Development of the Link and Match Learning Program through the Application of the Dual-System Method to Support the Industrial Revolution 4.0 in Sinergy with Freedom to Learn

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Abstract: This study aims to describe a Link and Match program used on dual-system models that is valid, practical, and effective to support industrial revolution 4.0 in profile freedom to learn. This type of research is development research with the ADDIE development design which includes analyze, design, development, implementation, and evaluation. The data analysis technique uses a mixed method which combines qualitative and quantitative methods. The results showed that: The Link and Match program using a dual-system model is declared valid, including syllabus, RPP, e-LKPD and e-Handout whose learning process is designed to include activities that adapt to Indonesian national work competency standards (SKKNI Level II) by maximizing the use of various representation that can support the industrial revolution 4.0 with the profile of independent learning. The presentation of e-LKPD and e-Handouts has been adapted to the local wisdom competencies available in Lampung Province and the needs of students to study independently or in groups so that they can support the industrial revolution 4.0 with the profile of independent learning; The practicality of the Link and Match program using a dual-system model is reviewed based on student responses which include responses to the learning process, responses to e-LKPD and e-Handouts so that they can be used as a productive learning topic on Rubber Processing in SMK class XI semester odd; The effectiveness of the Link and Match program using a dual-system model is categorized as high which show that there is an average difference between the experimental class and the control class. The output of this development is the establishment of MoU (Memorandum of Understanding) with various DUDI in Lampung Province.

Keywords: Dual-System Method; Freedom to Learn; Industrial Revolution 4.0; Learning Program; Link and Match

Introduction

Education with a dual system pattern in schools and training in the industrial world is being encouraged to achieve competency in order to prepare skilled human resources in their fields. In some developed countries such as Germany, the conditions of the dual system of vocational education and training changed fundamentally during the second half of the 20th century (Baethge & Wolter, 2015). This is in line with the increasingly massive need for human resources in the era of the industrial revolution 4.0 (Ridwan, 2021). Learning from various programs and activities that integrate theory and work practice through a curriculum

specifically designed as a knowledge practice that involves students who can integrate a learning process (Atkinson, 2016). Due to the massive development of vocational education in various developed countries, modern education such as dual education, continuous vocational education and others, needs to be improved and implemented into the education process, especially vocational high schools (Berezovska et al., 2020).

Khurniawan & Haryani (2016) describe two problems underlying the implementation of technology and vocational education in Indonesia. From the demand side, industry circles state that the qualifications of graduates do not meet the expectations of the business/industrial world, both in mastering hard skills, soft skills (work ethic and independence), as well as communication skills which are needed to anticipate developments. technology. This means that the industry needs workers who are skilled and have a good attitude or are productive and resilient. From the supply side, vocational education institutions are faced with limited resources (facilities, human resources and finances) and low involvement of the business world/industrial world as users of graduates in the development of Vocational High Schools, resulting in a gap in information about industry demands. Education is expected to not only produce skilled workers but also make society more democratic, humane and socially just (Subkhan, 2023).

Entering the era of industrial revolution 4.0, vocational schools face the challenge of being able to carry out reforms or changes in several sectors in order to be able to produce human resources that are able to compete in the world of work. The challenge of the industrial revolution 4.0 is not only competition between human workers but also with machines (Kholiq, 2020). The situation of shifting human labor towards machines and digitalization is a form of challenge that needs to be responded to by students. This challenge needs to be answered by increasing student competence, especially mastery of computer technology, communication skills, the ability to work collaboratively, and the ability to continue learning and adapt to environmental changes (Fadli et al., 2019).

Departing from this, the government's current up to date program is Education 4.0, namely a program to support the realization of intelligent education through improving and equalizing the quality of education, expanding access and the relevance of utilizing technology in realizing world class education that produces collaboration, communication, critical thinking and creative. In an effort to improve the quality of human resources, the Minister of Education and Culture synergized to implement the Freedom to Learn education program which is used as a direction for future learning, namely by leading the recovery movement for freedom of learning.

