Development of Industrial Electronics Learning Tools Based on Teaching Industry Model

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Abstract. This research aims to produce Teaching Industry-based (IT-based) learning tools in accordance with the characteristics of the Implementation of Merdeka Curriculum (IMC) in Vocational High Schools (VHS) and produce IT-based learning modules for implementing learning in accordance with IMC in VHS. This research is a research & development that follows Plomp's (2007) development model, which starts from initial investigation, model trials, and implementation of IT model-based learning tools. This research focuses on the development of IT-based learning tools in VHS and the development of IT-based learning modules that match the characteristics of VHS. The development procedure begins with an assessment of IT learning theories, theories of learning models relevant to the IT concept, and an assessment of the IMC concept. Furthermore, IT-based learning syntax in the context of IMC is adopted and elaborated from learning syntaxes relevant to the IT concept. The developed learning module starts from the stage of analyzing learning objectives and work competencies that must be mastered by learners (Hard-skills and Soft-skills. Furthermore, the module was tested to users with 45 respondents. Data was analyzed using quantitative descriptive analysis techniques to describe the feasibility of learning modules.

Keywords: Learning Tools, Teaching Industry, Independent Curriculum.

1 Introduction

The development and direction of vocational education in Indonesia have become increasingly significant in addressing the country's economic needs and labor market demands. As Indonesia continues to experience rapid economic growth, the role of vocational education is recognized as crucial for equipping students with the necessary skills to enter the workforce effectively. This educational sector is designed to provide practical training that aligns with industry requirements, thereby enhancing employability and reducing unemployment rates among graduates.

One of the primary focus of vocational education in Indonesia is to create a skilled workforce that meets the demands of various sectors, including emerging industries such as halal tourism. highlights the role of vocational education in preparing graduates specifically for careers in halal tourism, which is a growing sector in Indonesia [1]. This

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targeted approach not only addresses the specific needs of the industry but also contributes to the overall economic development of the region. Additionally, emphasizes that vocational education is pivotal for sustainable economic growth, as it focuses on practical skills that are directly applicable in the job market [2].

Despite its potential, vocational education in Indonesia faces several challenges. argue that there is no significant difference in earnings between vocational and general high school graduates, which raises questions about the effectiveness of vocational education in enhancing economic outcomes for students [2]. This finding suggests a need for reform in vocational education to ensure that it provides a clear pathway to better job opportunities and higher wages. Furthermore, the high unemployment rate among vocational graduates indicates a disconnect between the skills taught in schools and the actual needs of employers [3]. This gap necessitates a reevaluation of the curriculum and teaching methods to better align them with industry standards.

The concept of "Link and Match," introduced by the Indonesian Ministry of Education, aims to bridge this gap by fostering partnerships between educational institutions and industries [4].This initiative encourages vocational schools to collaborate with businesses to develop curricula that reflect the skills and competencies required in the labor market. Such partnerships are essential for ensuring that students receive relevant training that enhances their employability. Additionally, the integration of technology in vocational education, as discussed by, can further improve the quality of training by incorporating innovative teaching methods and resources [5].

Moreover, the development of vocational education in Indonesia is influenced by various factors, including government policies and international cooperation. The government's focus on improving the quality and relevance of Technical and Vocational Education and Training (TVET) is crucial for adapting to the changing economic landscape [6]. Furthermore, international collaborations, such as those with Germany, provide valuable insights and best practices that can be adapted to the Indonesian context [3]. These efforts are aimed at enhancing the overall effectiveness of vocational education and ensuring that it meets the evolving needs of the economy.

In conclusion, the development and direction of vocational education in Indonesia are critical for fostering a skilled workforce capable of contributing to the country's economic growth. While there are challenges to overcome, such as aligning curricula with industry needs and improving graduate employability, initiatives like "Link and Match" and international collaborations offer promising pathways for reform. By focusing on practical skills and fostering strong partnerships with industries, vocational education can play a vital role in shaping the future of Indonesia's workforce.

