGS AND DISCUSSION

How learning rules are used?

In order to be orderly and successful during the online learning process in this Smart Learning Model, surely ethics/attitudes are needed that can be understood and agreed upon by the participants of online learning, as can be seen in Table 1.

Table 1. Ethics/Attitudes Needed by The Participants of Online Learning

No.	Ethics/Attitudes	Explanation
1	Setting the Device Up Properly	Make sure you have access to and are properly set up with computer hardware, USB headphones, and microphones while preparing synchronized online sessions.
2	Explanation	Be proactive in approaching teachers for assistance with coursework issues and setting up IT for technical problem-solving.
3	Keep Your Options Open	Be open to sharing your own opinions while also listening to other's opinions about your work and the work of your fellow participants, even if they offer unfavorable advice from time to time.
4	Taking Time	The capacity to think things through before replying to others.
5	Respond quickly and in a clear manner.	Respond to emails sent by other participants and engage in synchronous and asynchronous discussions with them.
6	Be Honest in Your Comments	Be receptive to feedback from other participants and don't assume that it's negative; rather, assume that it's constructive and encouraging.
7	Discipline and Responsibility	By giving yourself the time to read, participate in, and explore the course material, you discipline yourself and are in charge of controlling your own learning.
8	An association that is sincere, respectful, and open	When corresponding with other participants, maintain an open, polite, and sincere relationship.
9	Control Your Time	By giving yourself the time to read, participate in, and explore the course material, discipline and self-management of your own learning are emphasized.
10	Limit each other while remaining open to alternative debate topics.	As long as they don't distract from anyone's work, side conversations are encouraged during synchronous sessions in this course.
11	Concentrate the conversation on recent references	Focus on recent citations from books or journal articles, usually from the past 5 to 7 years, unless the chosen older work is frequently cited by more recent works.

Source: (International Labour Organization (ILO) & United Nations Educational Scientific and Cultural Organisation (UNESCO), 2002; Mahazir et al., 2015)

How to connect to webcasting technology?

To connect to webcast technology, you must use a webcast application or encoder. Webcast encoders are available from online webcast manufacturers for a range of uses, such as webinars and education. Wowza, Zoom, Wirecast, Youtube, Skype for Business, Meet with Google Hangouts, Cisco WebEx, GoToMeeting, and Join.me are all listed but not discussed in this section because it explains how the encoder is used. The following tasks must be completed as connection preparations for the webcast to be a successful learning tool before, during, and after the webcast event (Burns, 2020; Yunus et al., 2006).

Step 1: Pick Your Audio and Video Sources

The first step in streaming for the first time is choosing a video source as a content source that can be converted to digital format. Use a camera with an output like HDMI, HD-SDI, or Component, if possible. Depending on how complex it is (multiple cameras), the intended broadcast may use one video source or a number of video streams that switch back and forth. Choose a professional camera and an isolated microphone that can be placed in the best location if you want better results. For audio, this can come from inside the camera or from a different audio capture device, like a standalone microphone.

Step 2: Choose an Encoder

An encoder for turning audio-video content into a format that can be broadcast over the Internet is called webcasting. Encoders can be based on hardware or software. The encoder will always receive input from the video and audio sources. The encoder will then be broadcast to the associated streaming URL for the chosen shipping method. For instance, the webcast used must support RTMP (Real Time Messaging Protocol) if the video solution only accepts this protocol.

Step 3: Choose a Delivery Method

Choosing a delivery method depends on the purpose of the content distribution. If the webcast needs to be secured, the content provider (lecturer) has the option to limit access. Security is a concern because the restriction is particularly severe if the webcast must be internal (personal) only. The sending method must be flexible enough to accommodate a large number of participants, and the security system becomes scalable. Because flash is typically incompatible with cellular, RTMP-based encoders will only be able to reach participants who have a Flash-based player and will exclude participants who are using cellular.

Transcoding is necessary to make the flow mobile device compatible and to reach these participants. Adaptive streaming bitrate, a method of presenting different bitrate and resolution combinations of video content based on the connection speed of the viewer, ensures that participants can watch content at their connection speed. Current mobile-friendly delivery methods like HLS (HTTP Live Streaming) include this technology as a component.

Step 4: Secure the Internet Connection

The key action is protecting an Internet connection. Webcasts need a dependable and quick internet connection. The caliber of the broadcasted content affects how quickly a connection is required. Securing upload speeds that are roughly twice as fast as the intended content bitrate is a good general rule. The upload speed must be 2 Mbps if you want to stream at 1 Mbps. A faster connection speed will be needed if you use a service that calls for sending higher bitrates through the encoder. Although in this case all the bitrates must be added, speed is based on quality. For instance, if someone provided inputs of 2.5Mbps, 1Mbps, 500 kbps, and 250 kbps, the combined speed would be 3.25Mbps. A 6.5 Mbps upload speed will therefore be necessary. This is why it's advised to use cloud transcoding to produce additional bitrates for live content.

Step 5: Configure the Webcast Encoder

Configuring the webcast encoding is the final step. This step depends on the sending strategy and connection speed.

What are the phases and steps of the webcasting-based smart learning model?

The nine facilities and learning steps that make up the offered smart learning model are shown in Table 2. The formal limited trial was conducted for 4 (four) meetings (1 synchronous class in the laboratory and 2 asynchronous classes). The initial meeting was used to explain the concept and implementation of the model along with the learning modes contained therein. The researcher assumed that the participants (students) who had been selected as test subjects had a fairly good initial knowledge of informatics systems, because they had attended the specified conditional lectures.

After the limited trial and efforts to ensure the readiness of the smart learning model for expanded trials, the researchers measured the perceptions of lecturers and students on the effectiveness of learning on the model. By using the instrument, a description of the lecturers' perceptions or assessments of several aspects of the implementation of learning on the model is summarized as Table 3.

Table 2. Smart Learning Model on Webcast Technology

Activity Number	Learning on Webcast Technology	Activities on the Smart Learning Model	Literatur Study
1	Lecture online easily: Simple ways for lecturers and teachers to schedule online lessons	By clicking "webcast," lecturers can easily convert any presentation into an online lecture program. They can also save time during the preparation process by using the special recording feature of Encoder Webcasting.	Yunus et al. (2006)
2	Online lectures are available anywhere, at any time: Access to lectures anywhere and at any time with an ID code	When using webcasts, students can access their course's online lecture rooms from any location at any time as long as they have their ID code.	Shah (2023); Simamora (2020)
3	Online lecture room settings: customize the learning page (online lecture room) lecturer	Lecturers can create learning pages (online lecture rooms) for students before landing pages for online lectures begin, so when they arrive early for the lecturer webcast, they will still know that they are in the right online lecture room.	Wallick et al. (2004)
4	Active and interactive learning: digital notes and interactive frequency ask questions (online)	Allows for active learning. During the webcast, students can post digital comments and ask the lecturer, teacher-student, student-student, or student-lecturer questions.	Amoudi and Tbaishat (2023); Basar et al. (2021)
5	Review of the live event: Assessment of learning outcomes	Students can assess their progress in synchronous online college learning, their level of participation during and after the webcast, and other student activities.	Hokanson et al. (2019); Raouna, (2022)
6	Pause and replay lecture material: DVR (encoder webcast) playback and pause controls	Students can find the last point of the video watched (video material followed). Students can rewind their live feed on DVR in a similar fashion to TiVo and then immediately find it again.	Ahmad and Begen (2009); Solari (2000)
7	Online lecture index that can be searched: Video recording index for search	Students will not lose course material. Every word uttered by a lecturer or instructor is automatically indexed by a webcast and displayed on the screen in a student broadcast, ensuring that the student webcast recordings are complete.	Chang et al. (2007); So (2002)
8	Live streaming multi-camera for learning	Webcasts deliver high-quality multi-camera playback on any device without the need for third-party browser plugins when using HTML5 or higher.	Duhamel, (2023); Mattamala et al. (2021)
9	Streaming live video to a smartphone or tablet	Anywhere in the world, students can participate in live webcasts of online lectures. On Android and iOS, users can stream live videos to their mobile devices using the webcast application.	Chaves et al. (2017); Gomes (2019)

Table 3. Lecturer Assessment of Learning Effectiveness

No.	Aspect of Assessment	Assessor (Lecturer)				Score (%)	Average Score
		A	B	C	D		
1	Validity aspect	12	11	12	12	97,92	3,92
2	Reliability aspect	4	3	3	3	81,25	3,25
3	Objectivity aspect	11	10	11	11	89,58	3,58
4	Practicality aspect	7	7	7	7	87,50	3,50
	Total Average					87,50	3,50

In general, lecturers assessed that the smart learning model with webcast technology developed can improve students' abilities. It allows for simultaneous learning interaction in synchronous and asynchronous classes at various locations, triggering student engagement in

learning activities and increasing different learning styles, thinking and problem-solving skills. Lecturers also assessed that the stages and steps of implementing learning in the model and all its devices would be easy to implement (the practicality aspect almost reached 90%). Similarly, the aspect of the suitability of the model to the efforts to achieve the objectives and the accompanying impact of the model itself. On the other hand, lecturers have little doubt about the suitability of the learning and strategies offered by MPIT-SMC, with a variety of other courses (reliability aspect at 81.25%). Although the average score of this aspect is 3.25, in terms of model development, this still needs attention.

Table 4. Student Assessment of Learning Effectiveness

No.	Aspect of Assessment	Rater						Score (%)	Average Score
		A	B	C	D	E	F		
1	Validity aspect	7	7	6	7	7	7	85,42	3,42
2	Reliability aspect	3	2	3	3	3	3	70,83	2,83
3	Objectivity aspect	11	11	12	11	11	11	93,06	3,72
4	Practicality aspect	6	8	6	6	7	7	83,33	3,33
	Total Average							83,16	3,44

In line with the lecturers, the assessment of students who were the subjects of the model trial also gave more or less the same results. The most prominent aspect of student assessment is the objectivity of learning. This aspect is considered very important considering that students as learning actors give a very positive perception (93.06% or an average score of 3.72) of the model. Students also assessed that the model is quite practical and able to improve student competence as its main target (synchronous and asynchronous classroom learning interactions in various locations, triggering student involvement in learning activities and improving different learning styles, ways of thinking, and problem-solving abilities), although they have doubts about the suitability of the model for various courses. Table 4 illustrates this more fully. In general, from the students' point of view, the model is considered effective for improving students' competencies with a good level of practicality and efficiency.

CONCLUSION

In conclusion, the analysis of the effectiveness of the model has proven that the results of the development of the TVET smart learning model using webcast technology are important to pay attention to several stages: (1) How the learning rules are used; (2) How to connect with webcasting technology; and (3) What are the stages and steps of the webcasting-based intelligent learning model. The model approach proposed in Table 2 is proven to be able to trigger learning interactions simultaneously in synchronous and asynchronous classes in various locations, trigger student involvement in learning activities and improve different learning styles, ways of thinking and problem solving abilities according to the data in Table 3 and Table 4. This research is supported by previous studies that also explored how webcasting can be used to increase student engagement, improve learning outcomes, and support different learning styles (Chen et al., 2021; Cheung et al., 2021; Dimitriadou & Lanitis, 2023; Li et al., 2016). The future direction of vocational education research related to smart learning with webcast technology, it is important to consider the technical challenges and constraints that may be associated with the use of webcasting, such as unstable internet connections, accessibility, and the need for appropriate hardware. Furthermore, it relates to learning strategies: which includes research on how to effectively integrate webcasting technology into different learning strategies, such as blended learning, flipped classroom, and distance learning.

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Paving the way for integrated STEAM-H education in agricultural product processing vocational high school

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ABSTRACT

The increasing boundaries of agriculture and health disciplines in STEM to STEAM-H (Science, Technology, Engineering, Agriculture, Mathematics, and Health) is an opportunity for the world of education to expand integration between disciplines for solving increasingly challenging and complex problems. The Agricultural Product Processing Program, one of the spectrums of vocational education in Indonesia that focuses on agriculture, is located in the STEAM-H area. Therefore, this study aims to explore cross-subject connections, essential concepts, and teacher beliefs to implement integrated learning. This study used a qualitative approach with a case study design. Data were collected through interviews and documents. Participants were teachers at SMK Agrotechnology Processing Agricultural Products in Ciamis, Indonesia. Descriptive analysis was carried out on the standard subject matter of agribusiness, mathematics, and science to obtain an overview of interdisciplinary connections in STEAM-H and the essential concepts within it. The findings of this study are that mathematics and science have a role in processing agricultural products subject, as indicated by the existence of conceptual connections in them. Concepts of processing products of agriculture become conceptual and contextual integrators of science and mathematics. The essential concepts of mathematics and science are either explicit or implicit, within or outside the secondary school curriculum set by the government. Based on the participants' beliefs, integrated STEAM-H in learning can be carried out at agribusiness vocational schools. This finding has implications for integrated STEAM-H learning planning that requires further research.

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INTRODUCTION

Toni (2014) introduced STEAM-H (Science, Technology, Engineering, Agriculture, Mathematics, and Health) as an extension of the boundaries of multidisciplinary research. Agriculture and health are additional disciplines of STEM that have been popular. STEM education has been widely researched and developed beyond STEM disciplines with various objectives. Khine and Areepattamannil (2019) have integrated arts in STEM into STEAM as an effort to help students

understand analytical concepts through the use of creativity. Vallera and Bodzin (2020) have integrated agriculture through the STEM program with AgLIT (Agricultural Literacy Through Innovative Technology) to increase agricultural and STEM literacy. Denner (2020) has integrated health in STEM to find creative solutions to dealing with the Covid-19 problem.

Perceptions of STEM education experience many interpretations. Li (2014) views STEM education as subject-based education or as integrated STEM education. The discipline-based STEM approach defines the concepts and skills in each discipline separately. Gao et al. (2020) view STEM based on the nature of scientific disciplines, so three categories of STEM integration are monodisciplinary, interdisciplinary, and transdisciplinary. English (2016) views STEM based on its increased integration, so four classifications of STEM education are disciplinary, multidisciplinary, interdisciplinary, and transdisciplinary approaches.

The pattern of interdisciplinary integration has developed a lot. English (2016) explained that this pattern emphasizes the features of integration between two or more interconnected disciplines that study concepts and skills. Furthermore, Gao et al. (2020) explain that interdisciplinary is an effort to build relationships (knowledge and skills) between various disciplines to solve complex and sophisticated problems. Roehrig et al. (2021) explained that before implementing an interdisciplinary approach, we need to look at the nature of disciplinary integration to synchronize cultural differences between disciplines (differences in terminology, notation, and sign conventions).

Implementation of an interdisciplinary approach refers to the diversity of situations and goals. Barrett et al. (2014) integrated meteorological and engineering material presented in a module for junior and early secondary school students to increase learning achievement. Ku et al. (2022) tested high school students' STEM integration behavior at a national technology competition. Wang et al. (2020) explained that implementing an interdisciplinary approach requires confidence and preparation from teachers and their teams to set learning objectives and collaboration structures. Teachers also need to know the impact of STEM implementation on their institutions (Evans et al., 2019). However, the results of the study report that the implementation of integrated STEM has several challenges (pedagogical, curriculum, structural, and assessment), there are concerns about student and teacher support (Margot & Kettler, 2019), and a lack of confidence in implementation (Shernoff et al., 2017).

Based on the development of integrated STEM, integrated STEAM-H education can be an opportunity to be implemented for vocational schools engaged in agriculture. In Indonesia, vocational high schools in agriculture are agribusiness and agrotechnology with expertise programs consisting of crops, livestock, fisheries, processing of agricultural products, integrated agricultural businesses, and forestry (Minister of Education Culture Research and Technology of the Republic of Indonesia, 2022a). Each program has a more specific concentration. This research focuses on processing agricultural products.

By referring to the integrated STEM framework that has been developed by Kelley and Knowles (2016), English (2016), Gale et al. (2020), and Roehrig et al. (2021), integrated STEAM-H may become a new trend of multidisciplinary research in the world of education that supports elements of life. As an initial step in the development of integrated STEAM-H education, this research explored the connections of each subject involving the STEAM-H discipline, the important concepts of the curriculum, the nature of STEAM-H integration, and the beliefs of teachers to integrate several subjects and themes the integrator. The results of this study contribute to addressing barriers regarding pedagogical aspects, quality curricula, implementation effectiveness, and student, teacher, and teacher support in integrated learning (Margot & Kettler, 2019), which still require solutions..

RESEARCH METHOD

Paving the way to integrate STEAM-H in this study used a qualitative approach with a case study design. The research involved teachers at the agricultural product processing vocational high school in Ciamis District, Indonesia. Two schools organize this program. Participants are teachers in agriculture, mathematics, and science (physics, chemistry, biology). The agricultural discipline

teachers are teachers who teach according to the program or concentration of expertise and are better known as productive teachers. Table 1 shows the characteristics of the participants.

Table 1. Characteristics of Participants

Participants	Teaching Specification	Gender	Age (Year)	Length of Teaching (Years)	Ever used teaching STEM?
P1	Vegetable product processing	Female	27	1	Yes
P2	Basic techniques for handling agricultural products	Female	37	1	Yes
P3	Processing of animal products	Female	52	12	Yes
P4	Plantation processing	Female	26	4	No
P5	Processing of animal products	Female	61	4	No
P6	Basic quality control of agricultural products	Female	25	1	No
M1	Mathematics	Female	29	6	No
M2	Mathematics	Female	48	20	Yes
M3	Mathematics	Female	30	1	No
F1	Physics	Male	33	1	No
F2	Physics	Female	30	5	No
C1	Chemical	Male	33	7	No
C2	Chemical	Female	30	5	No
B1	Biology	Male	56	34	Yes
B2	Biology	Female	30	5	No

Participants received open-ended questions about the connection between the materials/concepts of agribusiness, mathematics, and science subjects (physics, chemistry, and biology). The concept comes from the content standards of secondary school education currently in force in Indonesia (Minister of Education Culture Research and Technology of the Republic of Indonesia, 2022b). Participants analyze the connections concepts by identifying the roles of mathematics, physics, chemistry, and biology in the standard content of agribusiness subjects. Extracting these connections aims to make STEAM-H connections more explicit and meaningful across disciplines and classes. The results of the analysis are then used to develop an understanding of the interaction between integrated content, skills, and ways of thinking (English, 2016), as well as to explore the important components of the curriculum (Gale et al., 2020), the central concept in each subject, as well as the nature of STEAM-H integration (Roehrig et al., 2021). Themes are core terms from curriculum content standards. Table 2 describes the themes of the core terms of the curriculum content standards.