The education system in Lampung is very concerned about the relationship between educational practices and national education policies which contain competencies for graduates, standards for educators and education staff, facilities and infrastructure standards, management standards, financing standards and assessment standards. From these aspects, of course, many educational policies have been made in the implementation of national education, one of these policies is link and match in the world of education (Disas, 2018). Furthermore, Rahayu et al. (2020) also conveyed the idea that the link and match policy implemented was able to increase cooperation with the business world to provide wider access for vocational school students to carry out field work practices for teaching and education staff, encourage industry to provide support for the development of teaching factories and infrastructure. , as well as accelerating the completion of work capability formulations which include aspects of knowledge, skills and attitudes that are relevant to the implementation of duties and terms of office determined in accordance with the provisions of applicable laws and regulations in the industrial sector. The existence of links and matches between labor suppliers and Vocational Education users can find out what competencies (skills) are most needed in the world of work. Apart from that, the link and match cooperation model are said to be effective if the link and match cooperation model delivers the competency standards of vocational school graduates the same as DUDI's expected competencies (Husein, 2019). Other researchers also revealed that the link and match program was very helpful in establishing vocational school collaboration with DUDI with various approaches such as competency based training (CBT) and strategies such as the MoU program for the business world and the industrial world (DUDI), curriculum alignment, industrial work practices (PRAKERIN), and expertise competency testing (UKK) so that the link and match will be effective and beneficial for both parties (Maulina & Yoenanto, 2022). The strategy implemented as a whole has increased the number of work readiness vocational school students in West Java. This is in line with the results of research by Andayani (2021) which revealed that the application of Link and Match through project-based learning with DUDI can develop vocational schools in producing graduates who are relevant to the changes occurring in society and DUDI.

The dual system model is a learning model that is implemented in two places, namely vocational schools and companies, both of which work together to create reliable work abilities for the training graduates (Muliati, 2007). Dual system is interpreted as dual system education. According to Lestari & Siswanto (2015), industrial work practices are part of the learning

program that must be carried out by every student in the world of work as a form of implementing the education system in vocational schools, namely the Dual System. It can be understood that in principle students receive theoretical lessons at vocational schools, and then learn directly about practice in companies or the world of work. This system integrates two main environments in the learning process, namely the school environment and the company environment.

Case study facts in the field supported by indirect interviews with vocational school physics teachers in Lampung province, it was found that the application of the dual-system model was still relatively minimal based on the teaching materials used. Post-pandemic, the teaching materials used by the majority are not sufficient as a guide to serve as a basis before practical work activities are carried out. Apart from that, the results of interviews with students revealed that many students complained about a lack of understanding regarding learning activities because the learning process activities were limited. Link and match are learning that creates learning between the school and the business world of industry (DUDI), where the program must be aligned with industry. The implementation of the Link and Match program which is supported by a dual system model has the potential to create conducive learning and can support the needs of the Industrial Revolution 4.0. Therefore, this research aims to develop a Link and Match learning program using a dual system model to support the Industrial Revolution 4.0 with an Independent Learning profile where the expected output from this development is the establishment of an MoU (Memorandum of Understanding) with various DUDI in Lampung Province.

Method

This type of research is development research with an ADDIE development design which includes analysis, design, development, implementation, and evaluation (Branch, 2010). Data collection techniques use non-test techniques and test techniques. Non-test techniques use instruments in the form of pre-research questionnaires, product validation questionnaires and teacher and student response questionnaires to measure product practicality. Meanwhile, the test technique is used to measure the achievement of the dual system between the experimental class and the control class using competency test questions certified by BNSP.

The data analysis technique uses a mixed method which combines qualitative and quantitative methods. Qualitative analysis includes analysis of pre-research questionnaires, analysis of expert validation questionnaires, and analysis of educators' and students'

responses. Quantitative analysis is used to determine the effectiveness of the program developed with a non-equivalent pretest – posttest control group design experimental design.
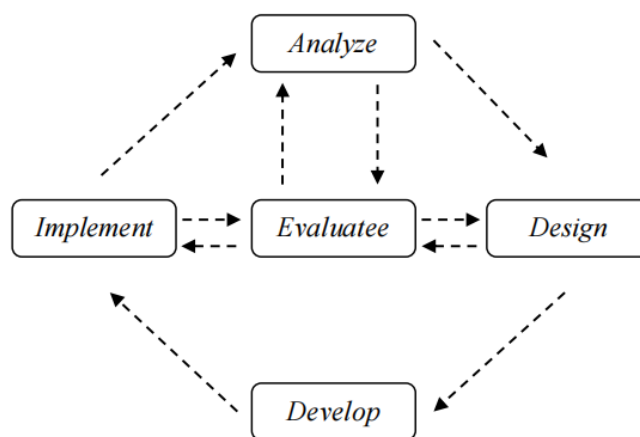
Figure 1. ADDIE's development design flowchart

Result and Discussion

The results of research on the development of the Link and Match program through the application of the Dual-System model to support the industrial revolution 4.0 include the results of analysis of teacher and student needs, validity test results, practicality test results, and effectiveness test results.