One prevalent misconception in vocational education is the belief that traditional, teacher-centered methods are sufficient for preparing students for the workforce. Many educators still rely heavily on lecture-based instruction, which can lead to a lack of engagement and practical skill development among students. As noted by this reliance on conventional teaching methods contributes to a perception that vocational education does not significantly enhance employability compared to general education [1]. This misunderstanding overlooks the necessity of integrating hands-on, experiential learning approaches, such as Project-Based Learning (PBL), which have been shown to foster critical thinking and problem-solving skills essential for success in the labor market [7].

Another misconception is the assumption that vocational education should focus solely on technical skills without considering the development of soft skills. argue that

in the context of Industry 4.0, vocational education must shift its focus from job-specific technical skills to broader competencies that facilitate labor market transitions [8]. This perspective emphasizes the importance of equipping students with skills such as communication, teamwork, and adaptability, which are increasingly valued by employers. However, many vocational programs still prioritize technical training at the expense of these essential soft skills, leading graduates who may struggle to meet the holistic demands of the workplace.

Therefore, this research focuses on developing a learning tool in teaching industry-based vocational high schools (VHS) that is adjusted to the characteristics of the Merdeka curriculum and the profile of Pancasila students. We need a learning tool that can grow or improve thinking skills and work abilities. Vocational education institutions, especially VHS and industry, cooperate to build industrial classes with the concept of teaching industry (TI) so that the 21st-century skills needed can be met in synergy between VHS, industry, and government policies. Therefore, vocational education is basically "education for work". So, it is very urgent to develop the "Teaching Industry" as a model for developing graduate skills, including the ability to use work equipment and critical thinking skills in facing the development of the global world of work. IT-based learning can adopt Project-Based Learning (PjBL) and, or Work-Based Learning (WBL) learning models. TI model also adopts a conceptual framework of Technological Pedagogical Content Knowledge (TPACK) introduced in 2006. The TPACK concept is a concept for teachers who integrate aspects of knowledge, pedagogy, and technology in the learning process [9].

1.1 The Merdeka Curriculum

The Merdeka Curriculum, introduced in Indonesia in 2020, represents a significant shift in the educational landscape, aiming to foster a more flexible and student-centered learning environment. This literature review synthesizes various studies on the Merdeka Curriculum, highlighting its objectives, implementation challenges, and implications for educational practices in Indonesia.

The Merdeka Curriculum, or "Freedom Curriculum," is designed to provide schools with the autonomy to tailor their teaching strategies to better meet the needs of their students. emphasizes that this curriculum aligns with the educational philosophies of Ki Hajar Dewantara, promoting student independence and encouraging learners to grow and learn autonomously while being supported by educators [10]. This principle of independence is central to the Merdeka Curriculum, which seeks to empower students to take charge of their learning processes.

One of the primary goals of the Merdeka Curriculum is to enhance the quality of education by focusing on essential competencies and character development. The curriculum aims to improve science literacy and critical thinking skills among students, equipping them with the necessary tools to navigate complex scientific issues [11].This focus on competencies is echoed by Ni'Mah, who notes that the curriculum emphasizes fundamental subjects while fostering creativity and critical thinking, essential skills for the 21st century [12].

Despite its promising objectives, the implementation of the Merdeka Curriculum has faced several challenges. For instance, discuss the difficulties elementary school teachers encounter in developing thematic learning tools that align with the new curriculum [13]. These challenges are compounded by a lack of understanding among educators regarding the curriculum's principles and requirements, as highlighted by 's research, which indicates that many school leaders and teachers need further training to effectively implement the Merdeka Curriculum [14].

Moreover, the transition from the previous curriculum, known as K-13, to the Merdeka Curriculum has raised concerns about the readiness of schools and educators to adapt to the new system. points out that the shift necessitates a comprehensive understanding of the curriculum's principles and a commitment to fostering a more engaging and meaningful learning environment [15]. This transition is critical, as the Merdeka Curriculum is intended to address the learning losses experienced during the COVID-19 pandemic by promoting more effective teaching and learning strategies [16].