Table 2. Integrator Theme

Theme	Code	Material scope
Health, work safety, and environmental conservation	HSE	Concepts, principles and procedures for occupational health and safety, first aid in accidents, personal protective equipment, environmental conservation
Business processes	Business	Industry classification, business scope, product planning, production process, marketing, equipment repair and maintenance as well as human resource management, logistics, job profile
Basic cultivation or production techniques	Production	Size reduction (cutting, slicing, grating, chopping, crushing, and grinding), thermal processes (cooling, freezing, pasteurization, sterilization, drying, roasting, roasting, and frying), chemical and biochemical processes (salting, sugaring, acidification/fermentation)), and separation processes (sifting, filtering, distillation, extraction, precipitation, agglomeration and evaporation)
The use of technology	Technology	Tools, product development and global issues
Entrepreneurship development	Entrepreneurship	Identification of business ideas/types, calculation and risk taking in developing and managing businesses, business management by utilizing knowledge and skills in the field of plant agribusiness expertise
Waste management	Waste	Handling solid waste, liquid waste, and hazardous and toxic waste

The scope in Table 2 is the conceptual basis for processing agricultural products in the curriculum. These concepts become interdisciplinary integrators in STEAM-H. To find out the connection between mathematics and science, the question: "What is the role of each math and science lesson on the basic concepts of agribusiness?". Figure 1 describes the flow of data analysis. The results of data analysis are the essential concepts of mathematics and science in each theme, both implicit and explicit.

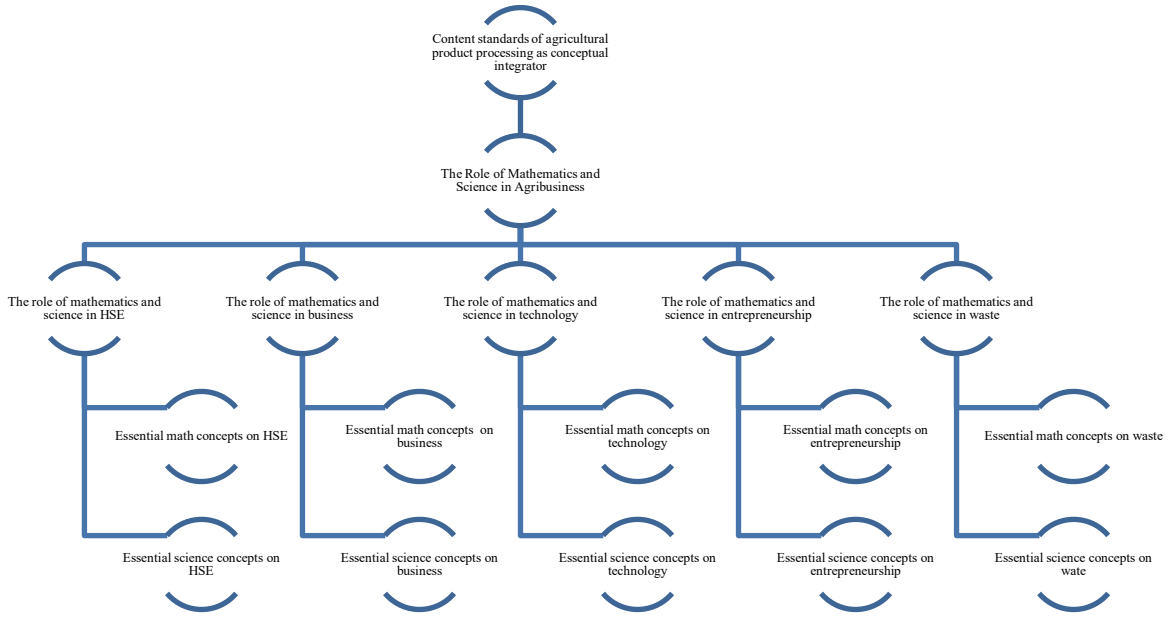

Figure 1. Data Analysis Flow

This study also explores participants' perceptions of beliefs about learning integration from several subjects and topics presented to students as conceptual integrators. The implementation belief of integrated learning is essential to challenges of intrinsic instructional (Dong et al., 2020) and determines teaching preparation (Wang et al., 2020). The chosen theme will be an integrator of two or more subjects to support student learning (Kelley and Knowles, 2016). Table 3 presents the questions posed to the participants.

Table 3. Distribution of Questions About STEAM-H Implementation Beliefs and Integrator Themes

Aspect	Question
Belief of integration implementation	Based on your perception, can agricultural product processing, mathematics, and science subjects be integrated together in intracurricular learning? If yes, how is the technical implementation? Are there any special prerequisites or conditions for implementation? If not, explain the reasons/technical constraints.
Integrator theme for math subjects	Based on your perception, what agricultural product processing contexts can be used as material in Mathematics Subjects?
Integrator theme for science subjects	Based on your perception, what agricultural product processing contexts can be used as projects/materials in science subjects?

FINDINGS AND DISCUSSION

Findings

The initial description as a result of the research is about the role of mathematical and scientific concepts (physics, chemistry, biology) on the content standards of agricultural product processing. Figure 2 illustrates the percentage of the role of mathematics and science (physics, chemistry, biology) in processing agricultural products in each integrator theme based on the responses of all participants. If explored further, the teachers argue that the concepts of mathematics and science have a role in each topic with different portions.

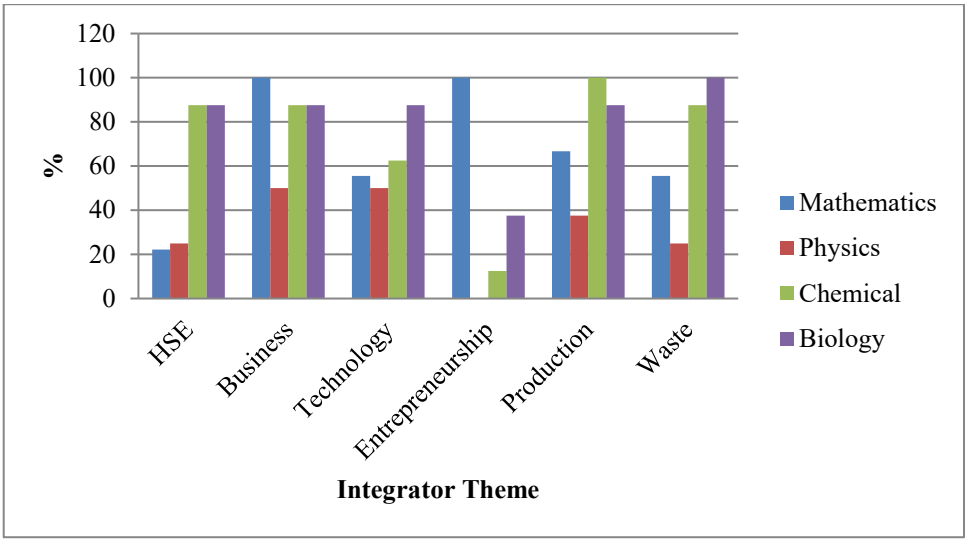

Figure 2. Percentage of Participants' Responses on the Role of Mathematics, Physics, Chemistry, and Biology on Content Standards for Agricultural Product Processing Subjects

In the HSE theme, chemistry and biology dominate the processing of agricultural products compared to mathematics and physics. Regarding business and entrepreneurship, mathematics has more roles than science. Regarding technology and waste management, biology is seen as having more of a role in processing agricultural products compared to mathematics, chemistry, and physics. On the production theme, chemistry has an important role in the processing of agricultural products. The participants perceive the mathematical and scientific concepts required for processing agricultural products explicitly or implicitly. Table 4 summarizes the important concepts of mathematics and science based on the participants' perspectives on the HSE theme.

Table 4. Participants' Perceptions of Mathematics and Science Concepts on the Themes of Health, Occupational Safety, and the Environment

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Calculate the need for tools and materials to support occupation-al health and safety	Number operations, situation modeling, systems of linear equations, linear program-ming	-	Standard use of personal protective equipment and occupation-al health and safety procedures	Knowledge of chemical properties of materials for work safety	properties and characteristics of chemical substances; Maintenance of production equipment that requires chemicals	Environmen-tal conserva-tion to maintain the ecosystem; positive attitude towards the environment	Environ-mental ecosys-tem

Based on Table 4, the essential concepts of mathematics and science exist inside and outside the secondary school curriculum. Based on participants' perceptions, mathematics plays a role in determining the number of tools and materials for work safety, and science plays a role in workplace safety and the environment. Mathematics and physics concepts tend to be implicit in the HSE theme, while chemistry and biology tend to be explicit in the curriculum.

Furthermore, the theme of business processes covers the concept of industrial classification, business scope, product planning, production processes, marketing, equipment repair, maintenance, human resource management, logistics, and job profiles. Table 5 summarizes the participants' opinions on the role of mathematics and science in the business process theme.

Table 5. Participants' Perceptions of Mathematics and Science Concepts on the Theme of Agricultural Business Process

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Analysis of opportu-nities in planning and production results; marketing, and profit	Real numbers, linear programming	Fluid and electrical concepts in the proc-ess of repair, maintenance, operation of equipment	In repair and maintenanc e there are physics concepts that need to be learned	Food safety in the pro-duction process (eg adding food additives to products); chemical substances in the product	Substance composi-tion	Classifica-tion of living things with their environ-ment; biotechnolo-gy such as fermentation techniques	Handling viruses and bacteria during packag-ing

Based on Table 5, we obtain explicit mathematical and scientific essential concepts that integrate disciplines. Mathematics is real numbers and systems of equations that occur more in the context of product planning, production processes, and marketing. Real numbers and systems of equations in the context of product planning, production processes, and marketing. Chemistry is the composition of substances in the production process and equipment maintenance/repair. The essential concept of biology is biotechnology in the context of the production process.

Next, we discuss the theme of basic techniques of crop agribusiness, fisheries, and processing of agricultural products. This theme is part of the agribusiness business process in the production process area. The material is more technical and in-depth than the material on business processes. Table 6 summarizes the participants' perceptions of mathematical and scientific concepts on the theme of basic techniques of agricultural product processing.

Table 6. Participants' Perceptions of Mathematics and Science Concepts on the Theme of Basic Techniques for Agricultural Product Processing

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Measure-ment in cutting and slicing	Real numbers, compari-sons, mathemati-cal modeling	Food preservation by heat energy, thermal processes such as pasteuriza-tion, sterilization, etc.	The principle of separation of mixtures is based on the particle size/quantity which is basically in the measurement material	chemical properties of the material, chemical processes, chemical preservation such as salting sugar	Mixed separation	Environment to maintain ecosystems, changes in tissue structure in size reduction, coagulation, fermentation	Environ-ment

Based on Table 6, the essentials of mathematics consist of real numbers, comparisons, measurements, mathematical modeling, and dimensions. This mathematical concept is more varied than other themes. Measurements and dimensions concepts are outside the secondary school

curriculum. On the other hand, the essential concepts of physics include matter and energy. The basic laws of chemistry, separation substances, purification substances, and colligative properties of solutions. The environment is the concept of biology.

Table 7. Participants' Perceptions of Mathematics and Science Concepts on Technology Themes

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Opportunity calculation, data collection, tool calibration	Data comparison, linear programming, real numbers, linear equations	Digital data processing; Electricity, waves	Laws of Physics, Fluids, Thermodynamics	food safety for product development agricultural product such as storage and preservation	Development of agricultural products with chemically addictive ingredients; standard analytical chemistry of foodstuffs	Product development pays attention to environmental interactions; Biotechnological innovations (e.g. fermentation)	Environment; biotechnology

Table 7 shows the role of technology in processing agricultural products. The concepts of mathematics and science on the technology theme are more explicitly connected, especially in the context of equipment and product development. Both are part of the business process, while product development is specifically related to the basic techniques of cultivation or production. Therefore, the essential concept between business and basic cultivation/production techniques has a wedge.

Table 8. Participants' Perceptions of Mathematics and Science Concepts on the Theme of Entrepreneurship Development

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Calculation and risk taking; Farming analysis	real numbers, matrices, linear equations, linear programming	-	-	Entrepreneurship development on target market and product classification	-	Growth and development of living things	-

On the entrepreneurship theme, mathematics tends to dominate connections compared to science because there is a concept in the standard of entrepreneurship content, namely calculating needs and taking risks in developing and managing businesses. The theme of entrepreneurship and business processes intersects with aspects of product planning, production processes, and marketing.

Table 9. Participants' Perceptions of Math and Science Concepts on the Theme of Waste Management

Mathematics		Physics		Chemistry		Biology	
Productive teacher	Math teacher	Productive teacher	Physics teacher	Productive teacher	Chemistry teacher	Productive teacher	Biology teacher
Measurement of certain doses of chemicals in chemical waste handling	Matriks	-	Waste handling equipment (vacuum, aerator, etc.)	Chemical properties of waste	Separation and purification of substances, titration, colloids in sewage treatment	food safety; positive attitude towards the environment	Waste and pollution

Waste management is an integrator theme and interest because it can involve all STEAM-H concepts. In the aspect of science, it is seen in Table 9 that many have a role, especially in chemistry and biology. Based on Tables 4-9, we can see the role of mathematics and science in agribusiness content standards, which have many connections. This result aligns with the participant's beliefs about the possibility of implementing integrated STEAM-H-based learning in a 100% confident position to implement STEAM learning.

Table 10 describes the specific themes chosen by the participants of agricultural product processing-mathematical and agricultural product processing-science subjects in the STEAM-H learning. Participants argued about implementing STEAM-H learning integrated with agricultural projects through syllabus adjustments, models learning, and plans to learn, using a schedule, student grouping, a continuous cultural process from the beginning of planning to results, and adequate financial support.

Table 10. Participants' Perceptions of Integrator Topics for STEAM-H Implementation

"Specific" integrator theme	
Agribinis-Math	Agribisnis-Sains
Agricultural product processing business planning	Handling of production waste
Material composition measurement	Vegetable products and animal products
Organoleptic test	Product development and food diversity
Business analysis	

The topics in Table 10 are believed by the participants to be implemented with learning strategies that involve agricultural projects. Participants see the need for syllabus adjustments, learning models, integrated learning plans for all subjects, use of time schedules, student groupings, a continuous cultural process from initial planning to results, and adequate financial support. Another belief of the participants in the possibility of successful implementation of integrated STEAM-H in agricultural product processing agrotechnology is the establishment of communication between teachers of mathematics, science, and productive subjects.

Discussion

STEAM-H has six disciplines. Science, mathematics, and agriculture are explicit subjects at SMK processing agricultural products. Technology, engineering, and health are implicitly included in the standards for processing agricultural products. Science in vocational learning is carried out partially or integrated. The research results show that there is a connection between the six disciplines. Fatimah et al. (2022) stated that making an explicit STEAM-H connection is the first step in an integrated STEAM-H implementation. According to English (2016), connections between two or more disciplines can be established.

Mathematics and agriculture are two related disciplines. The results of this study indicate a connection between the two. The connection between mathematics and agriculture can be seen from the role of both, as Muhrman (2016) revealed that mathematics is used by farmers all the time. Fatimah and Solihah (2021) explained the role of mathematics in producing processed vegetable products, namely calculating and measuring the various needs for tools, materials, and business planning analysis for producing processed vegetable products. Furthermore, Fatimah (2021) examines mathematical connection skills by presenting math assignments in an agricultural context to students. The results show that many students can make connections between mathematics and agriculture even though students are less able to make connections between mathematical concepts. These results show mathematics and disciplines' connection to mathematical thinking (Kelley & Knowles, 2016).

The results of this study also show that there is a connection between science and agriculture. The results of this study are supported by the results of the identification of physics concepts in agribusiness subjects conducted by Toto et al. (2022), which states that agricultural technology requires physical concepts and principles (quantity, measurement, fluid statics, fluid dynamics, heat, temperature, electricity). Hidayat et al. (2010) revealed the dominance of science in agriculture over

the local knowledge of farmers to realize an increase in food production. The findings also show a connection between science, technology, and agriculture.

The integration of science and engineering in education has also been carried out, even though the integration of agricultural engineering has yet to emerge. Pleasants et al. (2021) state that the use of science in engineering design still needs to be deeper and only lies at the end of the unit. Conceptual connections that are built can utilize and adapt engineering curriculum materials. Brand (2020) states that the development of understanding and practical value of science and engineering is determined by the exploratory nature of projects and instructional outcomes with their students. The strategy that can be implemented to achieve interdisciplinary integration is to redesign the curriculum Newton et al. (2018) with a discipline-based design. This design requires an educational research community with a deep grounding in disciplinary priorities, worldviews, knowledge, and practice (Henderson et al., 2017). Vocational secondary schools can adopt a discipline-based design strategy centered on agriculture. Agriculture is a conceptual integrator for science, technology, engineering, mathematics, and health.

Integrators can be concepts or contexts that combine various disciplines (Roehrig et al., 2021). Science, technology, engineering, agriculture, mathematics, and health can each become conceptual and contextual integrators for other disciplines. Fatimah et al. (2022) state that determining the integrator is an important step in preparing to implement STEAM-H-based learning after determining learning outcomes. Selecting agricultural integrators for vocational school students majoring in agricultural product processing is the right step to support student skills. The themes in the agribusiness concept classified into HSE, business processes, use of technology, cultivation, entrepreneurship, and waste handling can be selected as conceptual integrator themes in applying science and mathematics.

Connection is important to realize curriculum coherence in integrated STEAM-H implementation in agricultural product processing vocational schools. Connections that are explicit and contained in the curriculum are the most important components, even though not all math and science concepts are connected to other disciplines in STEAM-H. Therefore, it is necessary to understand the nature of integration in the designed curriculum unit. Agricultural concepts (including technology, engineering, and health in agriculture) can be conceptual and contextual integrators of science and mathematics concepts seen explicitly or implicitly in the curriculum. In addition, an understanding of the important concepts at the grade level is required.

The teacher's belief in this study is capital in implementing integrated STEAM-H. This belief is in line with Dong et al. (2020), which states that even though prospective teachers do not have a strong understanding, they have strong beliefs and intentions to teach STEM in their future careers. The results of this study indicate that teachers of agricultural vocational high schools know interdisciplinary connections, are aware of essential concepts for students, and have their beliefs about the possibility of implementing STEAM-H-based learning.

CONCLUSION

Integrated STEAM-H-based learning is very promising to be implemented in agricultural processing vocational schools. The teacher's perspective on the role of mathematics and science in content standards for processing agricultural products shows a lot of conceptual connections between them. The concepts of processing agricultural products become conceptual and contextual integrators of science and mathematics concepts. The concept of mathematics and science has a role in each theme with different portions. Dominant chemistry and biology have a dominant role in the processing of agricultural products compared to mathematics and physics on the theme of health, work safety, and the environment. Mathematics has a dominant role compared to science on the theme of business and entrepreneurship. Biology is dominant in the technology and waste handling theme compared to mathematics, chemistry, and physics. Chemistry has an important role in the dominant production of processing agricultural products. The teacher's belief in implementing integrated STEAM-H is supported by the teacher's knowledge of interdisciplinary connections and the determination of specific integrator themes to integrate agriculture and mathematics as well as agriculture and science. The results of this study provide opportunities for further research to

understand the nature of integration in the STEAM-H curriculum unit, which produces a conceptual flow for each subject at the grade level. Variations in integrator themes that have been explained based on participants' perceptions as teachers in agricultural product processing vocational schools will pave the way for understanding the nature of this integration.

