Optimizing 4C Skills through Team Based Projects Using Product Oriented Modules for Electrical Engineering Education Students

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Abstract – **In order to prepare a reliable generation in the future, students need 21st century skills which are abbreviated as 4C, namely critical thinking, collaboration, creativity, and communication. The Government through the Minister of Education and Culture responded to all forms of 21st century learning challenges by launching the Merdeka Learning Campus Merdeka (MBKM) activity. The Decree of the Minister of Education and Culture of the Republic of Indonesia Number 754/P/2020 concerning Main Performance Indicators (IKU), especially in KPI 7 concerning collaborative and participatory classes, states that in 21st century learning there are two learning methods used in the classroom, namely case method and team based projects. Therefore, the Electrical Engineering Education Study Program responded by implementing team based project learning combined with using product oriented modules to optimize 21st century skills. The research model used in this study was the ADDIE model which consisted of analysis, design, development, implementation and evaluation. The instrument used is the 4C skill instrument based on P21. This research is implemented in the 5th semester in Electrical Machinery course in the Electrical Engineering Education Study Program.**

The results obtained in the research are team based projects using product oriented modules are able to optimize the 4C skills of Electrical Engineering Education students well.

Keywords – **team based project, product oriented modules, 4C, students.**

1. Introduction

In the 21st century, technology and information greatly affect every aspect of life [1]. This will certainly make it easier for students to access anything. But if this is not used wisely, it can have a bad impact. Therefore, we have to prepare our students to become reliable students, who are ready to face the challenges of 21st century development. To face the challenges of the 21st century, students need 21st century skills which are abbreviated as 4C, namely critical thinking, collaboration, creativity, and communication [2],[3]. This is where the role of education becomes very important. Education is expected to produce human resources who have the ability in the field of communication, collaborative, technological, creative, innovative and able to solve problems [4].

In order to prepare students who are ready to face the challenges of the 21st century, the Electrical Engineering Education Study Program carries out learning innovations. The learning style has to be adapted to the needs so that the learning materials have to be more authentic [5].

The learning innovation carried out is through the implementation of a team based project on Electrical Machine learning. This is in line with the Decree of the Minister of Education and Culture of the Republic of Indonesia No. 754/P/2020 concerning Main Performance Indicators (IKU), especially in KPI 7 regarding collaborative and participatory classes that in 21st century learning there are two learning methods used in the classroom, namely the case method and team based projects. The team-based project strategy is effectively used to develop

student innovation ideas, because students have the confidence to show their best when with their group [6]. Team based project implementation will be combined by using product oriented modules. This is done because the character of the Electrical Machinery course is very suitable if it is applied to learning that produces a product output.

The selection of product-oriented modules is done because product-oriented learning can help facilitate or facilitate independent learning so that students will be able to construct 21st century or 4C skills [7]. The use of modules can help students in learning and have an impact on improving learning outcomes [8], [9]. Learning with media modules can make it easier for students to understand lecture material [10]. Modules can facilitate students to learn independently (self-instructional) and are written in unit competency courses [11], [12]. The use of modules in the learning process does not only look at the activities of lecturers, but also involves students actively in learning. The use of the module will create an independent learning process [9], [13].

Based on the explanation above, this research aims to provide innovative team based project learning by developing product oriented modules. Team based project learning innovations using product oriented modules are implemented in the Electrical Machinery course. The development of product oriented modules is expected to be feasible and effective to optimize 4C skills.

2. Method

The research method used in this study is the ADDIE Model. The ADDIE Model including Analysis, Design, Development, Implementation and Evaluation. The representation of these steps can be seen in Figure 1.
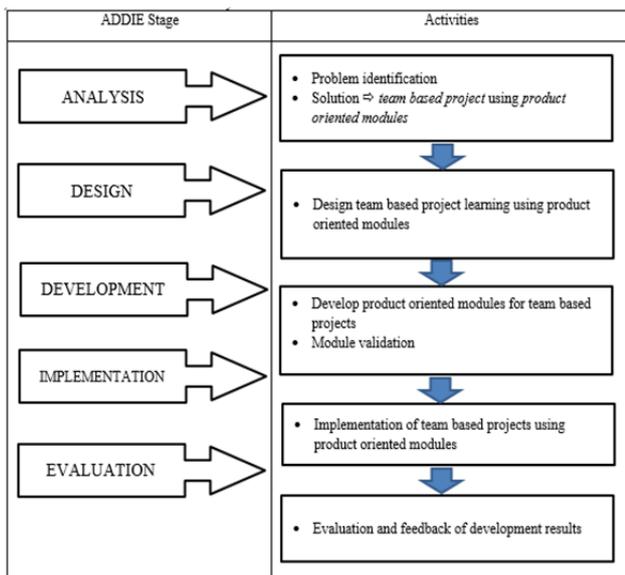