In conclusion, the Merdeka Curriculum represents a transformative approach to education in Indonesia, emphasizing student independence, competency development, and contextualized learning. While the curriculum holds great potential for improving educational outcomes, its successful implementation is contingent upon addressing the challenges faced by educators, enhancing their understanding of the curriculum, and fostering supportive leadership within schools. Future research should focus on identifying the best practices for implementing the Merdeka Curriculum and exploring its long-term impacts on student learning and development.

1.2 The Pancasila Learner Profile (P3)

The Pancasila Learner Profile aims to make Indonesian students lifelong learners who are competent, characterised and behave according to the values of Pancasila. In this context, the Pancasila learner profile has a formulation of competencies that complement the focus in achieving the Graduate Competency Standards at each level of the Education unit in terms of instilling character in accordance with the values of Pancasila [17].

The Pancasila Learner Profile is a Graduate Competency Standard (SKL) that is formulated in an integrated manner in the form of a description, consisting of 6 (eight) competencies that characterise the profile of Pancasila learners [18].This profile reflects the quality of the generation in accordance with the National Education Goals and the views and ideals of the founding fathers [19]. Furthermore, Pancasila learners are the embodiment of Indonesian learners as lifelong learners who have global competencies and behave in accordance with the values of Pancasila [17]. The six competencies that characterise Pancasila learners are faith, devotion to God, and noble character; global diversity; cooperation; independence; and critical and creative reasoning [20].

1.3 Project-Based Learning (PjBL)

Project-Based Learning (PBL) has emerged as a significant pedagogical approach in vocational education, offering students opportunities to engage in hands-on, real-world projects that enhance their learning experiences. This literature review synthesizes various studies on the implementation and effectiveness of PBL in vocational education, highlighting its benefits, challenges, and the necessary conditions for successful integration.

PBL is characterized by its student-centered approach, where learners actively participate in planning, executing, and reflecting on projects that are relevant to their fields of study. describe PBL as an alternative learning model that allows students to develop metacognitive skills through project work, enabling them to assess their learning processes and outcomes effectively [21]. This aligns with the findings of, who emphasizes that PBL is particularly relevant for vocational education, as it equips students with both theoretical knowledge and practical skills necessary for industry adaptation [17]. The integration of PBL in vocational settings fosters critical competencies such as problem-solving, collaboration, and communication, which are essential for success in the modern workforce.

The effectiveness of PBL in enhancing labor literacy among students has been noted by who argues that project-based teaching can significantly improve students' readiness for the labor market [22]. This is echoed by who highlight that PBL can be tailored to meet the specific needs of diverse learner populations, including women in rural areas, thereby promoting inclusivity in vocational education [23]. Furthermore, the flexibility of PBL allows for the incorporation of various teaching methods and tools, making it adaptable to different educational contexts.

However, the successful implementation of PBL in vocational education is contingent upon several factors. emphasize the importance of teacher training and industry collaboration in facilitating effective project-based learning experiences [24]. Teachers must possess the necessary skills to guide students through the complexities of project work, which often requires a shift from traditional teaching methods to more facilitative roles. Additionally, the integration of industry input into project design ensures that the projects are relevant and aligned with current market needs, enhancing the employability of graduates [25].

Challenges in implementing PBL include the need for adequate resources and institutional support. note that the development of e-modules for project-based learning can help address some of these challenges by providing structured guidance for both students and educators [26]. Moreover, the establishment of a supportive learning environment that encourages experimentation and risk-taking is crucial for fostering creativity and innovation among students.

In conclusion, Project-Based Learning represents a transformative approach in vocational education that promotes active learning and skill development. While there are challenges to its implementation, the benefits of PBL in enhancing student engagement, labor literacy, and employability are well-documented. Future research should focus on

identifying the best practices for PBL integration, teacher professional development, and the role of industry partnerships in maximizing the effectiveness of this educational model.

1.4 Work-Based Learning (WBL) Work-based learning

Work-Based Learning (WBL) has become an essential component of vocational education, particularly in Indonesia, where it aims to bridge the gap between theoretical knowledge and practical skills required in the labor market. This literature review synthesizes various studies on the implementation and effectiveness of WBL in vocational education, highlighting its benefits, challenges, and implications for educational practices.