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The effectiveness of flipbook-based e-modules in increasing student creativity in nail art subject in higher education

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ABSTRACT

Incorporating technology into the learning process has resulted in the development of various new media for lecturers to use in delivering subject matter. Furthermore, the material presented is intended to enable students to develop creative and innovative ideas in higher education vocational majors in makeup and beauty. The purpose of this study is to determine how effective the flipbook-based module is in increasing student creativity in nail art subject at the Department of Beauty and Cosmetology at Universitas Negeri Padang. This study employs a quantitative and experimental approach (One Group Pretest-Posttest Design). Data were collected from thirty respondents using a Likert scale questionnaire and a pretest and posttest of nail art practice skills. All respondents are students in the Department of Cosmetology and Beauty, Faculty of Tourism and Hospitality, for the 2021/2022 academic year. All data were then analyzed descriptively and correlated using SPSS 23 software. Overall, the analysis results showed that using flip book-based e-modules could increase students' creativity in nail art subjects. These results can be proven by the effectiveness test of students' creativity, with an average value of 71.9%. Furthermore, the correlation analysis revealed a significant value of 0.05 and a t-score of 7.083 > t-table of 2.045. The results of this study imply that it can provide references for education in choosing learning media and strategies for delivering learning materials that are effective in increasing creativity. Furthermore, this can be used as a basis for further development to produce effective media and learning approaches.

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INTRODUCTION

Currently, nail art is an activity that has a positive impact on beauty trends. The development of beauty trends is always identical to updates from time to time. Fashion development requires constant innovation to produce new works (Bae & Kang, 2016; Banga & Patel, 2014). Also, a person's fashion or appearance can reveal a lot about him. This great demand sparked the notion of incorporating some fashion features, such as an interest in nail art (H.-S. Cho & Rhee, 2019; Leny et al., 2021).

Nail art necessitates ingenuity in using many techniques to create stunning works of art (Fadilah et al., 2021). Nail art fashion trends have been around for a long time, but the 1920s saw the

emergence of fashions depending on how to dress (M. J. Cho, 2017). In 1932, the cosmetic business Revlon introduced unique nail paints. It is inspired by glossy automotive paint and is similarly long-lasting. Maxwell Lappe invented artificial nails in 1934 for clients who frequently bit their nails (Yang & Kang, 2017; Yun & Kang, 2017). Creativity in nail art might use several techniques that are put together to produce their work as their trademark. The high creativity produced in a work or nail art product can produce a high selling value, given the current high consumer demand for nail art (Yusnita et al., 2018). Nail art for women today is a plus for women's beauty, especially for career women who do much social interaction (Putri et al., 2022; Yun & Kang, 2017).

Creativity is a creative thought that produces originality, purity, and value. Creativity is described as the ability to create or generate something new, original, unique, and useful, and it is related to the ability to create and imagine (Mulyadi et al., 2016). Creativity can generate new things in the form of ideas, insights, new products, or adaptations (innovation) and address issues (Oronce & Manalo, 2021). Rhodes found that creativity is often described as personal, process, press, and product. Creativity as a person is a unique manifestation of the full person as an individual interaction, feelings, attitudes, and behavior; creativity as a product is the output of a creative process (Putri et al., 2022).

Nevertheless, some of these indications still need to be owned by students; in terms of creativity and student skills, practice is the most important factor in mastering teachings (Ridwan & Lutfiati, 2020). So, the creative attitude that emerges from students when practicing will impact the sharpening of these skills. Lecturers are expected to invite students to interact when offering direction regarding the subjects being conducted following the work steps followed. It will issue students' creative ideas by constructing learning activities as innovations through media, ensuring that learning flows smoothly (H.-S. Cho & Mun, 2021).

According to Engkizar et al. (2018), Yusnita et al. (2018), and Syafril et al. (2021), creativity can develop critical thinking, and critical thinking can nurture creativity. Many educators use electronic-based learning media in connection with the development of the global era. However, the problem that often arises in learning is that learning media could be more appealing, so it is necessary to renew learning media to encourage student creativity in learning, particularly nail art (S.-E. Jeong & Kim, 2015; Saprudin et al., 2021).

The ideal conditions and the importance of the role of student creativity are, in fact, outside of existing reality. Several studies have raised the same problem related to low creativity. A study describes that students' creative thinking skills still need to improve due to difficulties in understanding concepts and a lack of teaching materials that demand students' creative thinking skills (Sari et al., 2020). This low creativity is also illustrated in learning activities that involve designing activities or activities that require new ideas (Mustika & Ain, 2020).

On the other hand, low creativity can also be observed in students who emphasize memorization methods of material and are not based on thinking new things that can solve problems (Sholeh & Fahrurozi, 2021). Furthermore, indicators of low student creativity can also be observed from several still low indicators, such as curiosity, expressing ideas, asking constructive questions, and answering questions (Saleh, 2016). The problem of creativity is an important thing to solve, considering that creativity is one of the benchmarks for the quality of education (Harfiani & Fanreza, 2019).

The condition of low student creativity is also in line with the results of preliminary studies conducted by researchers. The picture of student creativity in nail art class is still relatively low. This can be observed from several indicators, such as the lack of students who have new ideas and designs related to nail art. This can be known because students are only adrift and follow the design pattern the lecturer exemplifies. The second indicator is that student initiative in overcoming problems related to nail art still needs to be higher. This is observed from the attitude of students who rely more on asking lecturers than trying to find alternative ways of solving independently. These conditions are a description of the current student's creativity profile.

In reality, learning prioritizes mastery of the material alone without emphasizing the element of increasing creativity. Creativity should ideally be prioritized because creativity can foster critical thinking and vice versa. Critical thinking can foster creative thinking (Engkizar et al., 2018; Syafril et al., 2021; Yusnita et al., 2018). Therefore, educators are responsible for fostering creativity through

learning design and the media used. However, the learning media used is less attractive to students, so it cannot increase creativity (S.-E. Jeong & Kim, 2015; Saprudin et al., 2021).

Learning media's primary function is as a teaching tool that updates circumstances, achievements, and the learning environment. Educators create learning media to help students study more effectively (Kusumawati et al., 2022). One of the forms of some electronic learning media in the form of e-modules (electronic modules) is the production of teaching resources that can boost student interest in learning (Hidayah et al., 2020). E-modules are learning aids that incorporate information, work stages, evaluation, and material conclusions produced systematically to attract students and motivate them to reach learning objectives (Wibowo, 2018).

An e-module based on a flipbook maker is a gadget developed in the form of a digital book that contains images, sounds, and movies that can stimulate students (Boo, 2015). This study utilized the exe format to create flipbook maker-based e-module learning media. According to Maharcika et al. (2021), exe is a web-based design software developed to make it easier for educators to plan, develop, and present subjects. This application program is also simple for people who need help understanding computer languages.

Flipbook maker-based e-modules offer compelling learning utilizing e-modules since video and audio may be integrated into them to create a unique learning impression. Since this e-module teaching material is used instead of the printed module without compromising its usefulness as a source of knowledge, it allows students to study material or theory outside of the classroom and practice without the supervision of a lecturer (Fonda & Sumargiyani, 2018). According to Ko's (2020) research, the use of flipbook maker-based e-modules boosted student creativity in learning, making it acceptable for use in the learning process. According to Hidayah et al. (2020), video can enhance learning creativity since video medium has a tremendous potential to help convey information and increase creativity. Creativity capacity can be assessed through fluency of thinking and flexibility of thinking.

The preceding explanation demonstrates how flipbook maker-based e-modules as learning materials can boost student creativity and use videos as a draw for learning (H.-L. Jeong et al., 2018). This product creation of teaching materials is also predicted to determine the extent to which students can think creatively in problem-solving and can enhance the educational process, increasing student learning outcomes (J. Kim & Jeong, 2014). This research aimed to assess the effectiveness of flipbook maker-based e-modules in increasing student creativity, as demonstrated through creative product results and students' creative personalities in studying nail art (Park et al., 2019).

RESEARCH METHOD

The type of research used is Research and Development, which is a research method used to produce certain products as well as to test the effectiveness of these products. To test the effectiveness of the products, this study used an experimental research design (one group pretest-posttest design). According to Ross and Morrison (2004), Hastjarjo (2019), and Ledyard (2020), an experimental research design is ideal if the researcher wants to examine the results or assessment of a product after it has been tested in a study.

The sampling of this study used a random sampling technique. The subject of this study was a student of the Department of Cosmetology and Beauty, Faculty of Tourism and Hospitality, Universitas Negeri Padang. Students involved in this research are members of the Nail Art course, with a total population of 80 students. Then, 30 students were taken as a sample from the population. This total sample was taken because considering the limitations of researchers. However, this sample still meets the criteria for the minimum number of research samples and the minimum sample limit for statistical tests of research data, which is as many as 30 students (Cohen et al., 2017).

The instrument for collecting the data used in this study was a questionnaire and test. The instrument contains statements/questions about personal creativity, and the test contains several indicators to measure students' creativity in the product. The research instrument grids are presented in Table 1.

Table 1. Personal Creativity Validation Instrument Grid

Variable	Indicators	Item Number
Personal Creativity	Have curiosity	1, 2, 3, 4
	Capable of spontaneously expressing ideas without feeling embarrassed	5, 6, 7, 8
	possessing and appreciating beauty	9, 10, 11, 12
	Have a vivid imagination.	13, 14, 15, 16
	Able to work solely	17, 18, 19, 20
	Total	20

Research instruments are validated using an expert validation approach (judgement experts). This aims to determine the level of validity and reliability of the instrument. Valid and reliable instruments can determine the accuracy of research results. After the instrument is declared valid and reliable, it is distributed throughout the data collection response.

After collecting the data, research continued at the data analysis stage. Data analysis begins with prerequisite analysis, namely normality and homogeneity tests. After the prerequisite analysis is met, a quantitative descriptive data analysis will be carried out that describes students' level of personal creativity. Furthermore, the analysis continues to test the research hypothesis using a paired sample t-test. This analysis aims to measure the difference between the results of measuring creativity before and after students take part in learning with flip book-based e-modules. Through this analysis, the researcher can prove whether the hypothesis is accepted or rejected. The hypotheses in this study are as follows:

H0: Flip book-based e-modules did not significantly increase student creativity in nail art subjects.
H1: Flip book-based e-modules have contributed significantly to increasing student creativity in nail art subjects.

FINDINGS AND DISCUSSION

The result of this study is the nail art flipbook maker-based e-modules. E module is produced through several stages of research and development. Researchers designed this E module to meet learning needs and increase student creativity. The design designed in this module is adapted to the characteristics of current students who are more interested in digital designs and following the times.

The resulting e-module design is designed to be more interactive and has several features that help students learn this e-module. Some of the advantages of this e-module include being accessible using a smartphone or laptop, can be accessed anytime and anywhere, learning materials are equipped with supporting images, there is a test feature that functions to measure student understanding independently, and there is a glossary that makes it easier for students to understand the special terms contained in this e module. E module can be accessed online or offline. Online access can be done with the help of internet access, while offline access can be used by installing this e-module application on smartphones and laptops. The description of the results of the nail art flipbook maker-based e-module development can be seen in Figure 1, Figure 2, and Figure 3.

Figure 1. Cover Display of Nail Art Flipbook Maker Based E-module

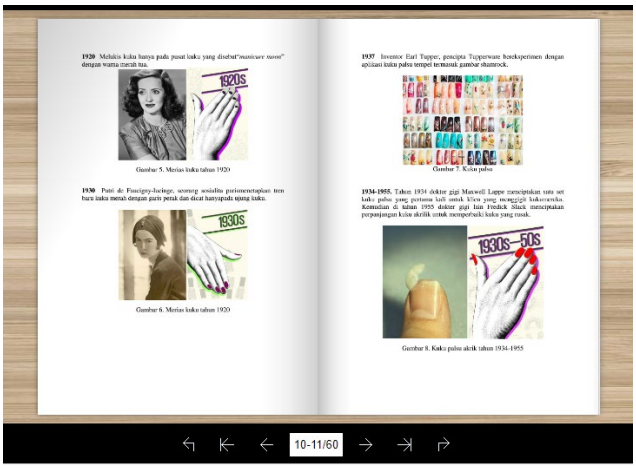

Figure 2. Display of E-module Content

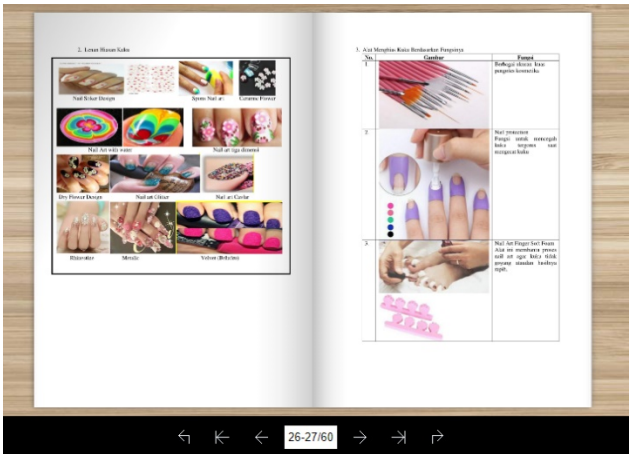

Figure 3. Display of E-module Learning Material

After describing the result of the module, researchers will discuss all research findings linked to students' creative personal evaluation stages and examine the usefulness of flipbook maker-based e-module learning media in learning. Researchers administered a questionnaire to thirty students to analyze students' creative personal stages. The questionnaire intends to examine students prior to learning utilizing modules designed to improve e-module-based learning. Table 2 shows the results of the statistical analysis of the questionnaire results.

Table 2. Results of Creative Personal Assessment

No.	Aspect of Evaluation	Percentage	Category
1.	Have curiosity	76.83%	Creative
2.	Capable of spontaneously expressing ideas without feeling embarrassed	61.5%	Quite creative
3.	possessing and appreciating beauty	68.4%	Quite creative
4.	Have a vivid imagination.	71.3%	Quite creative
5.	Able to work solely	81.7%	Creative
	Total	71.9%	Quite creative

Based on Table 2, the results of the creative personal assessment by 30 students on creative personal instruments in the aspect of having curiosity have an average value of 76.83% in the creative category. In the category of Creative Enough, the aspect of being able to voice opinions spontaneously and not being embarrassed has an average score of 61.5%. The feature of having and appreciating beauty gets an average score of 68.4%, with the category quite Creative. In the creative

category, possessing a strong imagination has an approximate value of 71.3%. The ability to work independently has an overall average of 81.7%, with an adequate category and a total score of 71.9%, indicating that the overall score is quite creative.

Thus, the practicality assessment tool employed in this study was distinctive from all elements of the assessment. There are two panelists from hand, foot, and nail treatment courses and one from industry. In the evaluation of creative works, three criteria are used: (1) originality, (2) resolution, and (3) detail. The pretest and posttest assessment results of the nail art course are described in Table 3.

Table 3. Basic Statistics of Creative Products on Pretest and Posttest

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	30	11.67	21.67	15.744	2.054
Posttest	30	15.00	26.00	19.355	3.109
Valid N (listwise)			30		

According to Table 3, students earn an average creative product result of 15.74 in the pretest and 19.35 in the post-test for creative products. Figure 4 portrays a histogram with more information.

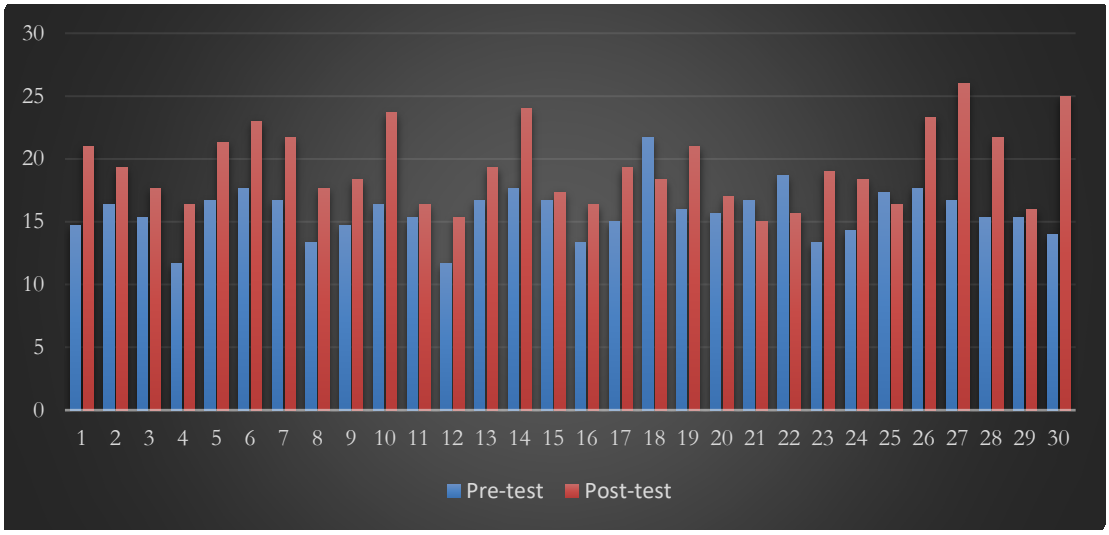

Figure 4. Histogram of Creative Products on Pretest and Posttest

Furthermore, comparing creative products from the two learning outcomes data determines the effectiveness of employing flipbook maker-based e-modules to enhance student learning creativity in learning nail art. Normality and data homogeneity tests are performed through one sample Kolmogorov-Smirnov Test (H. A. Kim & Yang, 2021).

Table 4. Result of Normality Test for the Creative Product

One-Sample Kolmogorov-Smirnov Test			
		Pretest	Posttest
N		30	30
Normal Parameters [a,b]	Mean	15.744	19.355
	Std. Deviation	2.054	3.109
Most Extreme Differences	Absolute	.127	.136
	Positive	.127	.136
	Negative	-.087	-.081
Test Statistic		.127	.136
Asymp. Sig. (2-tailed)		.200 [c, d]	.163 [c]

According to Table 4, all data groups in the pretest and post-test groups have a normal power distribution since they have an asymp. sig. > from 0.05 as the critical limit of the normal level of data to be evaluated associatively. The homogeneity test was then carried out on two data groups to determine the variance of cognitive data to be examined. Table 5 summarizes the findings of the homogeneity test of research data on creative items.

Table 5. Homogenity Test of Creative Product

Levene Statistic	df1	df2	Sig.
.076	1	4	.796

As indicated by the summary of homogeneity test results in Table 5, the total study data set has a significance score of 0.796 > from 0.05, implying that the data to be analyzed varies from the same population. Thus, the t-test can be employed to compare the outcomes of the two groups. After testing the classical assumptions on the data set that will be evaluated in comparison to determine the level of effectiveness of the creative products that have been generated, a comparative study of the creative product data from the two data sets is performed.