Figure 1. ADDIE Research and Development Flow

The research subjects in this study were students of the Electrical Engineering Education Study Program who took the Electrical Machinery course. The data collection techniques used in this study is observation and questionnaire. Observation is a way of collecting data which is done by conducting systematic observations or recordings of the phenomena that are being targeted for observation. Questionnaires are a number of written questions that are used to obtain information from respondents in terms of reports about themselves or things they know. In this study a questionnaire was used as a quantitative data collection technique. In more detail in this research and development, there are two questionnaires used. First, a product validation questionnaire was given to the validator to validate the product being developed. Second, the 4C questionnaire uses indicators that refer to P21 which are given to students who have used the developed product.

Data analysis techniques in this research quantitative data analysis in this study was conducted to analyze the data obtained from the results of expert validation, and the results of filling out questionnaires by students. Validation was carried out by experts and the questionnaire was filled out by students by providing responses with the criteria of strongly agree, agree, quite agree, disagree and strongly disagree. For data analysis we used descriptive statistical calculations. Determination of the size of the assessment is along with the weight of the value. There are five validation categories as presented in Table 1 [14].

Table 1. Validation Category

Coefficient	Category
$1 \leq Va < 2$	Invalid
$2 \leq Va < 3$	Not valid
$3 \leq Va < 4$	Quite valid
$4 \leq Va < 5$	Valid
$Va = 5$	Very valid

Note: Va is the value of determining the level of validity.

3. Results and Discussion

Based on the research results obtained, we conduct a discussion based on each stage that is passed in this research.

3.1. Analysis

Based on the results of the needs analysis carried out, it was found that the Electrical Machine course did not have teaching materials, especially product-oriented modules. So far, lecture teaching materials are still using material in the form of powerpoints presented by course lecturers using the lecture

learning model. This condition certainly needs to be updated considering the increasingly high demands and competitiveness of the world of work in the 21st century. In this 21st century era, students are required to have 4C skills which consist of critical thinking (critical thinking), collaboration (collaboration), creativity (creativity), and communication (communication) so that they are ready to face all the challenges that exist. To prepare students with 4C skills, one of the learning models that can be used is the Team Based Project model. This learning model is also the model set by the Government through the Decree of the Minister of Education and Culture of the Republic of Indonesia Number 754/P/2020 as the model used in the Independent Learning Campus Independent learning. This learning model is used as one of the items in the assessment of the Main Performance Indicators (KPI), especially in KPI 7 regarding collaborative and participatory classes.

Furthermore, based on theoretical studies, the Team Based Project learning model will be combined using Product Oriented Modules. It is intended that this course is able to produce outputs in the form of appropriate products which are the implementation of electric machine theories. The learning design is also in accordance with the learning outcomes of the Electrical Machinery course. The use of the Team Based Project learning model using Product Oriented Modules is expected to be able to provide a holistic learning experience to students so that students will be able to construct 4C skills.

3.2. Design

Based on the KPI Guidebook, the implementation of Team Based Projects has the following characteristics:

1. The class is divided into groups (>1 student) to work on an assignment together over a long period of time;
2. Groups are given original problems or complex questions, then given space to create work plans and collaboration models;
3. Each group prepares a presentation/final work that is presented to the lecturer, class, or other audience who can provide constructive feedback.

The Team Based Project stages above are then combined by using product oriented modules as a reference for student work in completing projects. The projects that students are working on are projects related to electrical machines. In this project, students will produce a product in the form of a 3 phase motor installation..

3.3. Development

1. At this development stage, Product Oriented Modules are produced for Team Based Project learning where the resulting modules have the following topics:
   a. One place Three Phase Motor Controller
   b. Two-place Three-Phase Motor Controller

2. Product Oriented Modules validation results
   The results of filling out the validation questionnaire from each expert is shown in Table 2.