WBL is characterized by its integration of real-world work experiences into the educational curriculum, allowing students to apply their knowledge in practical settings. WBL encompasses both school-based learning and workplace learning, emphasizing the importance of developing professional competencies through meaningful connections between knowledge, skills, and attitudes [27]. This dual approach is crucial for preparing students to meet the demands of the workforce, as it provides them with hands-on experience and exposure to industry practices.

One of the primary benefits of WBL is its ability to enhance students' employability. Research by indicates that WBL facilitates the integration of school-based and workplace learning, which is essential for developing the competencies that employers seek [27]. This is particularly relevant in vocational education, where practical skills are paramount. The study highlights that students who engage in WBL are better equipped to transition into the workforce, as they possess both theoretical knowledge and practical experience.

Moreover, WBL fosters the development of soft skills, such as communication, teamwork, and problem-solving, which are increasingly valued by employers. According to, the experiential nature of WBL allows students to engage in collaborative projects, thereby enhancing their interpersonal skills and preparing them for the dynamics of the workplace [28]. This aligns with the findings of those who emphasize that effective vocational education must focus on both technical and soft skills to ensure that graduates are well-rounded and capable of thriving in diverse work environments [29].

Despite its advantages, the implementation of WBL in vocational education faces several challenges. One significant issue is the need for strong partnerships between educational institutions and industry stakeholders. As noted by the effectiveness of WBL is contingent upon the quality of these partnerships, which can influence the learning experiences provided to students (Bishop, 2020). Furthermore, the alignment of curriculum with industry needs is crucial for ensuring that students acquire relevant skills that meet labor market demands.

Another challenge is the variability in the quality of WBL experiences. Research by indicates that not all workplace learning opportunities provide the same level of engagement or skill development (Syam, 2024). This inconsistency can lead to disparities

in student outcomes, highlighting the need for standardized guidelines and quality assurance mechanisms to ensure that WBL experiences are meaningful and beneficial for all students.

In conclusion, Work-Based Learning is a vital component of vocational education that enhances employability and skill development among students. While the benefits of WBL in fostering practical skills and soft competencies are well-documented, successful implementation requires addressing challenges related to industry partnerships and the quality of learning experiences. Future research should focus on developing effective strategies for integrating WBL into vocational education frameworks, ensuring that it meets the evolving needs of the labor market and prepares students for successful careers.

1.5 Teaching Industry Learning Model (TI Model)

The Teaching industry learning model is a learning model that aims to provide an actual experience to students through conditioning situations and industrial work processes in schools. In line with this, the Teaching Industry learning model has modeled the basic concept of transferring part of the educational process and industrial processes in a learning design so that competency-based education is held that produces human resources who win in global competition. Teaching Industry is an industrial learning activity that aims to condition students into the actual production process situation in the industry, by presenting materials that are combined between SMK curriculum materials with material from the industry so that synchronization occurs between the two materials. Teaching Industry or industrial learning is a form of effort to provide a real experience to students by involving students in production/services in industry or schools by involving students directly.

Industrial learning is certainly different from other learning, where industrial learning students gain real experience in accordance with the industry's needs. Thus, to realize the teaching industry is necessary to have the ability of teachers who are professional in their fields, and competent industrial instructors, innovative students who can make new technological innovations. In addition, government policies that overshadow the ongoing process, so that the synergistic partnership of SMK, DUDI, and the government so that the fulfillment of graduates' abilities can be achieved according to the objectives of vocational education so that they can face various challenges in the 21st century through the Teaching Industry.

2 Method

This research is research and development (Research & Developmental) oriented product development, namely the Teaching Industry-based (TI-based) Industrial Electronics Learning Tools to improve critical thinking skills and work abilities. However, this research is still at an early stage where the focus is on producing a TI-based learning tools. In addition, this initial stage of research also focuses on producing Learning Modules that will be used in TI-based learning. This initial stage of research was carried out at the Department of Electronic Engineering, FT UNM, to develop a TI learning model and develop, validate, and test TI-based learning modules. Modules are validated by 2

media experts and 2 module content experts. The subjects of the module trial were 45 students of the Mechatronics Vocational Education Study Program, Faculty of Engineering, State University of Makassar.