The hypothesis test in this study is designed to determine whether there are changes in the data on student learning outcomes on creative output as a result of student practice. The paired samples t-test was employed to evaluate the hypothesis test using SPSS software. The findings of the creative t-test in the pretest and post-test groups may be found in the hypothesis results in Table 6.

Table 6. Hypothesis Test of Creative Product

Paired Samples Test									
		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-3.611	3,299	.602	-4.843	-2.378	-5.994	29	.000

According to Table 6, if the value of sig. (2-tailed) is 0.000 0.05, then H0 is rejected, and Ha is approved. In addition to comparing the significance value (sig.) with a probability of 0.05, another technique to test the hypothesis is to compare the t-count with the t-table. It is well known that tcount has a negative value of -5.994. This negative t-count results from the pretest learning outcomes having a lower average value than the posttest learning outcomes. A negative Tcount can have a positive significance in this circumstance. As a result, the value of t-count becomes 5.994.

The analysis of the t-test score t-count of 5.994 compared to the critical value of the t-table for df 29 at a significance of 0.05, which is 2.045. The hypothesis that reads there is a difference in learning outcomes scores on creative products between the pretest and posttest groups at a significance level of 0.05 is then known to be t-count > t-table. As a result, there is an average difference between pretest and posttest learning outcomes, revealing that utilizing flipbook maker-based e-modules to improve students' creativity in studying nail art has an effect.

Education development is required to overcome challenges that still need to be optimal, from educational goals to attaining learning objectives in particular (Nurhasnah & Sari, 2020). The goals for enhancing the learning system include the planning, process, and evaluation of learning, which are the tasks and obligations of an educator. The fullest effort of an educator through innovation in learning is an action that necessitates processes to demonstrate that the results of a development that may be employed and useful to overcome challenges within the area of education are in the hands of educators (N. P. Kim, 2020).

Similarly, in learning hand, foot, and nail care, the author has attempted to create instructional media to increase student creativity in learning nail art. This learning media development features innovations that aim to change learning outcomes by utilizing the development

of the globalization age, which has mostly influenced the shift in teaching and learning activities. As a result, the author believes that the creation of learning media and innovations must be carried out so that the educational process is of good use because it was carried out in response to student needs.

A research discussion can be made based on the description of the research results offered on the research and development of flipbook maker-based e-modules to boost student creativity in studying nail art in the cosmetology and beauty education study program. In this study, the effectiveness test was carried out to assess the effectiveness of the flipbook maker-based e-module learning media that was applied to the research sample and whose application was carried out with all of the provisions in its application and development. A summative evaluation was designed to examine learning outcomes. According to the study's findings:

The findings of creative personal effectiveness were examined using a questionnaire issued to 30 students who scored 71.9% in the quite creative group. At a significance level of 0.05, the creative product hypothesis states that there is a difference in learning outcome scores before and after using flipbook maker-based e-module learning media. It is known based on the t-count score of 7.083 > t-table of 2.045. As a result of the value mentioned above, there is an average difference between pretest and posttest learning outcomes, indicating that employing flipbook maker-based e-modules to enhance student creativity in learning nail art has an effect.

The research findings demonstrate that the validity of the product in the expert assessment as a validator shows valid results in all assessments, the practical results show the average score in the practical category, and the effectiveness score shows the effectiveness results with the data results after using the flipbook maker-based e-module learning media higher than before consuming the media. According to H. A. Kim and Yang (2021) and Sutama et al. (2021), learning media can be said to be effective if it displays clear elements, can coordinate users so that they can attract students to cultivate or develop creativity, learning media are easy to understand, and it is hoped that students will accomplish more activities.

CONCLUSION

The study concluded that technological advancement can only be achieved with education. The advancement of technology has aided in the education of various media. Because development and innovative ideas are required in the Nail art course, researchers have tested flipbook-based e-modules for students majoring in cosmetology and beauty. E-modules designed by researchers have affected students in generating creative and innovative ideas and increasing creativity. This is obvious from the research results, which show that the personal effectiveness test has a value of 71.9%, the creative product effectiveness test has a significant level of 0.05, and the t-score is 7.083 > t-table is 2.045. As a result, flipbook-based e-modules can be utilized in universities as an alternative media for nail art.

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Implementation of BMC-based teaching and learning factory model in increasing student competencies in leather creative skills concentration and imitation in vocational school

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ABSTRACT

Learning in vocational education must be carried out with collaboration between educators, vocational schools, curriculum alignment, and learning in factories as miniature industries stakeholders to achieve assessment in the form of real assessment so that the achievement of learning objectives follows the needs of students and the world of work. Assessment in the form of assessment must be measured in real terms, with religious, character, moral, and cultural education values and work competencies following community expectations. The objectives to be achieved through this research are to produce a learning program that can improve student competence in Vocational High School (VHS), including identifying the current condition of learning implementation, obtaining learning planning findings, obtaining learning implementation findings, obtaining findings regarding the assessment of learning outcomes, identifying supporting and inhibiting factors, knowing students' perceptions of the implementation of the BMC-based teaching and learning factory model in improving student competence in the concentration of leather and imitation craft design and production expertise in VHS. With the implementation of a learning system using a block system as a teaching and learning factory, the implementation of learning must stimulate students to be more active in improving social skills, emotional skills, spiritual skills, scientific skills, mental skills, kinesthetic skills, as well as entrepreneurial skills, work ethics and safety, and work safety and the environment, which in turn can improve the competence and entrepreneurial character of students, following the vision and mission of the education unit.

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INTRODUCTION

Participants are educated graduates of Vocational High School (VHS) expected to become pious human beings, have work skills or competencies following the hope industry, and be spirited, creative, innovative, sporty, and entrepreneurs based on life skills or prowess life, which needed public, as well as produce a product which has score economical as support economy national (Rukmana et al., 2021). It means process education must produce a Source of Power Man (HR) that can humanize humans to be accepted in the human environment and between humans with human

values and norms directed at learning for life (Andra et al., 2022). Efforts to reach learning for life must embodied with an innovative curriculum that becomes curriculum implementation or customized curriculum with needs participant education and the needs of the world of work real method/model (collaborative learning) in order to produce creativity that is realized in an innovative, real medium, real assessment, real job, real results, real word and real life (life skills) (Diwangkoro & Soenarto, 2020).

Implementation of the learning process and, more broadly, the scope of education must result in competency, not a score result of one course because after the plunge to public, institution education or sector industry, results learning be measured with competent and not yet competent. Produce competence is a learning process leading to work competence to sustain life. The definition of competence must be viewed more broadly (Mourtzis et al., 2020). namely a combination of the realm of knowledge, concepts, rational views, the realm of hard skills that forms practice skills and ability as well as intelligence actual, then the realm of soft skills, which is embodiment from characters individual which next showed with prowess, emotional, prowess social, prowess spiritual, mental skills (morals, attitudes, personality, values and norms, behavior, act in demand, character, ethics, aesthetics and polite) as well as prowess kinesthetic.

Program synergy or integration of hard, soft, and life skills in learning should already be implemented in the 21st Century Education today. One of the characteristics of learning in the 21st century is a collaboration between good individuals, educators, and students in an integrated learning process, interacting between competence in a group with develop creativity embodied in innovation with the Teaching And model learning based on life skills (Zancul et al., 2020). The learning model assessed as the container for connect-between-eye lessons, called inter-multidisciplinary thinking, combines various domains of each competency resulting from the evaluation development of innovative learning, which positively impacts students' competence. This is evidenced by the value of learning outcomes for students who, on average, improved better than before. Besides, quality study participants are educated intellectually, emotionally, spiritually, and more focused.

Based on various views as well activities based on hard skills, soft skills, and life skills, the has a positive impact, so that push especially the role of educators to further maximize the hard synergy skills, soft skills, and life skills into the integrated learning process in reach enhancement competence participant educate following level development and needs. It is against this background that we, as the authors, are interested in conducting more in-depth research on the synergy of hard skills, soft skills, and life skills in model learning (Santosa, 2018).

Become consideration why use model teach and learning factory in implementation learning in one semester which juxtaposed with eye lesson product creative entrepreneurship which produce goods or services, or appropriate technology, so that learning becomes more meaningful, full of creativity which is manifested in an appropriate innovation with the demands of industry, institutions, and society, or life skills (Lestari et al., 2021). In efforts to realize various innovations, institutions take advantage of the potential and services of participants to educate process study, teach get and deepen as well as expand theory lectures (Elbestawi et al., 2018). This learning model can combine several eye lessons in an expertise study program in one semester, but what is seen is the essence of each subject, so there will be efficiency, effectiveness, and meaningfulness in studying needs-based in a public manner.

Destination education in VHS development not only fulfills the need for job positions in industry or continuing education to a higher level but is more focused on developing entrepreneurial character for stock independence in the public (ElMaraghy et al., 2017). Development VHS moment this, determined by the network built on government, good both at the central and national level (Jooste et al., 2020). Understanding which appropriate vocational development programs by various parties conducted steps strategically, particularly in planning and implementation by VHS administrators, good in the center, province, district, and city, other related agencies as well as society and world effort (Andersen et al., 2019).

VHS graduates must have faith and piety, have a mind and noble character through learning, and develop creative, innovative, sporty, and entrepreneurial (Triyanto et al., 2019). Process learning must support the development of economic creative and creative industries, namely the development of economic activity based on creativity, skill, and talent participants' education to create creative

power and individual creativity, which worth economical and have score sell, as well as take effect on well-being Public Indonesian (Simanjuntak, 2021). Implementation service prime education medium vocational for form graduate of which able and have religious education, moral education, character education, cultured education with a soul Entrepreneur, smart, ready to work, competitive, and have the teak self nation, as well as capable develop superiority local and can compete in the market (Bauer et al., 2018).

VHS education must be run based on the principle of investment in human resources (human capital investment); the higher the quality of education and training received by somebody, the more productive the person so that apart from improving productivity, increase also increases power energy competitiveness work in market work global. Efforts in competing in the global market, process learning in VHS, centered on making products that score economically according to the package of expertise. VHS must adopt values applied in carrying out disciplined work, be obedient to the principles, be effective and efficient, be responsible, and have a good work ethic (Mourtzis et al., 2020). With the deep effort to reach the destination, quality education must continuously improve.

Quality education related to process and product quality. Process quality could be achieved if learning is going on effectively, and students can appreciate and carry out the learning process meaningfully (Pittich et al., 2020). Quality products are achieved if participants are educated and show a high level of mastery of tasks studied following their needs in life and demand world work, good work in industry, or work as an entrepreneur. As an education system, VHS has a chance to follow as well as in a development system economy that rests on strong people and permanently grows in crisis (Büth et al., 2018). Efforts reach results the system economy national need sustained by perpetrators business which creative, innovative and powerful stand to change (Kucukaltan et al., 2022; Suhariyanto, 2019; Tvenge et al., 2016). Learning activities in VHS have potency, designed as a vehicle for developing potential perpetrator entrepreneurs who are creative, innovative, and have the power to change.

Learning moment this in VHS, yet to be able to produce students with the attitude, character, entrepreneurial behavior, and life skills. Many VHS graduates still need to work or are self-employed because they are unable to meet the work competencies required by the industrial world and create their own employment. Often, the industrial world finds that graduates of VHS entering the workforce need more provisions adequate for the expected qualifications of workers. VHS students must be prepared to do some of the activities that make it possible to become entrepreneurs following the concentration of expertise they chose.

The phenomenon is not optimal; mastery of work competence and entrepreneurial character by students caused by several factors among other responses participants educate to entrepreneurship, the ability of the teacher to convey method learning as well as still at least, involvement of the business world to participate in creating graduates which have the strong entrepreneurial spirit (Centea et al., 2019). VHS must work together in partnership with the world effort and the industrial world in an inherent, tenuous, or detached manner. With working models like this, the VHS graduate preparation program can achieve the maximum with complete skills, i.e., theory, practice, and work.

VHS, as an important part of the vocational education system in Indonesia, consists of a special field of expertise in arts and creative economy, namely concentration on craft products, leather, and imitation to equip students with skills, knowledge, and attitude, an entrepreneurial character in order to have competence in the product design of various bases legs, bags and non-fashion using leather or imitation.

Another potential possessed by Bandung, Garut, Indonesia as a city of creative industry or economy, leather and imitation craft products provide enormous opportunities for employment creative craft product design vocational high school graduate leather and imitation, to become one of the important parts of the new development direction of field arts and creative economy. Related to enhancement competence, participants should learn PKK integrated with eye lesson general and project real subjects concentration expertise (Louw & Droomer, 2019).

Results study about learning held in VHS observed not being able to produce graduates with the attitude, character, behavior, culture, and manners to work and not yet comply with K3LH, so many graduates of VHS still need to be ready for independence. This condition occurs because graduates have yet to meet the required competencies in the industry world and cannot open jobs

independently. On recruitment, often the industrial world gets participants educated, which enter the workforce, need more provisions for qualification expected worker. Even after not being accepted into the industry, I am not interested in entrepreneurship. High school graduates must be prepared in the process and results study, which can develop an entrepreneurial character to open the field work and entrepreneurship, according to the package chosen skill (Mudassar et al., 2018).

The condition here that drives us, the researchers, to study for the plan, doing process learning which integrates several eye lessons General in form project strengthening profile Pancasila student, culture work and K3LH, project and required interest and eye lesson project creative entrepreneurship, in implementation of the BMC-Based Teaching and learning factory learning model for increase competence participant design education and production crafts at VHS (Mavrikios et al., 2018).

BMC-based teaching and learning factory learning model based on the demands of the 2021 Education Unit Operational Curriculum (KOSP), project-based learning models, industry and work culture learning in the world of work, support for quality education and training that is oriented towards school relations with the industrial world and the business world in implementing production units in schools. Another basis is the increasingly high cost of materials for student practice, equipment that must be maintained in standard conditions, motivation to improve welfare for school members, and self-confidence and pride for its graduates (Lindvig & Mathiasen, 2020; Umeda et al., 2019). In general, the teaching factory learning model aims to train students to achieve punctuality the quality demanded by the industry, prepare students according to their competency skills, instill a work mentality by adapting directly to industrial conditions and situations, and master managerial skills and be able to produce products. So, that has industrial quality standards.

RESEARCH METHOD

The approach in this study uses mixed methods developed by Creswell (2014). Mixed method research is mixed research that combines qualitative research with quantitative research. Figure 1 is a chart of the mixed-method research design used in this study.

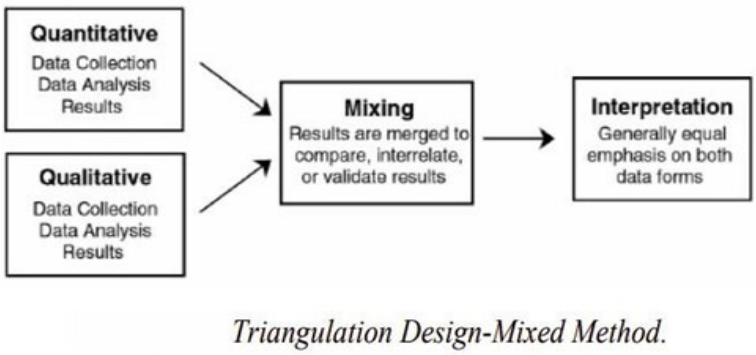

Figure 1. Mixed Method Flowchart
(Source : Creswell (2014))

This type of mixed research is a triangulation design based on the researcher's goal of obtaining different but complementary data to examine research problems with the same topic (Mourtzis et al., 2020). Furthermore, researchers want to directly compare and contrast quantitative statistical analysis results with qualitative findings to validate the quantitative results with qualitative data obtained so that they are more comprehensive, valid, reliable, and objective.

The design of this study was a quasi-experimental study with a control group pretest-posttest design, where research data could be collected before and after intervention or treatment. The qualitative method used to describe related details implementation of learning models BMC based teaching and learning factory for enhancement competence participant educates on concentration

creative craft product design expertise leather and faux. In contrast, quantitative methods used to see development competence think critical participants educate from the pretest and posttest results.

This research pretest was conducted before the intervention, and the posttest was conducted after the intervention. Activities studies preliminary development design learning covers activities as follows. Studies field addressed the condition of readiness subject and object for application of models. This activity covers the survey at SMK Negeri 3 Tasikmalaya, concentration subject project creative craft product design skills Leather and Faux, subjects PKK, related to planning, process, and evaluation activity ordinary learning done by teachers. The survey covers the use of facilities and infrastructure, resources study, state students, and climate school in a general manner.

Next, study and analysis of draft or theory learning constructivism models, teaching models, learning approaches and strategies, and results study previously related to developing learning models eye lesson productive (Büth et al., 2018; Lang et al., 2018). Finally, a review and analysis of the 2021 KOSP document was conducted, especially in the general subject group, creative craft product design, leather and imitation craft project concentration subjects, PKK subjects, and several guidelines on curriculum implementation.

The activities of preparing and developing learning models include the preparation of learning constructs and models in general subjects, subjects with a concentration of expertise in the design of creative leather and imitation craft products in PKK P5BK K3 LH subjects. The constructs and models are then discussed with all subject teachers, industry practitioners, curriculum experts, heads and deputy principals, and school committees to obtain validation. The activity was carried out using the direct focus group discussion method.

The model trial is conducted in a limited environment. Analysis of the trial results is carried out through activities to determine the place of limited trials, conduct limited trials, analyze or evaluate the results of limited trials based on predetermined criteria, and improve the learning model through trials on a wider scope so that an adequate model is obtained and ready to be tested for validity. Validation of the learning model is carried out to determine the experimental group and control group, research into the field, validation test on a predetermined sample, analyze or evaluate the validation test results, and compile a report on the validation test results.

The validation test tests the BMC model learning program based on a teaching and learning factory resulting from a wider trial. The validation test is related to the implementation and the quality of the model, as seen from the success of increasing the competence of education participants and the impact of mentoring. By conducting the validation test, the effectiveness of the learning program model that will be developed can be known. The validation test was carried out on four study groups, namely class XII students in the creative concentration of leather in the subject of workshop and entrepreneurship skills in leather craft product design and imitation. This validation test obtained a reliable learning program model and is ready to be implemented in VHS.

The stages used as a reference in implementing the BMC-based teaching and learning factory learning model are as follows: (1) Studying the analysis of the Merdeka Curriculum syllabus in the leather and imitation craftsmanship concentration subjects; (2) Developing a full block system schedule for 1 Semester; (3) Developing programs and carrying out syllabus analysis; (4) Designing Product Manufacturing Plans (RPP) and teaching materials according to product types using BMC-based teaching and learning factories; (5) Developing appropriate research grids and instruments to measure the results of the implementation of BMC-based teaching and learning factories, in improving competencies including, pretest questions, posttest questions, knowledge test questions according to the subjects taught, observation sheets of hard skills and soft skills, and soft skills of PKK subjects, real projects for the concentration of leather and imitation craft product design expertise.