Table 2. Validation Result

Aspect	Indicator	Result	Interpretation
Content	The material presented in the module is in accordance with the learning objectives	4	Valid
	The material presented in the module is in accordance with the needs	4,5	Valid
	The material presented in the module is in accordance with the user's level of thinking	4,5	Valid
Average		**4,33**	**Valid**
Appearance	The presentation of the material has been presented systematically	4,5	Valid
	The letters used are good	5	Very Valid
	The font size used is adequate	5	Very Valid
	The paragraph has been good	4	Valid
	The paragraph order in the module has been neatly arranged	4,5	Valid
	The design layout and colors used in the module are adequate	4	Valid
Average		**4,5**	**Valid**
Grammar	The language used in the module is easy to understand	5	Very Valid
	The language used can explain the material presented	4,5	Valid
	The language used is in accordance with the user's intellectual development	4,5	Valid
Average		**4,66**	**Valid**

Based on the table above, it can be interpreted that the resulting Product Oriented Modules meet the valid category and are suitable for use in Team Based Project learning in the Electrical Machinery course.

3.4. Implementation

At this stage, the implementation of a Team Based Project using Product Oriented Modules in the Electrical Machinery course is carried out as an effort to optimize the 4C skills of Electrical Engineering Education students. The results of the optimization of 4C skills are shown in Table 3.

Table 3. 4C Result

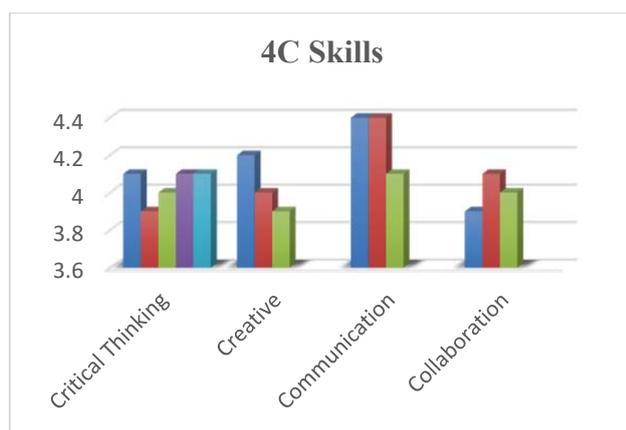| 4C Item	Item	Result	Interpretation
Critical Thinking	1	4,1	
	2	3,9	
	3	4	
	4	4,1	
	5	4,1	
	Average	4,04	Good
Creative	1	4,2	
	2	4	
	3	3,9	
	Average	4,03	Good
Communication	1	4,4	
	2	4,4	
	3	4,1	
	Average	4,3	Good
Collaboration	1	3,9	
	2	4,1	
	3	4	
	Average	4	Good

Figure 2. 4C Result Graphic

The explanation of the data from Table 3 and Figure 2 are as follows:

1. Team Based Project using Product Oriented Modules can improve Critical Thinking Ability

The average for critical thinking items shows the number 4.04 which is categorized as good. In the aspect of inductive reasoning or deductive reasoning,

a score of 4.1 was obtained which was categorized as good. The second aspect is analyzing the interrelationships of each part of the whole to produce a complex system with a gain of 3.9 which is categorized as good. The third aspect is analyzing and evaluating the facts by 4 which means good. The fourth aspect is drawing conclusions based on the results of the analysis showing the number 4.1 which is categorized as good. The fifth aspect is related to solving unusual/common problems both in conventional and innovative ways, the score obtained is 4.1 with a good category.

Articles that use similar indicators also show the same thing. The use of the Team Based Project learning model applied under certain conditions can optimize the indicators of critical thinking skills [15], [16]. Certain conditions in question, among others, are applied to subjects that emphasize mastery of knowledge and skills, organize students in meaningful activities, use media made based on learning strategies [17], [18].

The organizational form of student activities can be expressed in the form of product-based modules [19], [20]. By using a combination of product-oriented modules and team-based projects, students will be trained to carry out independent and group activities in a structured and focused manner [21], [22]. Critical thinking skills can be internalized through learning experiences using various media and learning strategies [23], [24].