The procedures/stages in this study are:

1) Initial research was conducted through a review of relevant theories and scientific articles. The initial research stage is intended to analyze the needs of the model to be developed. The activities carried out at this stage are: (a) Analysis of the learning process that has taken place so far; (b) Analysis of current TI learning problems related to the quality of VHS graduates; (c) Reviewing the TI concept, and its implementation indicators; learning theories TI, the principles of TI learning, and the analysis of the current TI learning models.
2) The model design stage aims to formulate: (a) The purpose of the learning model, namely writing IT learning indicators, describing the TI steps, drafting TI syntax, based on the analysis, a conceptual framework for the industrial electronics learning model is made. TI-based; (b) Interview sheets and observation sheets, namely developing evaluation products to measure the implementation of the developed model. This interview sheet and observation sheet were given to 10 industrial electronics productive teachers. (c) Methods, approaches, and strategies used in the model, namely formulating methods, approaches, and strategies for TI-based industrial electronics learning models; (d) TI-based industrial electronics learning model materials, namely developing learning tools and learning modules that will be used in the implementation of TI-based learning processes.

The learning module developed is for PLC subjects. The instrument for assessing the feasibility of the module was validated through testing on 45 respondents and analyzed using the Product Moment (Pearson) correlation test technique. The reliability test was carried out using the Inter-Rater Reliability and analyzed using the Cohen-Kappa and Cronbach's Alpha techniques.

3 Results and Discussion

3.1 Result

3.1.1 TI Model Syntax

Syntax is a phase (activity stage) in learning. As a result, the learning syntax will indicate the activities carried out by teachers and students. Thus, the syntax of the model is designed by considering the constructivist cognitive-behavioristic TI-based. Therefore, the syntax of the TI model leads to cognitive-constructivist-behavioristic. The TI Model syntax is presented on the table below:

a) Set up the school ecosystem

- Building an education unit culture that supports the implementation of the Pancasila learner profile strengthening project
- Understand the role of learners, educators, and the education unit environment in the implementation of the Pancasila learner profile strengthening project
- Encourage the strengthening of educators' capacity in the implementation of the Pancasila learner profile strengthening project

b) Designing the Project
- Project planning flow
- Design time allocation and dimensions
- Form a project facilitator team
- Identify the stages of readiness of the education unit in carrying out the project
- Determine project dimensions and themes
- Develop the project module
- Determine sub-elements (project objectives)
- Design project topics, activity flows, and assessments

c) Work on the project
- Initiate project activities
- Optimising project implementation
- Closing the project activities
- Optimising industry partner involvement

d) Document and report project results
- Collecting and processing assessment results
- Compile a report card on the project to strengthen the Pancasila learner profile

e) Project evaluation and follow-up
- Principles of project implementation evaluation
- Examples of evaluation tools and methods project implementation
- The role of education unit supervisors and industry in project evaluation
- Follow-up and sustainability of the project

3.1.2 TI Model Syntax

Please note that the first paragraph of a section or subsection is not indented. The first paragraphs that follow a table, figure, equation etc. does not have an indent, either.

a. Instrument Validity Test

The validity test was analyzed using the Product Moment (Pearson) method with the following criteria:

Significance Value < 0.05 = Valid

Significance Value > 0.05 = Invalid

Based on the results of the analysis, the significance value of all statement items is in the range of 0,00 – 0.03. So, it can be concluded that all statement items on the instrument are declared valid.

b. Reliability

Test Inter-rater reliability test used Cohen Kappa with the following criteria:

Approx value. Sig. < 0.05 = Unreliable

Value Approx. Sig. > 0.05 = Reliable

1) Media Expert Reliability Test (Inter-Rater Reliability)

The following are the results of the media expert reliability test using the Cohen Kappa method using SPSS version 26:

Table 1. Symmetric Measures of Media Expert

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	-.038	.206	-.181	.856
N of Valid Cases		22			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

The value of Approximate Significance is 0.856 > 0.05. So, it can be concluded that the media expert's instrument is declared reliable.