Need Analysis Result

Problem identification was carried out by distributing questionnaires related to learning on rubber processing material carried out by 8 teachers and 24 students from several vocational schools in Bandar Lampung. The survey results show that the physics learning carried out in schools is quite diverse with the use of student-centered learning models and methods, not only lectures but teachers also direct discussions, experiments, demonstrations and practicums. However, after the study and learning process, there are still many outputs that have not reached the expectations of being ready and accepted into DUDI, a link and match learning program through a dual-system model that is in accordance with the SMK slogan in order to create creativity, innovation and work readiness.

Based on problem identification through the distribution of questionnaires, it is known that the majority of learning carried out in schools is not in accordance with the needs of the industrial world market, this is due to a lack of coordination between teachers and DUDI. Because there is a lot of learning at school that does not match the competencies required by DUDI. The results of the dual-system model analysis

provide a brief overview that solving complex problems requires different activities which also involve market parties who will later absorb the output and participate in synergy according to DUDI's needs.

Next, a needs analysis was carried out in the form of a literature review from various previous studies as well as conducting interviews and filling out questionnaires with students and teachers in several schools in Lampung. A needs analysis was carried out to explore information about the physics learning carried out which included the learning models/methods used, the use of teaching materials in learning, skills trained, implementation of practicum activities, and assessment of learning outcomes.

Validity Test Results

Table 1. Summary of Construct Validation Results

Aspects	Expert Assessment (%)			Average (%)	Category
	I	II	III		
Assessment of the link and match learning program through the application of a dual-system model to support the industrial revolution 4.0 in synergy with independent learning (e-handout)	78	95	100	91	Very Valid
Assessment of the link and match learning program through the application of a dual-system model to support the industrial revolution 4.0 in synergy with independent learning (e-LKPD)	81	95	100	92	Very Valid
Average	79.5	95	100	91.5	Very Valid

Validation of the link and match program using a dual-system model was carried out by 2 academic expert validators and 1 practitioner expert validator. The assessments and suggestions from the validator are then used as a basis for revising the learning program. The results of the recapitulation of content and construct validation in the link and match program using the dual-system model in the syllabus and lesson plans shown in

tables 1 and 2 obtained an average score of 91.5% and 88.48% respectively with very high validity categories. These results indicate that the quality of the construction and content of the link and match program using the developed dual-system model is very good.

Table 2. Summary of Content Validation Results

Aspect	Expert Assessment (%)			Average (%)	Category
	I	II	III		
RPP assessment	76	96	100	90.67	Very Valid
e-Worksheet Assessment	81	93	100	91.33	Very Valid
Assessment of teaching factory syntax in e-Worksheet	50	100	100	83.34	Very Valid
Language assessment of e-Worksheet	77	84,65	100	87.22	Very Valid
Assessment of e-handout	78	94	100	90.67	Very Valid
Language assessment of e-handout	77	86	100	87.67	Very Valid
Average	73.16	92.28	100	88.48	Very Valid

These results are inseparable from the development of the syllabus and lesson plans which consider the completeness and each of its components, and are supported by workshop activities for preparing learning tools in the industrial era 4.0 with material on policies and dynamics of curriculum development, analysis of curriculum implementation, preparation of learning programs, quality improvement policies Structured education and assignments for preparing learning tools assisted in BPMP supervision.

Practicality Test Results

Table 3. Practicality Test Results

Component	Percentage (%)	Category
Response to the Learning process	91.13	Very high practicality
Response to e-Worksheet	89.36	Very high practicality
Response to e-handout	90.91	Very high practicality
Average	90.47	Very high practicality

The practicality test was carried out on 25 students who had experienced learning using the link and match program through the implementation of a dual system to determine students' responses to the learning

program that had been implemented. The practicality test was carried out using a student response questionnaire consisting of 33 statements as attached. Students' responses to the learning program are divided into three aspects, namely response to the learning process, response to e-LKPD, and response to e-Handout. Based on Table 3, the results of the practicality test were assessed based on students' responses to the learning process, e-LKPD and e-Handout which respectively obtained an average score of 91.13, 89.36, and 90.91% in the practicality category. very high which shows that the practicality of the link and match program through the application of the dual-system developed is very practical. These results show that the link and match program using the dual-system model is very practical to use and can be applied to a wider sample.

The response component to learning includes students' responses to their experiences during the learning process using the link and match program using a dual-system model which includes involvement during the learning process, absorption of the knowledge they have acquired, especially on the topic of rubber processing, learning progress, interest in learning, as well as their experience in solving the given problem. The results of the responses to the learning process obtained show that learning activities carried out using the link and match program using the dual-system model are able to motivate students to develop, foster enthusiasm for learning, facilitate their interactions with friends and teachers and can foster a sense of cooperation and responsibilities that will later involve industrial partners in the learning activity process. As well as supporting the sustainability of the industrial revolution 4.0 which has the profile of independent learning. This is because in every learning activity, whether at school or during industrial work practice, students can still carry out learning activities using media that has been designed to be easily accessed anywhere and at any time.