Based on the results of research analyzed by researchers, relevant research results, and expert opinions, it can be concluded that the use of Team Based Projects using Product Oriented Modules can optimize critical thinking skills.

2. Team Based Project using Product Oriented Modules can improve Creative Thinking Ability

The results of the questionnaire on the average creative thinking ability show the number 4.03 which is categorized as good. The first aspect, namely creating new ideas, got a score of 4.2 which was categorized as good. The second aspect is to expand the basic ideas/concepts to improve and maximize creative efforts by obtaining a score of 4 in the good category. The third aspect is applying creative ideas as a real contribution in life, getting a score of 3.9 with a good category.

The research results are supported by relevant research results and expert opinion. The implementation of a guided team based project can help optimize creative thinking skills. Creative thinking abilities with cognitive, affective, and cognitive and affective dimensions can be optimal if students are directed to meaningful activities with teacher guidance [25]. Students can explore ideas maximally through project-based modules which will eventually produce products [26].

Creative thinking is not making something that does not exist into existence, but the ability to generate new ideas by making combinations, making changes, or applying existing ideas to different areas [27]. Based on the results of research analyzed by researchers, relevant research results, and expert opinions, it can be concluded that the use of Team Based Projects using Product Oriented Modules can optimize creative thinking skills.

3. Team Based Project using Product Oriented Modules can improve Communication Skills

The average for items on communication skills is 4.03 which is categorized as good. The first aspect is related to expressing thoughts or ideas through oral, written or nonverbal obtaining a score of 4.4 with a good classification. The second aspect is using communication for various purposes with a score of 4.4 being categorized as good. The third aspect is using various media or technology in learning to get a score of 4.1 with a good category.

The research results are supported by relevant research results and expert opinion. Research by Morimoto stated that there was a significant difference in the communication skills of students using team based projects [28]. This is because, in the team-based project model, students are accustomed to expressing their ideas to others, both orally and in writing. Online communication through social media with lecturers and other students is also well established. The use of the team based project learning model has a positive effect on student communication through electronic media, namely social media [29].

Team-based projects will familiarize students to be more open and active in their opinions, ideas, and thoughts both orally and in writing [30]. Based on the results of research analyzed by researchers, relevant research results, and expert opinions, it can be concluded that the use of Team Based Projects using Product Oriented Modules can optimize communication skills.

4. Team Based Project using Product Oriented Modules can improve Collaboration Ability

The average item for collaboration ability shows 4 which is categorized as good. The first aspect is showing the ability to work effectively in groups with a score of 3.9 which is categorized as good. The second aspect is accepting the division of responsibilities and contributing to completing group assignments, obtaining a score of 4.1 with a good category. The third aspect, namely providing input and showing mutual respect for fellow friends, got a score of 4 with a good category.

The research results are supported by relevant research results and expert opinion. Berestova's research states that the ability to collaborate in a team increases when the Project Based Learning model is applied through organized group activities on social media [29]. Students will find it easier to collaborate and foster a sense of responsibility and respect if they are organized in group activities in a team-based project model [21], [31]. Based on the results of research analyzed by researchers, relevant research results, and expert opinions, it can be concluded that the use of Team Based Projects using Product Oriented Modules can optimize collaboration capabilities.

The learning theory that underlies the development of this model is constructivist learning theory. The constructivist learning theory states that learning is a process of forming (constructing) knowledge by the learner himself, which means that the knowledge possessed is the result of his own construction or formation [32]. Learning by constructing concepts results in a fundamental change from previous knowledge. This change can be in the form of replacing, adding or modifying previous knowledge. Knowledge is built or constructed from experience, learning is the result of the interpretation of individual knowledge and collaborative learning [33].

Constructivistic learning helps students to internalize and transform new information. Transformation occurs by generating new knowledge, which in turn will form a new cognitive structure. In constructivist schools, knowledge is understood as a continuous formation by someone who is constantly reorganizing because of new understandings [34]. Some of the skills needed in the process of constructing knowledge are: (1) the ability to remember and re-experience experiences; (2) the ability to compare and make decisions about the similarities and differences about something, and (3) the ability to prefer an experience.