2) Content Expert Reliability Test (Inter-Rater Reliability)

The following are the results of the media expert reliability test using the Cohen Kappa method using SPSS version 26:

Table 2. Symmetric Measures of Content Expert

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	.175	.217	.801	.423
N of Valid Cases		20			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

The value of Approximate Significance is 0.423 > 0.05, so it can be concluded that the content expert instrument is declared reliable.

3) User Reliability

Test User reliability test uses Cronbach's Alpha with the criteria:

Cronbach's Alpha value > 0.6: reliable.

The following are the results of Cronbach's Alpha using SPSS version 16:

Table 3. Reliability Statistics

Cronbach's Alpha	N of Items
.959	40

Cronbach's Alpha value is 0.959 which is greater than 0.6, so it can be concluded that the instrument for users is declared reliable.

Table 4. The Result of Media Expert Validation

Score Interval	**Category**
$X \geq 66$	Very Good
$55 \leq X < 66$	Good
$44 \leq X < 55$	Not Good
< 44	Very Not Good

MEDIA EXPERTS	**SCORE**	**PERSENTAGE**	**APPROPRIATENESS**
EXPERT1	72	81,82%	Very Good
EXPERT2	74	84,09%	Very Good
AVERAGE	73	82,95%	Very Good

Table 5. The Result of Content Expert Validation

Score Interval	Category
X ≥ 60	Very Good
50 ≤ X < 60	Good
40 ≤ X < 50	Not Good
< 40	Very Not Good

MEDIA EXPERTS	SCORE	PERSENTAGE	APPROPRIATENESS
EXPERT1	69	86,25%	Very Good
EXPERT2	67	83,75%	Very Good
AVERAGE	68	85%	Very Good

Table 6. Result of the module trial (45 respondents)

(Likert scale 1-4)

	GRAPHIC ASPECT	MATERIAL PRESENTATION ASPECT	LANGUAGE ASPECT	BENEFIT ASPECT	SCORE TOTAL
NUMBER OF ITEMS	13	11	1	15	40
SCORE MAX	2340	1980	180	2700	7200
SCORE TOTAL	1916	1592	148	2211	5867
AVERAGE	3,28	3,22	3,29	3,28	3,26
PERCENTAGE	81,88%	80,40%	82,22%	81,89%	81,48

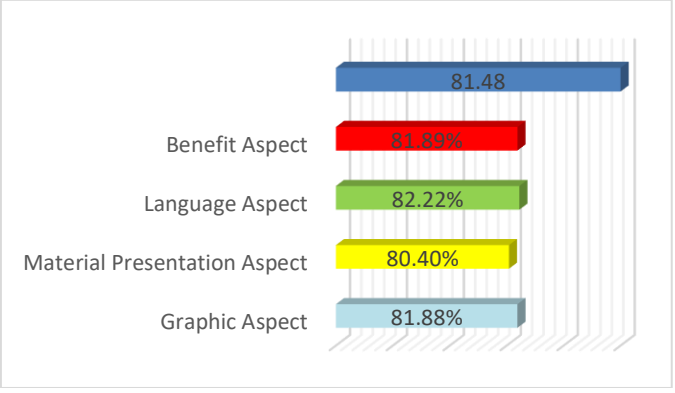

Fig.1: Module Test Result Graph

Based on the data from the learning module trial results above, it shows that the four aspects in the developed learning module have an average percentage above 80 percent. So, it can be concluded that the learning module developed based on the characteristics of the independent curriculum is suitable for use in the learning process in industrial electronics classes.

3.2 Discussion

Learning using the TI Model, the role of the teacher is needed to handle individual situations. Therefore, the teacher can monitor how far the tasks have been done by students so that students who have difficulty will convey their problems to the teacher. Furthermore, the teacher is expected to provide directions or limited assistance to students in solving the problem (scaffolding).

Teachers need to encourage and create situations that allow students to play their roles as optimally as possible and allow for the growth and development of student ability. Therefore, for students (groups) who have difficulty in completing assignments, the teacher can ask guiding questions (guidance questions) that allow students to connect learning tasks with the material in the schema (metacognitive knowledge), as well as be able to guide students to learn. complete the task.