Effectiveness Test Results

To control differences in the initial abilities of the dual-system experimental class and control class, a pretest was carried out. After being given different treatment, both classes were given a posttest to determine the dual-system improvements experienced.

Based on the research results, a picture was obtained of an increase in dual-system capabilities in the experimental class and control class. In general, both classes experienced an increase in dual-system capabilities, but in different portions. The experimental class experienced a greater increase in dual-system capabilities compared to the control class. This is stated in the pretest and posttest results obtained in the

competency test. Figure 1 shows a comparison of the increase in dual-system capabilities in the experimental class and control class for each component.
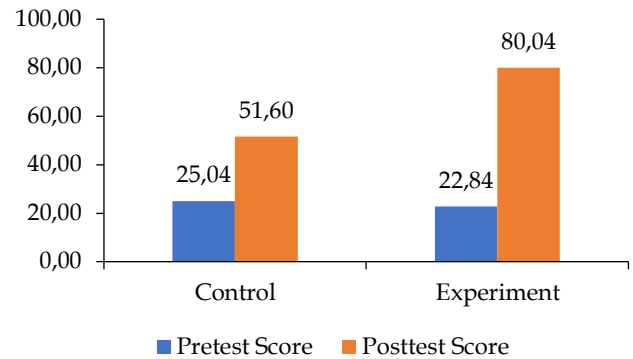
Figure 2. Comparison of Experimental Class and Control Class Dual-System Improvements

Table 4. Class Pretest and Posttest Normality Test Results Control Experiment

Uji One Sample K-S	Control Class		Experiment Class	
	Pretest	Posttest	Pretest	Posttest
Sig.	0.110	0.196	0.200	0.200
A	0.05	0.05	0.05	0.05
Decision	Normal	Normal	Normal	Normal

Table 5. Variants of the Experimental Class and Control Class

Data	Levene Statistic		
	A	Sig.	Decision
Pretest	0.05	0.198	Homogeneous
Posttest	0.05	0.697	Homogeneous

In Table 4, it appears that the Asymp.Sig (2-tailed) pretest for the experimental class = 0.200 > 0.05, and the control class = 0.110 > 0.05, this means that the pretest data for the experimental class and the control class are each normally distributed. Therefore, independent sample t-test parametric analysis can be used. Meanwhile, Asymp.Sig (2-tailed) posttest experimental class = 0.200 > 0.05 and control class = 0.196 > 0.05, this means that the average posttest data for the experimental class and control class are each normally distributed.

The results of the pretest data homogeneity test using Levene's test shown in table 5 obtained a Sig value. 0.198 > 0.05. In accordance with the decision making rules, if Sig. > 0.05 then Ho is accepted, meaning that there is no difference in the variance or mean range of pretest and posttest between the experimental class and the control class or in other words, the two classes are homogeneous. Based on the prerequisite test for

statistical analysis, a normality test using one sample K-S, data was obtained that the pretest and posttest scores were normally distributed with homogeneous variance. So, to find out whether there is a difference in the average before treatment, use the independent sample t test.

Table 6. Independent Sample T-test Results

	α	Sig. 2-tailed	Decision
Pretest	0.05	0.488	H_1 is rejected
Posttest	0.05	0.000	H_1 is accepted

In Table 6 it appears that the Sig value is obtained. = 0.488. In accordance with the decision making rules, if Sig. > 0.05, then H0 is accepted and H1 is rejected, which means there is no difference in the variance or variety of the pretest average between the experimental class and the control class. Furthermore, after the two classes received different treatment, a posttest was carried out to determine the achievements of the dual-system program in each class. Because the average dual-system posttest between the experimental class and the control class is Sig. < 0.05, then H0 is rejected and H1 is accepted, so it can be concluded that there is an average difference between the experimental class and the control class. Calculation of the effect size is to see the size of the effect between before and after treatment, posttest scores for the control class and experimental class, with a covariate of pretest scores.

Table 7. Effect Size Result

Sig.	Effect Size	Category
0.000	0.808	High

Table 7 shows the Sig value. 0.000 < 0.05. So, with the decision making rules, if Sig. < 0.05 then Ho is rejected, meaning that there is a significant difference in improvement between the experimental class and the control class due to the difference in treatment given. The magnitude of the difference in influence or effect size of the treatment given is 0.808 or 80.8%. When interpreted based on the effect size coefficient according to Cohen, this value is included in the high category. This means that there was a high difference in improvement between the experimental class and the control class after it was implemented.