Constructivistic learning can improve critical thinking [35]. Presentation and discussion are learning strategies that are constructivist so that they can improve students' thinking skills [36]. The process of interpreting and evaluating information is also included in the presentation process in an effort for students to present the topics to be discussed. This concept is certainly very relevant to the implementation of team based projects using product oriented modules because in this learning students will be directed to carry out independent learning, so that students will be able to construct their own knowledge and understanding.

In addition, based on the experience cone theory proposed by Edgar Dale, it is stated that the learning experience through the process of doing or experiencing it yourself will provide a lot of learning experiences [37]. Based on Edgar Dale's cone experience, it can be seen that direct experience (Do

real thing) occupies a basic position. Edgar Dale wants to emphasize that the more concrete students learn about teaching materials (hand experience), the more experience students will get. This study researchers use as a basis for implementing team based project learning using product oriented modes where students will carry out learning independently and experience it themselves to complete a product-oriented project related to Electrical Machines. The hope is that students will get the maximum learning experience in understanding Electrical Machinery courses.

The modules that will be developed in this study will embed learning skills and innovate 21st Century skills, namely (1) Critical Thinking, (2) Communication, (3) Collaboration and (4) Creativity [2], [38]. Critical thinking skills are important skills possessed by students in finding the source of the problem and how to find and find solutions to the problems at hand. Communication skills are skills to express new thoughts, ideas, knowledge, or information [39]. Collaborative skills are skills to work together effectively and show respect for diverse teams [40]. Creative thinking skills (Creative Thinking Skills) skills, which relate to the skills to use a new approach to solving a problem, innovation, and discovery [41]. Research conducted by Rahmawati, Budiyono, & Wardi stated that the module was effectively used to improve student learning outcomes, and increased student learning outcomes by 72.3% [42]. Research conducted by Diantari, Damayanthi, Sugihartini, & Wirawan stated that the module gave a positive response to students, the module can increase students' learning so that learning outcomes can be achieved optimally [43].

3.5. Evaluation

Based on the previous stages, it is known that the design of Team Based Project learning using Product Oriented Modules has been successfully developed by producing modules that are used for Electrical Machinery courses. The implementation of a Team Based Project using Product Oriented Modules has also succeeded in optimizing the 4C skills of Electrical Engineering Education students. This research only focuses on optimizing 21st century 4C skills which are learning and innovation skills, while other 21st century skills such as life and career skills as well as information, media and technology skills have not been studied. Therefore, further research can examine these 21st century skills.

4. Conclusion

The design of product oriented modules that have been developed empirically is proven to be used as a valid and effective teaching material in optimizing students' 4C skills related to Electrical Machinery courses. Team based project learning using product oriented modules provides independent learning experiences to students and provides direct learning experiences to students so that students have the opportunity to construct 4C skills.

The limitation of this research is that it only focuses on optimizing 21st century skills in the form of 4Cs which are learning and innovation skills, while other 21st century skills such as life and career skills as well as information, media and technology skills have not been studied. Therefore, further research can examine these 21st century skills. Therefore, further research can be carried out on a broader subject and pay attention to life and career skills as well as information, media and technology skills.

Acknowledgements

References

[1]. Sanjayanti, N. P. A. H., Darmayanti, N. S., Qondias, D., & Sanjaya, K. O. (2020). Integrasi Keterampilan 4C Dalam Modul Metodologi Penelitian. *Jurnal Pedagogi dan Pembelajaran*, *3*(3), 407-415. https://doi.org/10.23887/jp2.v3i3.28927

[2]. Redhana, I. W. (2019). Mengembangkan keterampilan abad ke-21 dalam pembelajaran kimia. *Jurnal Inovasi Pendidikan Kimia*, *13*(1). https://doi.org/10.15294/jipk.v13i1.17824

[3]. Yokhebed, Y. (2019). Profil Kompetensi Abad 21: Komunikasi, Kreativitas, Kolaborasi, Berpikir Kritis Pada Calon Guru Biologi Profile of 21st Century Competency: Communication, Creativity, Collaboration, Critical Thinking at Prospective Biology Teachers. *Bio-Pedagogi*, *8*(2), 94. https://doi.org/10.20961/bio-pedagogi.v8i2.36154

[4]. Andrian, Y., & Rusman, R. (2019). Implementasi pembelajaran abad 21 dalam kurikulum 2013. *Jurnal Penelitian Ilmu Pendidikan*, *12*(1), 14-23. https://doi.org/10.21831/jpipfip.v12i1.20116