In the phases above, by going around the teacher can monitor how far the group work mechanism can take place as desired. In this condition, the teacher needs to remind the group to share roles and give encouragement to each group to work effectively and optimally.

Therefore, to maintain and optimize cooperation in groups, it is important for teachers: (1) Always remind students to work in groups according to their respective roles; (2) Monitor the process and student work and provide feedback; and (3) Provide reinforcement for correct work results and provide corrections for incorrect work results, especially the use of students' knowledge aspects in solving problems (assignments).

Assessment is an important part of learning. Learning using the TI model is also used in various forms of assessment. The assessment may be in the form of a paper-and-pencil, a performance assessment, a portfolio, or in the form of a project assignment. The paper-and-pencil test is carried out at the end of the sub-discussion which is intended to measure whether students have mastered the teaching materials well or not. Performance assessment is intended to test students' ability to demonstrate knowledge and skills in solving project problems. Portfolios are intended to document student learning progress over time. While the project task (project) refers to combining the subject matter into a project task. In addition, project assignments are formatted as take-home (homework).

The principle of reaction is a pattern of activities that describes a reasonable teacher response to students, both individually and in groups, as well as. The principle of reaction relates to the techniques applied by the teacher in reacting to student behavior during learning activities, such as asking, answering, responding, criticizing, daydreaming, disturbing friends, being less serious, and so on. The role (response) of the teacher in the learning model is to achieve the learning objectives set, among others: (1) providing learning resources; (2) conveying information about the material; and (3) guiding students in solving problems. Thus, in the TI Model several teacher behaviors are expected, namely: (1) creating a conducive atmosphere in learning and generating student motivation to learn. For example, by preparing students to learn (calm students) and conveying competencies achievement indicators; (2) provide and managing learning resources that can support the smooth learning process, such as manuals and practicum instructions, worksheets, and so on; (3) conveying information about the reaction aspect

in learning; (d) guiding students to learn and guiding students to solve problems prepared on worksheets and worksheets; and (e) appreciate all student activities that support the learning process (positive reinforcement) and direct student activities that hinder the learning process (negative reinforcement).

The application of a learning model is directed at supporting the optimal achievement of predetermined learning goals or objectives. In fact, in principle, model users must try to synergize all model components to achieve learning objectives. Learning objectives are divided into main goals that are immediate/urgent to be achieved (instructional effect) and accompaniment objectives that are not immediately achievable or the results cannot be achieved immediately after learning takes place but are expected to be achieved in a relatively long time (nurturant effect). The instructional impact of the TI Model, namely: (1) mastery of teaching materials in the field of industrial electronics expertise relating to the achievement of basic competencies and indicators of achieving basic competencies planned in the lesson plan; (2) a positive attitude towards the field of expertise in industrial electronics is a follow-up impact of student involvement which is quite dominant in the learning process, which is the creation of a pleasant learning atmosphere and fosters a positive attitude towards the lesson. The impact of the TI model accompaniment, namely: (1) independence in learning: armed with industrial electronics knowledge and industrial electronics skills conveyed by the teacher, as well as individual activities carried out before studying in groups, students can become more independent in learning; (2) active learning: some phases of the TI Model syntax provide more space and opportunities to develop creativity for students to play an active role in the learning process. In these phases, student involvement is very dominant in developing problem-solving ideas and producing products from project learning given on worksheets and worksheets.

4 Conclusion

4.1 A Subsection Sample

The stages of developing Teaching Industry-based Industrial Electronics learning tools start from analyzing and studying teaching industry (TI)-based learning models, analyzing industrial electronics curriculum in universities, design and development of learning tools, implementation, and final evaluation of learning tools. Teaching Industry-based Industrial Electronics learning tools that have been developed meet the criteria of valid, practical, and effective for use in colleges in the field of industrial electronics. Student responses to the development of Teaching Industry-based Industrial Electronics learning tools are classified as very good categories seen from several aspects, namely aspects of graphics, aspects of material presentation, aspects of language, and aspects of usefulness.

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