The next activity was to test the research instruments to obtain the validity and reliability of the questions, difficulty level, and differentiating power. After the test was carried out, the next step was to make improvements based on the results of the instrument trials that had been carried out. The next stage of activities is to carry out industrial visits and direct observation of the world of work that is relevant to the competence of expertise, make industrial visit reports in the form of papers and presentation slides, presentations of industrial visit groups, make agreements between teachers and

students, practice communicating in the workplace with customers in product manufacturing and marketing.

FINDINGS AND DISCUSSION

The competence resulting from learning using the BMC-based teaching and learning factory model or using the conventional model is described in cognitive scores and vocational competence. The research results show that the average cognitive gain of experimental group students is relatively higher than the average cognitive gain of control group students (see Table 1). This shows an increase in the cognitive ability of students whose learning uses the BMC-based teaching and learning factory model rather than learning using conventional models. The average confidence interval of the competence of experimental group learners from all projects undertaken is the same as the average gain. Learners' competence significantly differs between the experimental and control groups in terms of the projects undertaken.

The project competency scores of learners who took part in learning using the BMC-based teaching and learning factory learning model were significantly higher than those of learners who took part in learning using the conventional model. The description of learner competence shows that the BMC-based teaching and learning factory model is highly effective in improving learner competence in PKK, P5BKK3LH, and real project subjects in the concentration of expertise. Other data about learners tested for validation are the ability of soft skills, hard skills, learners' perceptions of the learning model, data on learner attendance, application of work culture, adherence to K3LH, and SOP standards, which are described in Table 1.

Table 1. Perception of Student Entrepreneurship Character Development

Group	Treatment	Statistics	Leather Craft Product Design
Experiment	Pre test	N	32
		Average	63.35
		Std. Dev.	3.7
		Max	70
		Min	55.83
	Post test	N	32
		Average	73.84
		Std. Dev.	7.49
		Max	89.17
		Min	63.33
	N-Gain	N	32
		Average	0.06
		Std. Dev.	0.04
		Max	0.15
		Min	0.01
Control	Pre test	N	36
		Average	62.66
		Std. Dev.	4.9
		Max	69.17
		Min	53.75
	Post test	N	36
		Average	63.78
		Std. Dev.	3.82
		Max	69.17
		Min	56.25
	N-Gain	N	36
		Average	0.01
		Std. Dev.	0.01
		Max	0.02
		Min	0

The overall average acquisition of soft skills of experimental group students after participating in learning with the BMC-based teaching and learning factory model shows an increase. The soft skills ability of students is in the sufficient category after participating in learning with the BMC-based teaching and learning factory model. Students' total soft skill ability after participating in learning by using the BMC-based teaching and learning factory model is higher than the average value. The overall average acquisition of hard skills of experimental group students after participating in learning by using the BMC-based teaching and learning factory model shows an increase. Learners' hard skills are in the high category after participating in learning with the BMC-based teaching and learning factory model. The BMC-based teaching and learning factory model can significantly improve students' hard skills.

Based on the research data, learning using the BMC-based teaching and learning factory model can improve learning achievement. Using the BMC-based teaching and learning factory model exposes learners to a new atmosphere and experience in teaching and learning activities. The new experience that learners feel is that students must be able to apply what they have learned in a new place in the form of an industrial situation so that students feel the need to master the concepts and skills needed before doing the next profession. A person's behavior changes can be triggered based on experiences gained through observation, hearing, reading, or imitation. The direct experience gained by learners from BMC-based teaching and learning factory is expected to develop the potential of learners as a whole and in-depth, both personal skills, social skills, emotional skills, academic skills, and vocational skills following the demands of competency standards.

The BMC-based teaching and learning factory learning model will further improve learning outcomes because students will directly apply knowledge, psychomotor, and attitudes in the form of creativity and innovation, application of work culture, and HSE, which are obtained during practical learning. Learners are required to learn independently with direct supervision by the teacher so that the learning carried out will take place in an organized manner, and this condition will make learners feel important because they can independently acquire practical skills following relevant knowledge. This organized learning condition makes learners feel needed and important. When learners make clothing orders to serve consumers, they must learn by extracting information from guidebooks or other sources. The aim is that learners can fulfill consumer requests, which is needed to answer and satisfy the consumers they serve. This sense of responsibility towards consumers makes learners more independent in learning and practicing.

Table 2. Students' Perception of Conventional Learning in the Experimental Group

Data	Average Student Perceptions of Conventional Learning Control Group	Criteria
N	23	
Average	56.17	
Std. Dev.	3.59	Average
Max	62.50	
Min	50.50	

Experimental group students' perceptions of conventional learning models decreased after students took part in learning with the BMC-based teaching and learning factory model. Based on the results of data analysis, it is known that students' perceptions of conventional learning models are lower than those of BMC-based teaching and learning factory models. Thus, the BMC-based teaching and learning factory model has fulfilled the ideal value students desire. This means that the BMC-based teaching and learning factory model is preferred by learners over conventional learning models.

In essence, the BMC-based teaching and learning factory model is based on the following assumptions and rationale: (1) Vocational education must be organized holistically, realistically, and realistically as in the world of work so that all aspects of learners' potential can be developed; (2) Learners must be trained in reconstructing knowledge as well as being able to construct thoughts; and (3) Education in VHS does not solely focus on vocational skills, but also includes academic skills, personal skills, social skills, emotional skills, communication in the workplace, man work and HSE, and complying with SOPs/work sheets.

Table 3. Average Student Perception of Conventional Learning in Control Group

Expertise Program	Criteria	Interval	Frequency	Percentage
Leather and Imitation Crafts	Very High	80.1 - 100.0	0	0
	High	60.1 - 80.0	0	0
	Currently	40.1 - 60.0	19	82.61
	Low	20.1 - 40.0	4	17.39
	Very Low	1.0 - 20.0	0	0

Based on the data in Table 3, it can be explained that the average perception of students in the control group towards conventional learning is in the medium criteria. This data shows that students feel normal with conventional learning. The following presents the perceptions of experimental group students towards the BMC-based teaching and learning factory model presented in Table 4.

Table 4. Student Perception of Teaching and Learning Factory Learning Model based on BMC Experiment Group

Expertise Program	Criteria	Interval	Frequency	Percentage
Expertise concentration in leather and imitation creative craft product design	Very High	80.1 - 100.0	18	78.26
	High	60.1 - 80.0	5	21.74
	Currently	40.1 - 60.0	0	0
	Low	20.1 - 40.0	0	0
	Very Low	1.0 - 20.0	0	0

Table 4 shows that the experimental group students' perceptions of the BMC-based teaching and learning factory model learning are in very high criteria, namely 78.26%. Furthermore, Table 5 explains that the average student perception of implementing the BMC-based teaching and learning factory learning model is very high, with a value of 87.93. This criterion shows that students feel enthusiastic, happy, and excited about implementing the BMC-based teaching and learning factory model.

Table 5. Average Student Perception of Teaching and Learning Factory Model Implementation Based on BMC Experiment Group

Data	Vocational High School A	Criteria
n	23	
Avarage	87.93	
Std. Dev.	5.20	Very High
Max	98.5	
Min	78	

More clearly, the following presents the average perception of students towards learning by using the BMC-based teaching and learning factory model. The soft skills of learners that develop during the use of the BMC-based teaching and learning factory model are the ability to negotiate in project work, communicate in the workplace, express willingness and interest in project work, submit the final results of work, comply with SOPs, obey Work Culture and HSE, punctuality in project work, punctuality in attendance at work, and punctuality in worship or religious spirit (faith and devotion to Allah SWT God Almighty, experienced a positive and significant increase.

The results of the data calculation show that implementing the BMC-based teaching and learning factory model can improve students' soft skills. The hard skills of learners in the BMC-based teaching and learning factory model include analyzing projects, creating new, unique, and different types of projects or products of goods and services so that they become solutions, the ability to determine the main and supporting materials for doing projects, the ability to operate and maintain the main and supporting tools, the ability to work on projects, comply with SOPs, implement work culture and HSE, and carry out quality control. The hard skills of students while using the BMH-

based teaching and learning factory model have increased significantly and positively. In terms of entrepreneurial character development, the application of the BMC-based teaching and learning factory model and digital marketing in marketing the results of students' professions or projects, including achievement motivation, future orientation, business networking, leadership, and responsiveness and creativity to change, online shop implementation shows a positive and significant increase. This proves the BMC-based teaching and learning factory model can develop entrepreneurial character and digital markets through online shop implementation in marketing development.

The condition of learning implementation at the VHS, where the research was conducted, is a center of excellence school that uses the Merdeka Curriculum. As the implementer of the teaching factory program, it can be described as follows: lesson planning (RPP) has been previously prepared by the subject teacher by including components of subject identity, Core Competencies (KI), Basic Competencies (KD), indicators, learning objectives, theoretical learning materials, sources, tools, materials, learning methods or approaches, learning activities, and evaluation. Teachers make teaching materials, job sheets, and evaluation instruments for knowledge, psychomotor, and attitude. The preparation of lesson plans still needs sharpening on competency indicators cognitive, psychomotor, attitudes, work culture, and HSE, which follow learning objectives.

The implementation of learning has been carried out quite well but still requires development in achieving the expected competency indicators. Implementing general subject learning, basic vocational projects, the concentration of expertise projects, PKK, and P5BK K3LH has only fulfilled the value of assignments. It has yet to be directed at making projects with economic value following customer expectations. Entrepreneurship learning has only instilled the concept of entrepreneurial character and has yet to focus on developing student entrepreneurial character. The learning process of general courses, basic vocational projects, the concentration of expertise projects, PKK, P5BK K3LH are still separated and not fully integrated according to the needs of students, the world labor market, so that the time to achieve competence becomes longer and even the desired competence is not achieved due to time delays. Learning implementation has yet to be oriented toward achieving competency indicators. It has not been following learning objectives, so a learning model is needed that can position students to learn to develop creativity and entrepreneurial character and can be used to improve my competence.

Observations of learning outcomes evaluation planning and implementation have gone quite well. However, sharpness is needed in formulating aspects and indicators of competency achievement in general subjects, basic vocational subjects, concentration of expertise subjects, PKK, and P5BK K3LH. In addition, completion time has yet to be calculated based on industry-standard time efficiency. Implementation of tasks is carried out separately from each subject. It is necessary to utilize the learning process time in an integrated, collaborative manner to achieve the expected competencies. Attitude assessment is more directed at the attitude of work culture, K3LH, how to communicate correctly in the workplace, and not only on attitudes in the form of soft skills.

Evaluation of learning outcomes is still influenced by the formality of assessments limited by KKM, so students have yet to interpret the assessment because it is only limited to fulfilling report cards. Learning facilities and infrastructure follow industry standards but are only used conventionally and conditionally when learning takes place, and their use has yet to be optimally, efficiently, and effectively utilized without any income for practical and maintenance costs. Teachers and education personnel have been certified following their educational background, as a professional teacher, and as a requirement as an assessor (Nurhasanah et al., 2022).

Preparations for the implementation of learning have been carried out quite well and completely but still need improvement to facilitate the implementation of this model. Based on the results of observations covering the process of changing school management to industrial management, communication training activities in the workplace, negotiation projects, and practice analyzing projects have been running with good enough criteria. However, it is very necessary for teachers of general subjects, basic vocational projects, the concentration of expertise projects, PKK, and P5BK K3LH to more thoroughly understand the process, stages, and steps of implementing the BMC-based teaching and learning factory model, either through workshops, seminars, and other discussions.

Based on the observations, the implementation of the BMC-based teaching and learning factory model at the preliminary stage, namely the project negotiation step, the step of analyzing the project, and the step of declaring the project's workability, has been carried out well, it is very necessary to understand the concepts and practice communication and analyzing projects continuously, to improve the quality of the next implementation. Implementation at the core stage includes the step of doing the project, the step of doing quality control, the step of submitting the final project results, and it has been done well, but it is still necessary to do careful quality control to improve the quality of the next project work.

As consultants, assessors, and facilitators for teachers of subjects in the concentration of expertise in creative leather and imitation craft product design, including general subjects, basic vocational projects, concentration of expertise projects, PKK, and P5BK K3LH, it has done quite well, but still needs a more intensive understanding in formulating the aspects and indicators needed in the assessment of related subjects.

Cognitive assessment is obtained from project analysis exercises and the implementation stages of the BMC-based teaching and learning factory model. The results of the cognitive ability assessment show a significant increase so that students can link essential subjects into creativity and realize them in innovation and have an average of mostly high criteria, including for the experimental class. The control group was at medium criteria. The assessment of results during project negotiations experienced a significant increase, especially during project work and the final project. The average improvement at these stages is mostly at high criteria. The results of observations on the hard skills show a significant increase. This can be seen from the implementation of the steps of analyzing projects, working on projects, carrying out quality control, and applying work culture and HSE, and it can be concluded that the average increase at these stages is mostly at high criteria (Rukmana et al., 2021).

There is no significant difference between the perceptions of educated participants towards conventional learning models at the beginning and end of learning in the control class. While in the experimental class, there was a significant change and decrease. Based on these data, it shows that the experimental class negatively assessed the conventional model. The experimental class students' perceptions of the implementation of the BMC-based teaching and learning factory model are included in the high criteria, especially in improving the competence of students with the concentration of leather and imitation craft product design expertise, developing entrepreneurial character, applying BMC, applying work culture and HSE, and how to communicate work in the workplace. This illustrates that students in the experimental class took part in learning happily and enthusiastically. Furthermore, the research data proves that there has been an increase in students' cognitive abilities, soft skills, hard skills, and entrepreneurial character.

Students' perceptions of entrepreneurial character development are significantly different, on average, most of the students in the experimental class, most of them are in the high criteria, while the average in the control class is in the medium criteria. Implementing the BMC-based teaching and learning factory model in improving student competence in the concentration of creative leather and imitation craft product design expertise entrepreneurial character development has increased cognitive knowledge, hard skills, soft skills, and student entrepreneurial character values. This achievement is reflected in the achievement of each aspect and indicator, which includes achievement motivation, future orientation, business leadership, business networking, responsiveness, and creativity, all of which are at high criteria. The results of combining the six steps in the implementation of the BMC-based teaching and learning factory model with the development of entrepreneurial character, work culture, and HSE are at high criteria.

Supporting factors in the implementation of the BMC-based teaching and learning factory model are that the VHS learning place is a center of excellence school, which uses the Merdeka Curriculum, which has been aligned with the needs of students and the world of work which has been supported by human resources, infrastructure, and learning facilities following industry standards. The VHS management is very supportive of implementing the BMC-based teaching and learning factory model with a concentration of expertise in creative leather and imitation craft product design, with the hope that it can mutually support the implementation of production unit activities with the learning system so that it is relevant to the needs of education participants and the world of work.

Teachers with a concentration of expertise in creative leather and imitation craft product design, general subjects, basic vocational subjects, the concentration of expertise subjects, PKK, P5BK K3LH, are very enthusiastic and eager, supporting the implementation of the BMC-based teaching and learning factory model, with the hope of increasing students' knowledge, skills, attitudes, learning motivation and creativity and innovation, increasing the implementation of work culture and K3LH, and instilling Pancasila character and student behavior following the demands of society, stakeholders, students and the needs of the world of work. The learning infrastructure for practical learning of the concentration of expertise in creative leather and imitation craft product design, general subjects, basic vocational subjects, concentration of expertise subjects, PKK, and P5BK K3LH follows industry standards (Diwangkoro & Soenarto, 2020).

The inhibiting factors in the implementation of the BMC-based teaching and learning factory model are that, at first, it takes time and serious effort to convince the Principal, as the highest policyholder in the school, to make it easier to change school management into industrial management so that it requires scheduling adjustments in the concentration of expertise in leather and imitation creative craft product design, general subjects, basic vocational projects, expertise concentration projects, PKK, and P5BK K3LH in implementing the BMC-based teaching and learning factory model with a block system.

Another obstacle is the difficulty in changing school management to industrial management so that teachers and students must be able to understand learning in an industrial setting. In addition, a small number of teachers are still resistant to the step-by-step implementation of the BMC-based teaching and learning factory model and a need for more understanding of implementing the BMC-based teaching and learning factory model. Teachers' efforts as facilitators and assessors still need to be improved, especially in creating an industrial atmosphere where students are directed to actual learning conditions, like production activities in an industry. There still needs to be more clarification as to whether the implementation of the BMC-based teaching and learning factory model is supported by a school production unit in procuring projects that must be done in the implementation program of the BMC-based teaching and learning factory model.

In observations made by researchers on the ability to develop entrepreneurial character, the application of BMC, and the digital market, there is a significant difference, namely having an average with high criteria. These results are evidenced by the achievement of aspects and indicators of the entrepreneurial character of students, which include achievement motivation, future orientation, business leadership, business networks, and responsiveness and creativity to change combined with the application of stages in the implementation of the BMC-based teaching and learning factory model. The process of developing students' entrepreneurial character has gone well. For teachers of fashion and entrepreneurship skill packages, it is necessary to understand the concepts, aspects, and assessment indicators of entrepreneurial character achievement following the objectives of implementing the BMC-based teaching and learning factory model (Zancul et al., 2020).

This research has produced a learning model to improve the competence of creative craft product design expertise in the concentration of leather and imitation product design through implementing the BMC-based teaching and learning factory model. Improving the competency process of creative craft students through the implementation of the BMC-based teaching and learning factory model, with the development of the second step regarding project negotiations, in addition to model identification, model adjustment, materials, and supporting tools, size adjustments must be made for drawing techniques, either by taking the appropriate project size or taking measurements. Learners should provide information on the project's usefulness related to comfort, beauty, and personality.

Developing hard skills, namely the fifth step, is to carry out quality control, with sub-steps including checking the project's suitability when handing over the final project results to the customer. The development of these sub-steps follows the demands of the SOP in the creative craft concentration of leather and imitation product design.

CONCLUSION

Based on observations, the planning and implementation of learning outcomes evaluation has been running quite well. However, it needs sharpness in formulating aspects and indicators of competency achievement in general courses, basic vocational projects, concentration of expertise projects, Entrepreneurship Creativity Projects (PKK), Project Strengthening Student Profiles Pancasila Work Culture, Safety, and Security in the Workplace (P5BK K3LH). The completion time has yet to be calculated based on industry-standard time efficiency. Implementation of tasks is carried out separately from each subject. It is necessary to utilize the learning process time in an integrated, collaborative manner to achieve the expected competencies. Attitude assessment is more directed at the attitude of work culture, security, safety, and security in the workplace (K3LH). Learning infrastructure facilities follow industry standards but are only used conventionally and conditionally for learning, and their use has yet to be optimized, efficient, and effective. Teachers and education personnel have been certified according to their educational background.