The effectiveness of the learning program being developed can support the industrial revolution 4.0 with the profile of independent learning as indicated by the t-test results of pretest and posttest scores which show differences in the increase in learning outcomes after being given treatment. The effectiveness of the link and match learning program using the dual-system model is strengthened by the effect size results of 0.808 in the high

category. This is in line with the implementation of the link and match program using a dual-system model at SMK SMTI Bandar Lampung schools but with different classes receiving various types of learning media. For experimental classes, online-based media and smart classes are used which are easy for students to access anywhere and anytime. However, in the control class it is implemented using conventional teaching materials. Basically, this treatment experienced a significant increase because the effect size obtained was included in the high category. Apart from that, both the experimental class and the control class will receive certification activities from the Professional Certification Institute from the National Professional Certification Agency with the KKNI (Indonesian National Work Competency) scheme level II as a form of supporting the industrial revolution 4.0 in accordance with competencies and the tasks required by business world, industrial world.

Dual system learning programs often refer to a learning approach that integrates classroom learning with learning in the world of work or real life. This approach aims to provide practical experience to students and prepare them to enter the world of work. When viewed in terms of practical experience, students gain direct experience in the world of work or industry related to rubber processing learning material. This helps them apply theoretical knowledge obtained in the school environment to real contexts in the world of work which is assisted by critical and analytical thinking skills (Azizah, 2020; Saroji et al., 2023) which of course will have an impact on improving work skills where students do not only gain theoretical knowledge, but also develop practical skills needed in daily work. This is in line with the dual process theory developed by Kahneman (2011) who introduced the concepts of System 1 and System 2. System 1 involves fast, automatic and creative thinking, while System 2 involves slow, conscious and analytical thinking (Faghihi et al., 2015). More or less the same concept was also put forward by Stanovich & West (2000) who introduced the concepts of automatic systems and reflective systems in the context of the Rationality and Reflective Mind framework. This concept discusses how humans have two systems that produce different information that can influence decision making and problem solving.

Dual system learning programs reflect an educational approach that combines classroom learning with hands-on experience in the workplace or industry. This approach can be supported by several learning theories which state that effective learning involves practical experience and real context (Mooij, 2007; Azizah, 2020; Saksono et al., 2023; Ramadhan & Hindun, 2023). Some of these theories are action-based learning (Action Learning). This concept focuses on learning

through action and practical experience (Marquardt & Waddill, 2004; Marquardt & Banks, 2010; Pedler, 2011). Dual system programs, by providing students with opportunities for direct involvement in the workplace, support this action-based learning approach. Experience-based learning (Experiential Learning) This theory emphasizes the importance of direct experience in the learning process (Kolb & Kolb, 2009; Yardley et al., 2012; Kolb et al., 2014). Students in dual system programs have the opportunity to learn through experiences in the world of work, helping them better internalize knowledge and skills. The concept of a career-based learning approach (Career-Integrated Learning) includes integration between education and training in the world of work (Shea & Joy, 2018). Dual system programs naturally support this approach by integrating academic learning with hands-on work experience. And the last one is social learning theory where this approach highlights the importance of social interaction in learning (Bandura & Walters, 1977; Akers & Jennings, 2015). Students in dual system programs can learn through direct observation and interaction with industry professionals, acquiring the necessary knowledge and social norms that will be useful for their future career development (Krumboltz et al., 1976).

Conclusion

Based on the results of the research and discussion, it can be concluded that the Link and Match program using a dual-system model is declared valid, including syllabus, RPP, e-LKPD and e-Handout whose learning process is designed to include activities that adapt to Indonesian national work competency standards (SKKNI Level II) by maximizing the use of various representation that can support the industrial revolution 4.0 with the profile of independent learning. The presentation of e-LKPD and e-Handouts has been adapted to the local wisdom competencies available in Lampung Province and the needs of students to study independently or in groups so that they can support the industrial revolution 4.0 with the profile of independent learning; The practicality of the Link and Match program using a dual-system model is reviewed based on student responses which include responses to the learning process, responses to e-LKPD and e-Handouts so that they can be used as a productive learning topic on Rubber Processing in SMK class XI semester odd; The effectiveness of the Link and Match program using a dual-system model is categorized as high which show that there is an average difference between the experimental class and the control class. The output of this development is the establishment of MoU

(Memorandum of Understanding) with various DUDI in Lampung Province.

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