[5]. Asviangga, A. B., Sunardi, S., & Trapsilasiwi, D. (2018). Analisis kemampuan 4C's siswa dalam menyelesaikan soal matematika berpikir tingkat tinggi. *KadikmA*, *9*(1), 17-23. https://doi.org/10.19184/kdma.v9i1.8017

[6]. Hrabowski III, F. A. (2014). Institutional change in higher education: Innovation and collaboration. *Peabody Journal of Education*, *89*(3), 291-304. https://doi.org/10.1080/0161956X.2014.913440

[7]. Gustafson, K. L. (1991). *Survey of instructional development models*. ERIC Clearinghouse on Information & Technology.

[8]. Gita, S. D., Annisa, M., & Nanna, W. I. (2018). Pengembangan modul IPA materi hubungan makhluk hidup dan lingkungannya berbasis pendekatan kontekstual. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *8*(1). https://doi.org/10.24929/lensa.v8i1.28

[9]. Nilasari, E., Djatmika, E. T., & Santoso, A. (2016). Pengaruh penggunaan modul pembelajaran kontekstual terhadap hasil belajar siswa kelas V Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *1*(7), 1399-1404. http://doi.org/10.17977/jp.v1i7.6583

[10]. Darwin, W., Ridwan, ., & Ahyanuardi, . (2020). Efektivitas Pengembangan Modul Berbasis Konstruktivisme Pada Mata Pelajaran Sistem Komputer Bagi Siswa TKJ Tingkat SMK. *Jurnal Edutech Undiksha*, *8*(1), 147. https://doi.org/10.23887/jeu.v8i1.27259

[11]. Irwandani, I., Latifah, S., Asyhari, A., Muzannur, M., & Widayanti, W. (2017). Modul digital interaktif berbasis articulate studio'13: pengembangan pada materi gerak melingkar kelas x. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *6*(2), 221-231. https://doi.org/10.24042/jipfalbiruni.v6i2.1862

[12]. Pratiwi, P. H., Hidayah, N., & Martiana, A. (2017). Pengembangan Modul Mata Kuliah Penilaian Pembelajaran Sosiologi Berorientasi HOTS. *Jurnal Cakrawala Pendidikan*, *36*(2), 201-209. https://doi.org/10.21831/cp.v36i2.13123

[13]. Rasmawan, R. (2018). Development of Chemistry Module for Junior High School Based on Inquiry Accompanied by Performance-Based Assessment. *JPI (Jurnal Pendidikan Indonesia)*, *7*(2), 111-119. https://doi.org/10.23887/jpi-undiksha.v7i2.10617

[14]. Rasyid, M., Azis, A. A., & Saleh, A. R. (2017). Pengembangan media pembelajaran berbasis multimedia dalam konsep sistem indera pada siswa kelas XI SMA. *Jurnal Pendidikan Biologi*, *7*(2), 69-80. http://dx.doi.org/10.17977/um052v7i2p69-80

[15]. Husamah, H. (2015). Thinking skills for environmental sustainability perspective of new students of biology education department through blended project based learning model. *Jurnal Pendidikan IPA Indonesia*, *4*(2), 110-119. https://doi.org/10.15294/jpii.v4i2.3878

[16]. Husamah, H. (2015). Blended project based learning: Metacognitive awareness of biology education new students. *Journal of Education and Learning (EduLearn)*, *9*(4), 274-281. https://doi.org/10.11591/edulearn.v9i4.2121

[17]. Widowati, W., Sawitri, S., & Krisnawati, M. (2015). Efektivitas Model Pembelajaran Berbasis Proyek Dalam Peningkatan Hasil Belajar Mahasiswa Pada Mata Kuliah Pengembangan Desain. *TEKNOBUGA: Jurnal Teknologi Busana dan Boga*, *2*(2).

[18]. Kholifah, U. (2019). Kajian Penerapan Blended Project Based Learning dalam Meningkatkan Kemampuan Komunikasi dan Kolaborasi pada Matakuliah Komunikasi Data dan Jaringan Komputer. *JUPITER (Jurnal Pendidikan Teknik Elektro)*, *4*(2), 35-42.