The preparation for the implementation of learning has been carried out quite well and completely but still needs improvement to facilitate the implementation of this model. Based on the results of observations covering the process of changing school management to industrial management, communication training activities in the workplace, project negotiations, and project analysis training have been running with good enough criteria. However, it is very necessary for teachers of general subjects, basic vocational projects, concentration of expertise projects, Entrepreneurial Creativity Projects (PKK), and Project Strengthening Student Profiles Pancasila Work Culture, Safety, and Security in the Workplace (P5BK K3LH)

In order to better understand the process, the stages and steps of implementing the BMC-based teaching and learning factory model have been socialized and implemented through workshops, seminars, and other discussions. The school principal and school management, subject teachers in the Expertise Concentration of leather and imitation creative craft product design, including general subjects, basic vocational projects, skill concentration projects, Creative Entrepreneurship Projects (PKK), and the Strengthening Student Profile Pancasila Work Culture, Safety, and Security in the Workplace (P5BK K3LH) Project, strongly support the implementation of this model.

Implementing the BMC-based teaching and learning factory model by changing school management to industrial management makes students feel more challenged and motivated to learn seriously in this changing atmosphere. Students are required to work on several orders and implement the BMC-based teaching and learning factory model, which starts from project negotiations, analyzing projects, expressing willingness and interest in working on projects, carrying out projects, carrying out quality control, applying work culture and HSE, to submitting the final project results to consumers.

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The influence of digital and vocational information literacy on student learning outcomes

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ABSTRACT

Vocational students are confronted by intricate demands once they graduate. Despite the considerable need for vocational graduates in the workforce, most students have a limited understanding of digital and vocational information. This study used a descriptive quantitative method to determine the influence of digital and vocational information literacy on students' learning outcomes in three vocational schools in the Sragen Regency. Cluster Random Sampling was used to select a sample of 111 students. Data on digital and vocational information literacy were collected using a questionnaire, while those on the learning outcomes were obtained from the student's grades. The results showed that digital literacy influences vocational students' learning outcomes with a significance of 0.000 < 0.05. Vocational information literacy influences the students' learning outcomes with a significance of 0.000 < 0.05. Furthermore, digital and vocational information literacy simultaneously influence the students' learning outcomes with a significance of 0.000 < 0.05. These results indicate the necessity to familiarize and increase the students' literacy skills to improve learning outcomes. The results indicated that digital and vocational literacy partially and collectively influenced learning outcomes by 48.2%. Therefore, classroom instruction needs to be structured around learning models that actively stimulate the development of digital and vocational literacy skills, preparing students for workplace competitions. Consequently, teachers should consistently implement learning strategies that create a meaningful connection between the school environment and the realities of the professional world.

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INTRODUCTION

Information and Communication Technology (ICT) has transformed students' learning by providing flexibility and opportunity to obtain knowledge from social media (Moreno-Morilla et al., 2021). ICT and digital technology are used in education, especially during the COVID-19 pandemic when all learning activities are conducted online (Jang et al., 2021). Digital technology advancements facilitate online learning, enabling students to search for information and knowledge independently (Lember et al., 2019). Almost all information is accessed easily, quickly, and without limits using digital technology (Soewandi & Lukman, 2020).

Due to this easy access, individuals need good digital literacy skills (Patmanthara & Hidayat, 2018). Most people understand digital literacy only as writing and reading without considering the understanding, appreciating, and critical thinking aspects (Oktariani & Ekadiansyah, 2020). Technology and opinions about digital literacy change with time and are now interpreted as conveying information by writing, reading, exchanging ideas, speaking, listening, seeing, and thinking critically (Abidin, 2015). Gilster (1997) stated that digital literacy implies using technology and information from digital devices effectively and efficiently in academic, career, and everyday contexts. Digital literacy skills include finding, working on, evaluating, creating, and utilizing the information obtained wisely, intelligently, and carefully (Rasi et al., 2019). These skills foster a critical and creative mentality that helps people obtain the right information (Ahmad, 2022).

The digital literacy skills of Indonesians still need to improve (Rizal et al., 2019). The country is ranked 60th out of 61 countries with low literacy levels, and Finland is first place (Anisa et al., 2022). Due to this weak digital literacy, hoax news often consumes people (De Paor & Heravi, 2020). Furthermore, the weakness contributes to the need for more understanding and effective ways to use digital information media (Mudra, 2020). This requires getting used to digital literacy culture early in the family and school environments (Wulandari & Sholeh, 2021). Indonesia's education should apply digital literacy learning because it is a practical solution to form human resources with character (Asari et al., 2019). Students with digital literacy skills could thrive in an all-digital environment. They could also handle various information, interpret messages, and communicate effectively (Pangrazio et al., 2020). Therefore, this skill relates closely to critical thinking skills and sensitivity in all areas of life (Tohara, 2021).

Indonesia's high unemployment rate could be reduced by vocational education (Ardiansyah & Pramono, 2019; Watrianthos et al., 2022). This education bridges the gap between the curriculum and community needs (Verawadina et al., 2019). Conceptually, vocational education implies the courses and skills that help students prepare for the workforce (Jayanti et al., 2020; Ngadi, 2014). There has been a significant shift in the nature and scope of work from conventional methods to digitization. This transition towards digital technologies greatly influences industries, leading to fierce competition among companies to implement advanced digital systems. As a result, job seekers needing more digital skills often face disadvantages in the hiring process.

In Indonesia, the disparity in digital literacy among job seekers is pronounced. This inequality often leaves some groups needing access to job information, leading to unemployment. To address this, schools must proactively develop and train students to ensure their graduates possess the necessary digital competencies. Improving digital skills enhances graduate performance and supports companies during their transition, helping them maintain competitiveness in the rapidly changing digital landscape. This shows the importance of students having vocational information literacy skills. This shows the importance of students having vocational information literacy skills.

Information literacy is analyzing and understanding information for personal or social life (Mulyono & Ansori, 2020). In line with this, vocational education prepares graduates to be competent and ready to work (Edi et al., 2017). Therefore, vocational information literacy is the students' skill to analyze and understand information to prepare for the industrial world. Therefore, students must train in vocational information literacy skills to learn about the industry (Ali, 2021). Industrial Revolution 4.0 necessitates current and prospective employees to possess suitable skills. The key competencies required in this era include digital, technological, and human literacy (Indrawati & Kuncoro, 2021). Interconnecting with this demand, studies on work readiness, career, and career development imply that work readiness combines skill-based and academic preparedness (Lau et al., 2020).

According to the World Economic Forum's 2015 New Vision for Education Report, students in the 21st century need to develop 16 essential skills, including Information and Communication Technology (ICT) Literacy (World Economic Forum, 2015). ICT Literacy encompasses knowledge of information, computers, digital technology, and the internet. UNESCO defines digital literacy as the fundamental understanding of ICT devices, including the ability to access, manage, comprehend, integrate, communicate, evaluate, and create information safely and appropriately using digital technology in work and entrepreneurship contexts (Lau et al., 2020). Due to its wide application, digital literacy has become crucial for students of all disciplines and ages (Park et al., 2021). Becker

et al. (2017), established that students possessing strong digital literacy have a higher promotion rate. They are also more likely to adapt efficiently to varying work environments than those lacking digital proficiency.

Result or product refers to an activity impact that causes changes in functional inputs. In the learning process, individuals are expected to experience significant changes (Sadapotto et al., 2021). According to Djamarah and Zain (2008), the achievement of activities performed individually and in groups results from learning. Learning outcomes require strenuous efforts, sacrifices, and many change factors (Fahyuni & Istikomah, 2016). Previous studies showed that digital literacy influences student learning outcomes. Students with good digital literacy skills use digital media to complete school work and study (Susilo, 2019). Wright (2012) revealed that there are ten benefits that can be obtained by implementing digital literacy, namely: (1) saving time, (2) learning faster, (3) saving money, (4) more security, (5) getting the latest information, (6) connectivity, (7) making better decisions, (8) simplifying work, (9) creating happiness, and (10) influencing the world.

Sari (2022) stated that vocational information literacy influences student learning outcomes. Students have good work readiness when they have high vocational information literacy. Readiness is also interpreted as preparedness for something (Banjongprasert, 2017). Work readiness is the foundation of personnel preparedness supported by good health and mental or psychological well-being (Sijabat, 2018). It relates closely to the suitability between individuals' understanding, knowledge, skills, and workplace demands (Qomariyah & Az-zahra, 2020). Vocational education teaches people how to work effectively, this is supported by the statement of Perwita (2017) which states that vocational high school graduates are prepared to enter the world of work. Therefore, job readiness is the main source and capital to adapt to work to achieve optimal results (Daud et al., 2017).

Previous research shows that students need digital literacy and vocational information literacy skills that affect their critical thinking and work readiness. Therefore, researchers are interested in conducting a study entitled the effect of digital literacy and vocational information literacy on the learning outcomes of vocational high school students. The study aims to analyze the partial and simultaneous effects of digital literacy and vocational information literacy on the learning outcomes of vocational high school students. This study is unique in terms of the aspects and subjects explored. For example, a previous study conducted by Sari (2022) focused only on the religious aspect, although it showed the impact of vocational literacy on learning outcomes. In contrast, this study focuses on both digital and vocational literacy aspects. The subjects in the previous study were students from general education, while this study explicitly examined vocational high school students.

Due to the different learning design and behavioral characteristics of vocational high school students, it is important to conduct separate research. Unlike general education students who are directed to develop broad knowledge, vocational students are prepared to enter the workforce directly. The importance of imparting digital and vocational literacy skills to vocational students during their education cannot be overstated. Therefore, it is imperative to analyze how these specific skills (digital literacy and vocational literacy) impact their learning outcomes..

RESEARCH METHOD

This study used a descriptive quantitative approach through surveys and literature reviews. In a quantitative study, the data obtained and processed in the form of numbers are analyzed statistically. A descriptive study describes an object or phenomenon broadly. This study used three variables, including digital literacy (X1), vocational information literacy (X2), and learning outcomes (Y). Data for variable X was taken using a questionnaire, while the learning outcomes data were obtained from the students' original scores.

The study was conducted in three vocational schools in Sragen Regency. The schools were selected based on the area representatives. The west, center, and east are represented by SMK Negeri 1 Miri, SMK Negeri 1 Sragen, and SMK Negeri 1 Jenar, respectively. The population of this study were all students of SMK Negeri 1 Jenar, SMK Negeri 1 Sragen, and SMK Negeri 1 Miri in the even semester of the 2021/2022 academic year. Samples were determined using the Cluster Random

Sampling technique by assuming all subjects have the same opportunity and the population has no strata.

From the Cluster Random Sampling technique, 48 students for class XI from SMK Negeri 1 Miri, 46 from SMK Negeri 1 Sragen, and 17 from SMK Negeri 1 Jenar were obtained, totaling 111 students. The procedure started with collecting information from previous studies, making instruments, testing their validity and reliability, distributing them, collecting and processing data, and concluding results. Data were collected using a questionnaire, observations, and documentation. They were analyzed using multiple linear regression analysis with the SPSS application. Figure 1 shows the research framework.

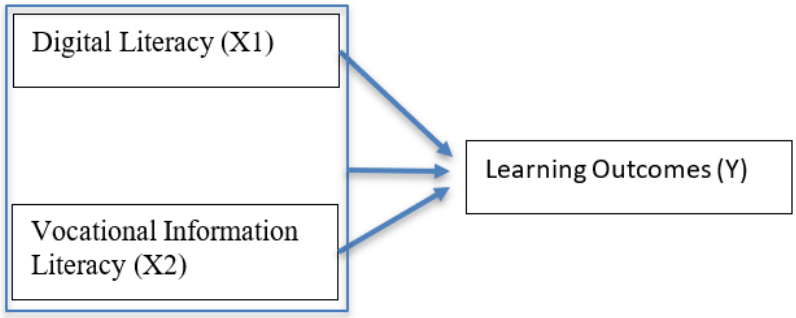

Figure 1. Research Framework

FINDINGS AND DISCUSSION

Findings

Data Description

The questionnaire used to collect digital literacy data has 22 statement items with an answer scale of 1 - 4 (Likert Scale). From statistical calculations, the highest and lowest scores were 81 and 53, with a range of 22 to 88. Furthermore, categorization was carried out using Azwar's theory. The categorization results can be seen in Table 1 and Figure 2.

Table 1. Category of Digital Literacy

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Moderate	51	45.9	45.9	45.9
	High	60	54.1	54.1	100.0
	Total	111	100.0	100.0	

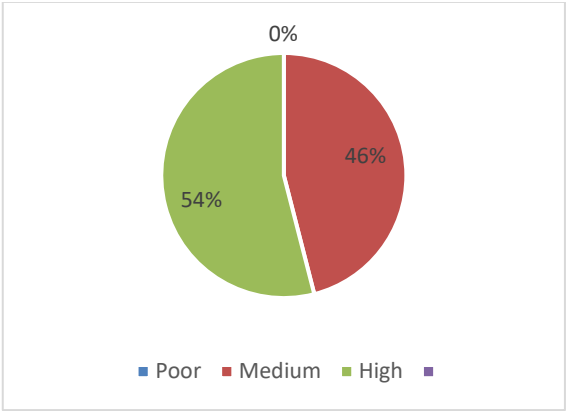

Figure 2. Category of Digital Literary

The vocational information literacy questionnaire consisted of 15 statement items with an answer scale of 1 - 4 (Likert Scale). From the results of statistical calculations, the highest and lowest values were 60 and 39. Categorization was carried out using Azwar's theory, and the results can be seen in Table 2 and Figure 3.

Table 2. Category of Vocational Information Literacy

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Moderate	21	18.9	18.9	18.9
	High	90	81.1	81.1	100.0
	Total	111	100.0	100.0	

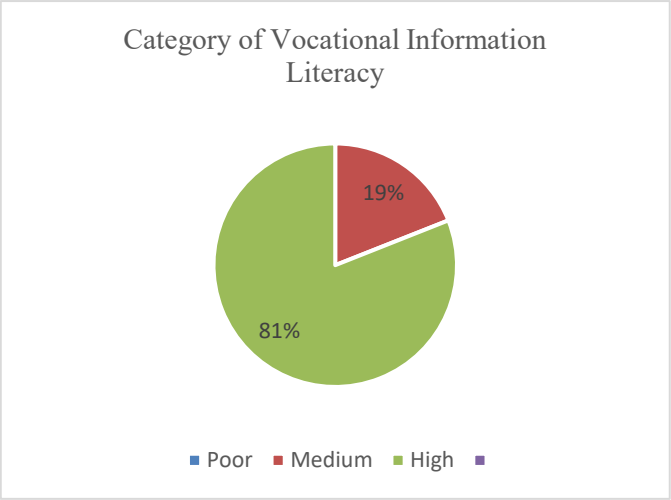

Figure 3. Category of Vocational Information Literacy

The learning outcomes data were obtained from student leger grades. The statistical calculations obtained the highest and lowest scores of 85.66 and 78.32, with a score range of 0-100. Furthermore, categorization was performed using Azwar's theory, and the results were presented in Table 3 and Figure 4.

Table 3. Category of Learning Outcomes

		Frequency	Percentage	Valid Percentage	Cumulative Percent
Valid	High	111	100.0	100.0	100.0

Figure 4. Category of Learning Outcome

T-test

The t-test on the multiple linear regression analysis models aimed to determine each independent variable's partial influence on the dependent variable. A significance value smaller than alpha (< 5% or < 0.05) meant the regression model was statistically significant. The regression analysis used the SPSS program to obtain the results presented in Table 4.

Table 4. T-test Result

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	69.332	1.381		50.206	.000
	Digital	.108	.020	.385	5.305	.000
	Information	.125	.019	.472	6.502	.000

The test obtained a significant value of 0.000 for digital and vocational information literacy. Since the significant values were 0.000 < 0.005, digital and vocational information literacy partially influenced the vocational students' learning outcomes.

F-test

Multiple regression analysis using the F (fisher) tested the significance of the regression model. The test aimed to determine the significant influence of digital and vocational information literacy on vocational students' learning outcomes. A value less than 0.05 (< 0.05) indicated that the regression model was statistically significant. Regression analysis was performed using the SPSS program and obtained the results shown in Table 5. The test obtained a significant value of 0.000 < 0.005, implying that digital and vocational information literacy simultaneously influence the vocational students' learning outcomes.

Table 5. F-test Result

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.447	2	46.224	50.225	.000[b]
	Residual	99.395	108	.920		
	Total	191.842	110			

Coefficient of Determination

The multiple regression analysis used the coefficient of determination to observe the independent variable's influence on the dependent variable. The results in Table 6 were presented in the model summary section based on the value of R square (R^2). Table 6 shows that the R^2 value obtained is 0.482 or 48.2%.

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.694[a]	.482	.472	.95933

Discussion

The Influence of Digital Literacy on the Students' Learning Outcomes

This study found that most students have high digital literacy, indicating they have excellent skills in utilizing the internet or social media as information material for the learning process. However, 45.9% of students have medium digital literacy. This implies they have moderate literacy in supporting the learning process. Figure 2 shows that digital literacy is categorized into two groups, specifically 46% at a medium level and 54% at a high level. Despite the high-level group being marginally larger, the 46% representation of medium-level digital literacy shows the need for many students to enhance their digital skills further. While 46% may seem smaller compared to 54%, it represents a significant portion of the student population in absolute numbers. Therefore, school

administrators must bolster digital literacy through various activities encompassing curricular and extracurricular avenues.

The t-test obtained a significance value < 0.05, signifying that digital literacy significantly influences learning outcomes. This is in line with Susilo (2019) and Lingga and Madiun (2022) that digital literacy significantly influences learning outcomes. Furthermore, Ting (2015) found that digital literacy increases students' independent learning abilities. The questionnaire indicated that students had used digital media to overcome the difficulties of school work and study difficulties. According to Siddiq et al. (2017), 21st-century students should have digital literacy, communication, collaboration, and problem-solving skills.

The results show that students can currently benefit from Information and Communication Technology (ICT), which enables tasks to be completed swiftly and effectively, independent of time and space constraints. This has also prompted a shift in learning orientation from passively receiving materials to proactively seeking them. Therefore, teachers must offer enhanced learning services, particularly from earlier generations, and teach in this digital media era (Warno, 2020).

The low teachers' ability in digital literacy has resulted in less appreciative students during classroom learning (Sudarti et al., 2022). For this reason, the role of teachers in the digital age is very important. They must have high achievement motivation in mastering ICT, so they are kept from current generations (students). Moreover, the current learning should be centered on students (student-centered learning), in which the students are actively involved to improve and develop their critical thinking, problem-solving skills, communication skills, good habits, and conceptual thinking based on the current era. Furthermore, new age literacy empowers individuals to use the internet and other ICT tools to pose important questions, seek information, critically evaluate, synthesize, and communicate with others (Leu et al., 2004).

The Influence of Vocational Information Literacy on Learning Outcomes

This study found that most students have high vocational information literacy. This signifies they have good skills in utilizing the internet or social media to increase knowledge about the environment and job prospects, supporting their work readiness. However, 18.9% of the students have moderate digital literacy. Therefore, they have sufficient vocational information literacy to support work readiness. Figure 3 shows that the vocational literacy of students exceeds their digital literacy in quantity. This shows that vocational students can be more psychologically prepared for career pursuits after graduation. It is crucial to examine this assertion to identify and examine the factors contributing to their heightened career readiness post-graduation.

The t-test obtained a significance value < 0.05, implying that digital literacy significantly influences learning outcomes. In line with this, Guggemos et al. (2022) found that vocational information literacy influences student learning outcomes. The vocational information literacy questionnaire answers indicated that most students have good work readiness. According to Li (2021), students must utilize technological developments to find information using online learning tools. These include mastering information skills and using online applications, search engines, and libraries based on proficiency in computer operations. Vocational literacy positively impacts work readiness, which is integral to career progression (Dau et al., 2019). Readiness is the state of preparedness for an event (Banjongprasert, 2017), while individual readiness refers to the preparedness to act, marking the correlation between potential and job success (Kraisuth & Panjakajornsak, 2017).

Work readiness encapsulates the preparedness to enter the workforce, propelled by internal motivation and backed by capability, knowledge, mental maturity, and comprehensive information (Pratama et al., 2018). It also involves a state of readiness fueled by physical health and psychological wellness (Sijabat, 2018). The depth of understanding, knowledge, and skills commensurate with workplace demands significantly influence work readiness (Qomariyah & Az-zahra, 2020). It is a key resource and asset for vocational graduates to adapt to work and achieve optimal results (Daud et al., 2017). Given the constantly evolving competency requirements of the workforce, often driven by market, economic, and technological changes, future workers need vocational literacy (Sony et al., 2021).

The Influence of Digital and Vocational Information Literacy on Learning Outcomes

The results showed that digital and vocational information literacy partially or simultaneously influence learning outcomes. A significant influence was seen from the coefficient of determination of 48.2%. This means that digital and vocational information literacy influence vocational students' learning outcomes by 48.2%. According to Azwar's theory, the categorization reference also obtained the same results in the moderate category. This implies that the significant influence of digital and vocational literacy on learning outcomes is small. Additionally, digital and vocational information literacy impacts students' knowledge and critical thinking skills.

Digitalization is proliferating and covers all aspects of life. Hence, education should adapt to this development (Kateryna et al., 2020). Digital literacy is in the spotlight to keep up with existing digitization (Bergson-Shilcock, 2020), especially for students as future successors and movers. Furthermore, this literacy is necessary because it affects student learning outcomes (Susanto et al., 2020). Various competencies and knowledge materials are now easily accessed via the internet, making digital literacy skills useful for self-development (Kim, 2019). Nowadays, graduates also need digital literacy to find work Coldwell-Neilson and Cooper (2019) and Falloon (2020) because many companies recruit online. This would benefit graduates with digital and vocational information literacy.

The rapidly changing dynamics of the professional world, influenced by market trends, economic shifts, and technological advancements, lead to continuously evolving competency requirements of the workforce (Sony et al., 2021). These changes necessitate the development of diverse human resource competencies across timeframes, past, present, and future (Pramudia et al., 2019). Consequently, gaining work experience in relevant fields has emerged as a crucial factor in sharpening skills and knowledge aligned with chosen disciplines, ultimately enhancing work readiness (Wiharja, 2019).

This rapidly evolving landscape brings digital literacy to the forefront. Defined as the ability to effectively and efficiently use technology to gather information for everyday life (Gilster, 1997), digital literacy streamlines work with the exponentially increasing volume of available data. Simultaneously, vocational education, which comprises various courses or skills that prepare students for their professional journeys (Sudira, 2012), is enhanced by the ready availability of vocational information via electronic media and other written sources.

Building on this foundation, developing strong literacy competencies is essential, with critical thinking emerging as a key indicator of these skills. Equally important is the guidance provided to students in accessing relevant, reliable, and accurate information sources. Therefore, work readiness is vital for vocational students advancing their careers (Dau et al., 2019). All these factors underscore the argument that digital and vocational literacy influence students' learning outcomes, both individually and collectively.

CONCLUSION

The results showed that digital and vocational information literacy partially or simultaneously influence learning outcomes. A significant influence was seen in the coefficient of determination of 48.2%. Therefore, literacy could help improve students' critical thinking skills and learning outcomes. Digital and vocational literacy significantly influence the learning outcomes of Vocational High School students in Sragen Regency. This study aligns with previous findings, which established that digital and vocational literacy impacts learning outcomes. There is a need for vocational students to master digital and vocational literacy compared to general education students. This necessity stems from the vocational students' imminent entry into a highly dynamic professional world post-graduation. This implies that students must adapt to digital media in the current technological era. Therefore, they need to hone their skills in understanding and analyzing information obtained from digital media properly. This would ensure students do not easily believe hoax news in digital and social media and improve their critical thinking skills. Students also need good vocational information literacy to improve their work readiness. Teachers are essential in improving the students' digital and vocational information literacy in the school environment. This study also advocated integrating a digital approach and industry collaboration in school learning

processes to produce graduates with robust skills, a sound understanding of industrial culture, and adaptability to the professional world.

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Application of Augmented Reality (AR) in vocational education: A systematic literature review

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ABSTRACT

Augmented Reality (AR) is a technology that combines two-dimensional and or three-dimensional virtual objects into a real environment and then projects these virtual objects in reality in real time. Through this AR technology, users can see virtual objects added to the real world with contextual information. In education, AR has been widely used to complement the standard curriculum. Text, graphics, video, and audio can be superimposed into the student's real-time environment. This article aims to examine how the application and impact of the use of AR in vocational education. The Systematic Literature Review (SLR) method is used to identify, study, evaluate, and interpret Augmented Reality in vocational education. Research data were identified using the SLR method with the help of the PRISMA 2020 form. Article collection was carried out on the Science Direct database. There were as many as 454 articles. After being selected using inclusion and exclusion criteria, the data used were 14 articles. The study results reveal that AR is applied in learning as an innovative learning medium, a new approach to learning to improve students' understanding of knowledge and skills and provide a concrete learning experience. The integration of AR in education has the impact of increasing students' understanding and learning experience, promoting positive attitudes, making the learning process fun and interesting, and learning efficiency.

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INTRODUCTION

This rapid development of technology makes most students still learn by listening to the subject matter delivered by the teacher or by just reading books, which often feel boring for students (Pranoto & Panggabean, 2019). With the rapid development of technology today, learning methods, as usual, are not fun nowadays (Nuralim & Aswan, 2019). The integration of technology in the learning process has emerged a lot to create fun but effective learning (Sandoval-Henríquez & Badilla-Quintana, 2021). One of them is the use of augmented reality in learning. In its development,

augmented reality is used as a learning medium to explain information to be accepted and provide interaction in the learning process (Herbert et al., 2021).

Augmented Reality (AR) is a technology that combines two-dimensional and or three-dimensional virtual objects into a real environment and then projects these virtual objects in reality in real-time (Krüger et al., 2022). This AR technology allows users to see virtual objects added to the real world with contextual layers of information (Ibáñez & Delgado-Kloos, 2018). In education, AR has been widely used to complement standard curricula. Text, graphics, video, and audio can be superimposed into a student's real-time environment, providing different experiences to students (Belani & Parnami, 2020). Augmented reality learning media in schools can significantly impact students' ability to understand learning concepts (Aprinaldi et al., 2019).

Chen et al. (2017) mentioned that Augmented Reality (AR) is a technology that utilizes digital products or information superimposed on physical objects or environments to create a hybrid reality where virtual objects and real-world environments can interact meaningfully to enhance the learning experience. In its application, AR uses various technological tools such as multimedia, 3D modeling, real-time tracking and registration, intelligent interaction, sensors, and others (Y. Chen et al., 2019). A significant advancement in virtual reality is the capacity to manipulate artificial world objects by using controllers such as Oculus Touch. Its capabilities allow students, for example, in education, to experience and acquire knowledge by engaging with objects in virtual environments more engagingly (Elmqaddem, 2019).

The main principle of AR is to incorporate virtual information generated by computers, such as text, images, 3D models, music, videos, and so on, into the real world through computer simulation. With such significant technological advances, AR makes it possible to manipulate objects in the virtual world using controllers or devices such as Oculus Touch. This allows students in an educational context to engage and gain knowledge by interacting with objects in a more engaging virtual environment.

AR in educational contexts allows students to experience practical learning and can increase participation in direct interaction with relevant objects or content (virtually). For example, in vocational education, AR can let students view and manipulate 3D objects virtually, perform practical simulation tasks, and gain immersive experiences through immersive learning environments. Thus, AR can enhance students' learning experience by incorporating virtual elements into their physical world.

Based on the background that the researcher has presented, this study aims to explore information on how AR can be used specifically in vocational learning, including the types of relevant AR applications and how this technology can be optimized to increase the effectiveness of vocational learning. This research also explores the impact of using AR in vocational learning in terms of student motivation and engagement, conceptual understanding, practical skills, and improved academic achievement.

RESEARCH METHOD

Systematic literature reviews are methods of identifying, evaluating, and interpreting all research related to a particular topic that is available and relevant to answer a particular research question, topic area, or phenomenon of interest by transparently and including all evidence and assessing its quality (Kitchenham & Charters, 2007). This article was created using the SLR method to examine the application of augmented reality in vocational education. At the beginning of the review, the research question is spelled out as a goal that must be answered. The database selected for the search is then indicated, as well as search keywords and criteria followed for evaluating and selecting studies. Finally, we introduce the publication at the end of the process (Zhao et al., 2021). The PRISMA flowchart for this research can be seen in Figure 1.

The systematic review methodology ensures that a comprehensive and systematic approach is followed in selecting and analyzing the articles. By searching for specific terms in the title, keywords, and abstract, the researchers aimed to identify articles that specifically address the topic of augmented reality in education. This approach helps to narrow down the focus and relevance of the articles included in the review. Using the Science Direct database as the data source ensures

access to various scholarly articles and publications in various disciplines. The researchers have utilized specific search strings to retrieve articles most relevant to the topic under investigation.

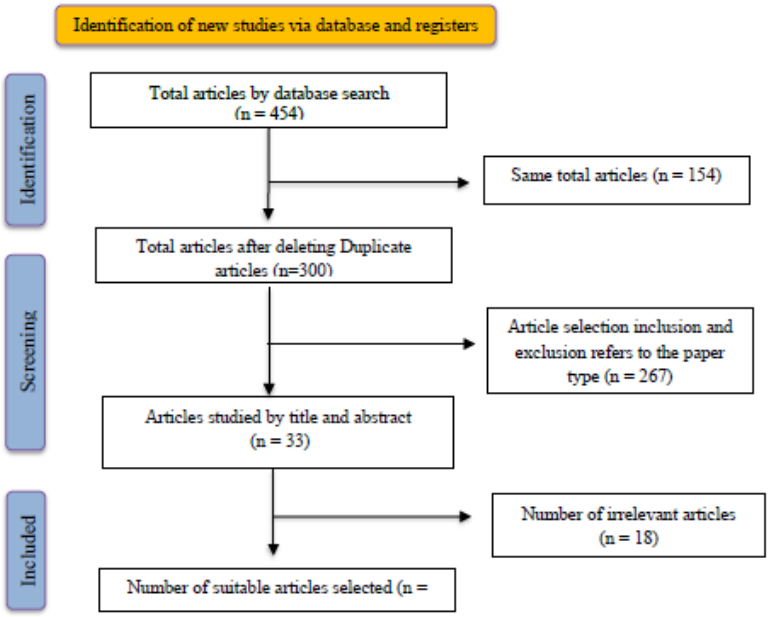

Figure 1. PRISMA Flowchart for this Research

This systematic approach helps to provide a comprehensive overview and analysis of the existing literature on augmented reality in education. Overall, by utilizing the Science Direct database and employing specific search strings, this literature review article aims to gather relevant and up-to-date research on the application of augmented reality in education, learning, and teaching.

Inclusion and exclusion criteria should be applied in any study. Inclusion and exclusion criteria are established to select relevant studies to obtain answers to the research questions asked. The study selection process is an iterative and incremental process divided into several stages with different activities carried out. The search was conducted to obtain articles on the research results on augmented reality in education. The initial search yielded 454 articles. The inclusion and exclusion criteria in this study can be seen in Table 1.

Table 1. Inclusion and Exclusion Criteria

No.	Inclusion	Exclusion
1	Research relating to augmented reality for educational or vocational learning purposes.	Research related to virtual reality or mixed reality.
2	Research articles published between 2018 - 2022.	Research articles not published between 2018 – 2022.
3	Research articles are written in English.	The article was written not in English.
4	Open access to research articles or can be downloaded the full version.	Research articles cannot be downloaded for the full version.
5	The research follows the appropriate structure and research methods.	The article is not a literature review, review, and bibliometric research

FINDINGS AND DISCUSSION

The literature review results will be presented in the form of answers or findings relevant to the research questions posed. The researcher will organize and present the findings systematically, based on certain themes or concepts that emerge from the literature analysis. Quotes and references from the articles reviewed will support these answers.

QA 1. How is the Application of Augmented Reality in Vocational Education?

Table 2 describes the application of augmented reality based on the selected articles.

Table 2. Table of Applications of AR in Vocational Education

No.	Journal Article Title	Application of AR in Vocational Education
1.	Augmented reality supported product design towards industry 4.0: A teaching factory paradigm	Application of advanced visualization techniques in product design
2.	Enhancing the attractiveness of learning through augmented reality	To improve communication and collaboration skills
3.	Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions	Augmented Reality (AR) based learning to develop flipped learning systems and test the effectiveness of the proposed approach
4.	Potentials of augmented reality in training	As an innovative learning medium that demonstrates several use cases and optimizes education and training to meet the needs of digitalization more successfully
5.	Improving the quality of teaching and learning in classes by using augmented reality video	Improving students' learning experience and improving their understanding of complex issues by incorporating mobile augmented reality (AR) applications into sewing workshops where threading tasks are performed to facilitate better learning
6.	Augmented reality experiment in higher education, for complex system appropriation in mechanical design	To visualize design or simulation models and apply real system manipulations, related to various representations, especially for students who do not have technological skills
7.	An augmented reality collaborative product design cloud-based platform in the context of learning factory	For product design, customization, and visualization with the use of AR will also be developed to gather useful insights about the skills and competencies acquired by the participants
8.	Assimilating disruptive technology: A new approach to learning science in engineering education	Elaborating the understanding of Ohm's law using AR technology. A marker-based AR application called AROhm has been developed that can make students learn in an augmented Hands-on way to give them a new and concrete learning experience
9.	Increase the interest in learning by implementing augmented reality: Case studies studying rail transportation	Application of augmented reality technology in the learning process. The case study used in this paper is the implementation of augmented reality in the subjects studied related to railway technology.
10.	Designing and evaluating a highly interactive augmented reality system for programming learning	To find a solution to make the concept of programming more real.
11.	Designing a framework for collaborative mixed reality training	To propose methods to extend collaborative extended reality (XR) applications to various platforms to support collaborative learning, but also other types of applications such as collaboration and remote maintenance
12.	Practical development of engineering simulation-assisted educational AR environments	Engineering simulation with AR/VR education is still challenging and requires expertise from various disciplines throughout technical development. Case studies were developed to teach chemical engineering concepts using the liquid soap synthesis process during the COVID-19 Pandemic
13.	Leveraging augmented reality to teach probability and sampling: Computers & education	Explore ways for students to learn basic statistical reasoning skills authentically and interestingly
14.	Augmented reality application in vocational education: A case of welding training	AR applications are designed and developed to provide welding knowledge and skills and training

Table 2 shows the application of augmented reality in vocational education from selected journals. From the table, it can be concluded that six articles show the balance of AR in education which generally aims to improve students' knowledge, skills, and learning experiences in a more interesting and differentiated way (Agrawal & Pillai, 2020; Iftene & Trandabăț, 2018; Mourtzis et al., 2020; Sharma & Mantri, 2020; Solmaz et al., 2021; Yip et al., 2019). In its use in schools, five articles show AR is integrated into the learning process as an interactive learning media (Mourtzis & Vlachou, 2018; Pranoto & Panggabean, 2019; Scaravetti & Doroszewski, 2019; Sorko & Brunnhofer, 2019; Yi-Ming Kao & Ruan, 2022). At the same time, the other three articles show the application of AR that complements new approaches to learning (Chang & Hwang, 2018; Conley et al., 2020; Kostov & Wolfartsberger, 2022). The application of AR in learning can improve students' learning experience through interactive learning media applied to various learning methods.

QA 2. How does the use of Augmented Reality in Vocational Education Impact?

Table 3 describes the impact of using augmented reality in vocational education based on the selected and shortlisted articles. From the table, it can be concluded that the impact of AR implementation in education is very positive. The use of AR in learning can improve student understanding and provide concrete learning experiences (Mourtzis & Vlachou, 2018; Scaravetti & Doroszewski, 2019; Sharma & Mantri, 2020), encourage positive attitudes (Chang & Hwang, 2018; Conley et al., 2020; Iftene & Trandabăț, 2018; Kostov & Wolfartsberger, 2022; Mourtzis et al., 2020; Yi-Ming Kao & Ruan, 2022), the learning process becomes fun and interesting (Pranoto & Panggabean, 2019) and efficiency in learning (Mourtzis et al., 2020; Solmaz et al., 2021; Sorko & Brunnhofer, 2019; Yip et al., 2019). It can be concluded that the impact of the application of AR in vocational education is to provide concrete learning experiences to students, the learning process becomes interesting and fun, positive attitudes arise, and efficiency in learning occurs.

Table 3. Impact of the Use of AR in Vocational Education

No.	Journal Article Title	Impact of AR Usage
1.	Augmented reality supported product design towards industry 4.0: a teaching factory paradigm	By using Augmented Reality, Teaching Factory participants have real-world experience in scaling the insights of the products they are designed and can interact with. the assembly of the final product is carried out 10% faster
2.	Enhancing the attractiveness of learning through augmented reality	The use of augmented reality to improve communication and collaboration skills between children, especially children with autism, and game-based student evaluations in various teaching areas, allows for a stress-free testing environment
3.	Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions	AR-based flipped learning is not only beneficial for students in terms of improving their project performance, but also increases learning motivation, critical thinking tendencies, and the self-efficacy of their group
4.	Potentials of augmented reality in training	The integration of AR technology in training and further development leads to significant cost reductions
5.	Improving the quality of teaching and learning in classes by using augmented reality video	These findings are consistent with the post-test value and the time it takes to learn the threading task. Some feedback items demonstrate higher learning efficiency with the use of AR video
6.	Augmented reality experiment in higher education, for complex system appropriation in mechanical design	Assistance in follow-up procedures (handling operations in practice sessions or assembly/disassembly operations). Here, AR is used as an educational support tool and introduces students to technology relevant to the industry.
7.	An augmented reality collaborative product design cloud-based platform in the context of learning factory	The proposed application allows the utilization of different platforms to suit easier implementation in any industrial environment at a low resource cost. Thus, breaking the boundary between the device utilization of similar platforms, the application's proposed collaborative design combines most of the existing devices in a more realistic collaboration experience
8.	Assimilating disruptive technology: A new approach to learning science in engineering education	Theme-based projects facilitate students to think outside the curriculum, and industrial projects help them to adjust to industry expectations. Results from the review of the technical expertise and documentation of the expert committee are enhanced. Competent students are allowed to continue their 6th-semester project as an institute research project (IRP) The vision of the IRP is to shape students with industry expectations and push their technical skills toward product development
9.	Increase the interest in learning by implementing augmented reality: Case studies studying rail transportation	The application of augmented reality technology in learning materials helps the learning process and increases the impressive and fun factor in the learning process and makes the learning process more interesting. The application of Augmented Reality in learning materials provides more information about the object being studied, information about the shape, and texture, and provides more visualization of the object.
10.	Designing and evaluating a highly interactive augmented reality system for programming learning	Para students in the high interactive group achieve a more positive experience in assembling puzzle cards to learn to program AR-based instruction, especially in the high interactive AR mode, helping students improve their programming performance, get higher learning motivation, reduce their cognitive load, and obtain a high level of technological acceptance
11.	Designing a framework for collaborative mixed reality training	Gain useful insights into collaborative training and serve as a good starting point for future projects
12.	Practical development of engineering simulation-assisted educational AR environments	Engineering stimulation with AR can facilitate versatile and sustainable educational tools for use in an active learning environment
13.	Leveraging augmented reality to teach probability and sampling: Computers & education	AR also had a positive impact on participants' perceptions of engagement. Thus, it will be strategic to continue to focus on the relationship between learning acquisition and engagement for research ideas involving the design and implementation of AR
14.	Augmented reality application in vocational education: A case of welding training	The final product is a mobile application that uses AR marker-based which can be used on Android phones

CONCLUSION

The application of augmented reality in education is an example of how schools are addressing the ever-evolving technologies in the industry and ensuring students, especially from vocational education, compete with the competencies available in the job market and set by the industry. Traditional learning carried out in the classroom is no longer fully effective in conveying information and materials to students. It is considered a method that does not contribute to productivity and instills learning motivation in students. Meanwhile, the application of virtual learning defines the variety of technology and supports educational strategies in promoting independent learning for students, increasing their productivity, and engaging them with effective learning. In addition to extensive online information, students can explore unlimited valid resources and introductions to online learning that contribute to improved collaboration between students and overall improve clear ways of communication and increase self-confidence. Innovations in learning strategies with augmented reality integration introduce simple learning and flexible time and location engagement. These strategies are available for distance learning and require only low investment. Overall, modern strategies of a combination of technologies such as augmented reality implanted in the classroom promote better and more conducive learning than traditional learning and thus improve student achievement academically and intellectually.

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Model concepts to support the improvement of students' skills in learning tasks

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ABSTRACT

This article aims to design a concept model that can support learning to improve students' ability in learning tasks to deal with problems that exist in the real world. Based on KKNI (Indonesian National Qualification Framework), there are six tasks in learning, namely routine tasks, critical book reports, critical journal reports, idea engineering (scientific or creative writing), mini research, and projects. Therefore, the learning process must be able to increase student learning motivation. In addition, it must also develop their competencies and skills to think critically, have high creativity, be able to work together in teams, be disciplined, be responsible, and be able to create frameworks and solve problems in life and the environment. Therefore, it is necessary to develop a learning model that is in accordance with these objectives. In this case, it is a learning model designed to encourage students to learn and practice, so that they are skilled in responding to problems based on their experience in learning. The approach in this development research was carried out using the ADDIE model. The design concept of this development model is done by combining a project-based learning model with six tasks based on KKNI (Indonesian National Qualification Framework). The results of the design concept of this development model consist of seven syntax stages, namely: material explanation, material review and formulation of problem formulation, study and review of book and journal literature, idea engineering (scientific or creative writing), mini research, project design and implementation, and presentation and evaluation.

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INTRODUCTION

Government Regulation of the Republic of Indonesia Number 65 of 2013 concerning Process Standards states that every educator in an educational unit must prepare a complete and systematic Learning Implementation Plan (RPP) to realize interactive, inspiring, fun, and challenging learning. It motivates students to participate actively and provides sufficient space for initiative, creativity, and independence per students' talents, interests, and physical and psychological development. The learning principles used in the Process Standards include a textual approach to process as a reinforcement of the scientific approach and from learning verbalism to applied skills. Education demands applying and implementing ideas to deal with life problems.

Education should aim to teach students how to apply knowledge and skills to solve real-life problems (Everwijn et al., 1993). General education should focus on developing abilities such as knowledge of facts, understanding of principles, thinking skills, and attitudes necessary for everyday

life (Potthoff, 1946). In higher education, it is important to assess and develop life skills such as teamwork, goal setting, time management, and interpersonal communication (Cronin et al., 2021).

Referring to the vocational level in KKNI (Indonesian National Qualification Framework), a student must be able to master the concept of science both theoretically and practically. Vocational education will be effective if it can enable individuals to utilize their interests, knowledge, and skills at the highest level. Vocational education enables individuals to utilize their interests, knowledge, and skills at the highest level (Febriana et al., 2019). The Indonesian National Qualifications Framework (KKNI) emphasizes mastery of theoretical and practical science concepts at the vocational level (Mon & Anifah, 2018). Efforts are underway to align the vocational education curriculum with the competencies required by industry, ensuring the relevance of vocational education to the world of work (Sulistiyo & Kustono, 2018). Developing vocational education in Indonesia includes introducing an apprenticeship system, internationalization of vocational education and training, and increasing the number of vocational school graduates (Wardhana et al., 2023). By implementing the KKNI-based learning model, SMKs in North Sumatra Province have improved students' soft skills, demonstrating the effectiveness of vocational education in enabling students to utilize their knowledge and skills effectively (Situmorang et al., 2019).

Based on KKNI, there are six learning tasks: routine tasks, critical book reports, critical journal reports, idea engineering, mini research, and projects. These tasks are designed to improve students' learning outcomes and enhance their skills in various subjects (Erlita et al., 2018; Kapile & Nuraedah, 2022; Putri & Putri, 2020). Therefore, the learning process must be able to increase student learning motivation, improve student competencies and skills to be able to think critically, have high creativity, be able to work together in teams, be disciplined, be responsible, and be able to create frameworks and solve problems in life and their environment.

In line with that, quality education will produce one or more of the following characteristics: (1) Students show a high level of mastery of the required learning tasks following the goals and objectives of education, including academic learning outcomes in learning achievement; (2) Educational results are in accordance with the needs of students in their lives so that learning is not just knowing something but can do something meaningful for their lives (learning and earning); and (3) Educational results are appropriate or relevant to environmental demands (Rizka & Arwizet, 2023).

Several articles are relevant to the concept of models to support students' skill enhancement in learning tasks. One article by Graham et al. (1992) discusses combining computer simulation models with case studies to create a learning environment for management education, aiming to improve strategic thinking skills and integrate modeling with policy and strategy formation. Engmann et al. (2017) explored various skills development models, highlighting key themes that can effectively improve the quality and relevance of education and skills provided to secondary-level students. Finally, Politsinsky et al. (2015) discuss the training of students at technical universities and the development of analytical skills through physics and chemistry problem-solving.

Based on these needs, it is necessary to develop actions in the learning process to improve students' ability to think, reason, and create as a talent by choosing a more appropriate learning model. The learning model must be following the characteristics of the learning material. Thus, learning materials can be more easily mastered quickly, make students think more critically, creatively, and innovatively, be responsible, have high reasoning power, and be able to analyze, conclude, and apply them. Therefore, developing a learning model that follows the learning objectives is necessary.

RESEARCH METHOD

The learning model development approach uses the Research and Development (R&D) method adapted from ADDIE by carrying out the Analysis, Design, Development, Implementation, and Evaluation processes. However, in this paper, only the design process of the learning model development is presented. The steps in designing the learning model follow the framework, as shown in Figure 1.

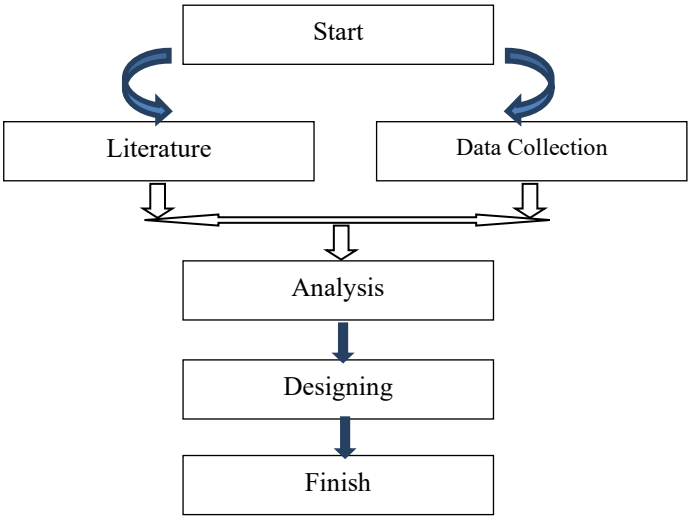

Figure 1. Research Framework

The research begins with a literature review and the required data collection. In this research, a literature review was carried out in the form of references and theoretical foundations relevant to the case of learning development, the project-based learning model with six Tasks based on the KKNI (Indonesian Qualifications Framework). References were obtained from books, journals, research report articles, and online sites. Data was obtained from focus group discussions and questionnaires.

The next stage is the analysis stage. The data analysis used was qualitative, namely analyzing the needs for developing learning models and the feasibility and requirements for model development at the design stage, namely designing teaching and learning activities. This activity also carried out the design of learning models suitable for teaching and learning activities. This learning model is the development of a project-based learning model (PjBL). This model is still conceptual and will underlie the development process later.

FINDINGS AND DISCUSSION

According to the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia No. 44 of 2015, article 14, paragraphs 3, 4, and 5, learning methods can be selected to implement teaching and learning. Furthermore, Joyce et al. (2011) said that by using a learning model, we take steps to avoid two mistakes. The first is the assumption that a learning model is feasible, and then the model must be applied. Second, the assumption is that each subject has a learning style, so it is impossible to change and improve. The learning model is very dynamic, following the needs and learning objectives. Modify, especially to some learning methods and models, and do as necessary to develop or adapt to needs. If necessary, professional teachers must adjust learning models and methods to achieve learning objectives (Khoerunnisa & Aqwal, 2020).

Based on this description, a learning model must be developed following the environment and learning outcomes. An appropriate learning model is significant to help students have skills in learning as well as doing the six tasks according to the implementation of the KKNI. From the existing learning models based on the criteria and syntax, the PBL model is the most suitable model to be developed to accommodate the intended learning following the implementation of the six tasks in the KKNI.

Project-Based Learning Model

One learning model that uses a scientific approach is project-based, namely a learning model that uses projects (activities) as the core of learning (Sumantri, 2015). Students use exploration, assessment, interpretation, synthesis, and information to produce various learning outcomes. Vocational schools developed the project-based learning model, which is easy to implement and

highly effective in improving the quality of graduates, as seen from student work readiness (Sudarsono et al., 2022).

Project-based learning is the application of active learning methods in student-centered classes (Zancul et al., 2017). The project-based learning model is designed for students to investigate and understand complex problems. This model begins the process of critical thinking and analysis to find answers (Chiang & Lee, 2016; Darmadi, 2017). Implementing project-based learning models can increase students' problem-solving abilities (Jalinus & Nabawi, 2018). The application of this learning is in the form of project assignments to produce real products that can encourage student creativity to be able to think critically in analyzing material in the concept of problems to improve students' understanding of learning (Habók & Nagy, 2016; Harmer & Stokes, 2014; Ismuwardani et al., 2018; Winatha & Abubakar, 2018). The application of the project-based learning model is more effective in assessing student project assignments than the conventional learning model using the tutorial method (Lesmana & Jaedun, 2015).

The learning steps in project-based learning, as developed by edutopia (2007) and used in this study, can be seen in Table 1.

Table 1. Project-Based Learning Syntax

No.	Phase	Description
1	Start With the Essential Question	- Learning begins with essential questions - Taking the topic according to reality and starting with an in-depth investigation
2	Design a Plan for the Project	- Planning the project collaboratively between teachers and students - Know the tools and materials that are accessible to help complete the project
3	Create a Schedule	- Teachers and students collaboratively arrange activity schedules
4	Monitor the Students and the Progress of the Project	- The teacher is responsible for monitoring the activities of the participants - The teacher does the monitoring by facilitating each process (becoming a mentor for students)
5	Assess the Outcome	- Assessment is carried out to assist teachers in measuring achievement standards - The teacher evaluates the progress of students
6	Monitor the Students and the Progress of the Project	- Teachers and students reflect both individually and in groups on project activities and results

Based on the description of the PjBL stages, Project-based learning is assumed to be suitable to support the learning model that will be developed. Therefore, the learning implementation with six tasks based on the KKNI can be optimally achieved.

The Concept of Learning Model Development Results

A learning model is needed to achieve the learning objectives based on the six tasks of the KKNI. From the existing models, the model that meets the learning objectives is the Project Based Learning Model, but this model only focuses on project implementation. Therefore, it is necessary to develop the PjBL model. Several researchers have developed the project-based learning model. Some researchers develop models to increase interest by collaborating investigations in project-based learning (Chu et al., 2011). In addition, some utilize the research results developed as a module in a learning activity (Parmin & Peniati, 2012). However, many teachers still need to develop models supporting learning with six KKNI tasks.

This learning model needs to be developed from a project-based learning model due to several assumptions, including: Through learning, students will build their skills in answering problems (Shepperson, 2017); Learners learn in small groups by working on real-world problems (Ram et al., 2007); Furthermore, project-based learning does not close the gap between cognitive and behavioral patterns (Kılınç, 2010); In project-based research findings suggest that learners with learning difficulties benefit in several ways from experiential learning (Filippatou & Kaldi, 2010)

The results of project-based research also show that learning activity has significant advantages in content knowledge and thinking skills of learners (Hernández-Ramos & De La Paz, 2009).

Following the philosophy of the project-based learning model in its development, this learning model is also based on the philosophy of constructivism and progressivism. Having the three main theories in learning, this development model is also based on the three theories: behaviorism, cognitivism, and constructivism. Therefore, by using this learning model, there will also be a change in a person's behavior, which is strongly influenced by the internal thinking processes that occur during the learning process, to achieve a balance and form a new scheme in students' minds.

Based on this description, a thinking framework is formed for developing the learning models concept. The concept is still a part of project-based learning models following behavioristic, cognitive, and constructivist based on the six tasks of the KKNI. The concept of developing the Learning Model developed in this study can be seen in Figure 2.

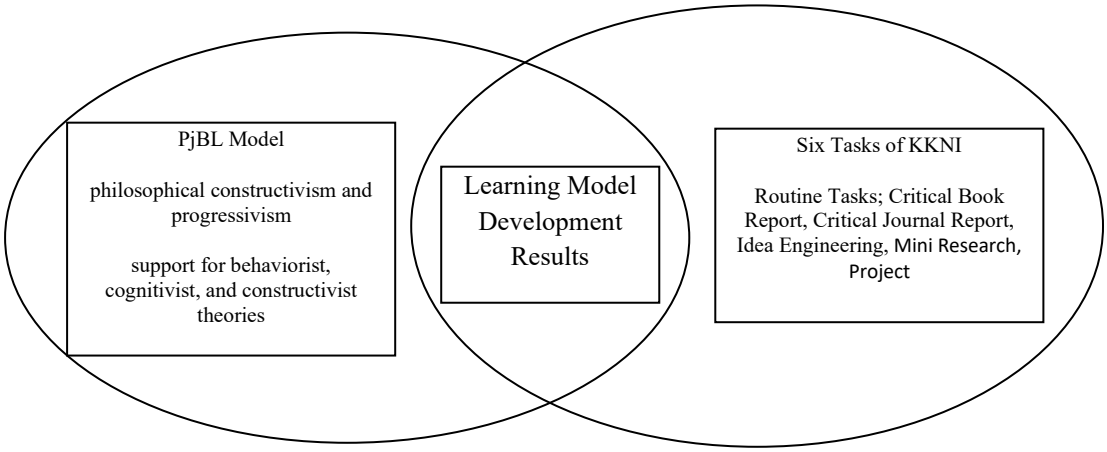

Figure 2. Development Model Concept Chart

Syntax Design of Development Outcome Learning Model

In developing this learning model process, it is necessary to synthesize the syntax of the project-based learning model by adding or developing several syntaxes. Therefore, the learning objectives using this development model can be achieved. The syntax in this development model begins with explaining knowledge and material related to learning. Then, proceed with identifying and formulating problems. This step is necessary because, in this learning, the students must first be able to read phenomena and formulate existing problems before students can do the next step. Thus, they can understand the purpose of solving existing project problems.

Following the tasks in the KKNI, the development is contained in the syntax stages 3, 4, and 5. The developed learning model can be seen in Table 2, which consists of seven steps.

Table 2. Syntax of Learning Model Development Results

No.	Steps	Description
1	Material explanation	- The teacher gives an explanation related to the knowledge in the learning material - Learners follow the lesson and ask questions
2	Review the material and formulate the problem (Routine Tasks)	- Students review the required knowledge related to the material - The teacher directs students to identify problems according to the facts that exist in the real world - The teacher directs students to formulate problems according to the real world
3	Literature review and review of books and journals (CBR and CJR)	- Students study literature and conduct studies and reviews of books and journals related to materials and problems that have been prepared - The teacher directs students to conduct studies and reviews that are in accordance with the material and problems
4	Idea Engineering (RI)	- The teacher attracts attention and opens the minds of students to be able to come up with ideas in answering problems - Based on the results of the literature review, students generate ideas to answer problems
5	Mini Research (MR)	- The teacher directs students to do small research to find answers to problems in accordance with the engineering ideas that have been made - Students do a small research to answer the problem
6	Project design and implementation	- The teacher directs students to make a schedule for project implementation - The teacher directs students to prepare equipment and materials for the project - Students make a schedule and prepare the necessary equipment and materials - Students carry out project implementation as solutions to problems
7	Presentation and Evaluation	- Students do the presentation of the work that has been done - Assessment is carried out to assist teachers in measuring achievement standards - The teacher evaluates the abilities and experiences of students after doing the project

CONCLUSION

Based on the development from the results of the project-based learning model slices with learning tasks according to the KKNI, a syntax design concept for this development model consists of seven stages. The syntax stages 1, 2, 6, and 7 adopt the PjBL model, while the syntax stages 3, 4, and 5 adopt learning tasks in the KKNI.

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