[19]. Almulla, M. A. (2020). The effectiveness of the project-based learning (PBL) approach as a way to engage students in learning. *Sage Open*, *10*(3), 2158244020938702. https://doi.org/10.1177/2158244020938702

[20]. Wijaya, K., Ganefri, G., Rizal, F., & Siregar, S. (2019). Development of Product Oriented Modules on Learning Building Materials for Civil Engineering Students. *International Journal of Scientific & Technology Research*, *8*(8), 122-124.

[21]. Wiyarsi, A., & Partana, C. F. (2009). Penerapan pembelajaran berbasis projek pada perkuliahan workshop pendidikan kimia untuk meningkatkan kemandirian dan prestasi belajar mahasiswa. *Paedagogia*, *12*(1). https://doi.org/10.20961/paedagogia.v12i1.35987

[22]. Wibowo, W. S., Roektiningroem, E., Bastian, N., & Hudda, K. S. (2018). Development of Project-Based Learning Science Module to Improve Critical Thinking Skills of Junior High School Students. *Journal of Science Education Research*, *2*(2), 71-76. https://doi.org/10.21831/jser.v2i2.22471

[23]. Gandi, A. S. K., Haryani, S., & Setiawan, D. (2019). The effect of project-based learning integrated STEM toward critical thinking skill. *Journal of Primary Education*, *8*(7), 18-23.

[24]. Easterbrooks, S. R., & Scheetz, N. A. (2004). Applying critical thinking skills to character education and values clarification with students who are deaf or hard of hearing. *American Annals of the Deaf*, *149*(3), 255-263. https://doi.org/10.1353/aad.2004.0024

[25]. Albar, S. B., & Southcott, J. E. (2021). Problem and project-based learning through an investigation lesson: Significant gains in creative thinking behaviour within the Australian foundation (preparatory) classroom. *Thinking Skills and Creativity*, *41*, 100853. https://doi.org/10.1016/j.tsc.2021.100853

[26]. Huang, N. T., Chang, Y. S., & Chou, C. H. (2020). Effects of creative thinking, psychomotor skills, and creative self-efficacy on engineering design creativity. *Thinking skills and creativity*, *37*, 100695. https://doi.org/10.1016/j.tsc.2020.100695

[27]. Moma, L. (2017). Pengembangan kemampuan berpikir kreatif dan pemecahan masalah matematis mahasiswa melalui metode diskusi. *Jurnal cakrawala pendidikan*, *36*(1), 130-139. https://doi.org/10.21831/cp.v36i1.10402

[28]. Morimoto, C. (2016, April). Improvement of IT Students' Communication Skills using Project Based Learning. In *CSEDU (2)* (pp. 147-152). https://doi.org/10.5220/0005891501470152

[29]. Berestova, A., Ermakov, D., Aitbayeva, A., Gromov, E., & Vanina, E. (2021). Social networks to improve the creative thinking of students: How does it works?. *Thinking Skills and Creativity*, *41*, 100912.

[30]. Putri, S. U., & Hidayat, S. (2019, October). The effectiveness of project-based learning on students' communication skills in science. In *Journal of Physics: Conference Series* (Vol. 1318, No. 1, p. 012006). IOP Publishing. https://doi.org/10.1088/1742-6596/1318/1/012006

[31]. Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*, 101586. https://doi.org/10.1016/j.ijer.2020.101586

[32]. Sari, R. T. (2017). Efektifitas modul pembelajaran biologi melalui pendekatan konstruktivisme. *Pakar Pendidikan*, *15*(1), 53-66. https://doi.org/10.24036/pakar.v15i1.53

[33]. Kuong, H. C. (2015). Enhancing online learning experience: From learners' perspective. *Procedia-Social and Behavioral Sciences*, *191*, 1002-1005. https://doi.org/10.1016/j.sbspro.2015.04.403

[34]. Elvita, J., Sumarno, S., & Rusdi, R. (2019). Pengaruh Kepemimpinan Transformasional Kepala Sekolah, Kompetensi Pedagogik, Dan Motivasi Kerja Guru Terhadap Mutu Pendidikan Pada Sekolah Dasar Negeri Di Kota Pekanbaru. *Jurnal JUMPED (Jurnal Manajemen Pendidikan)*, *7*(1), 54-67. http://dx.doi.org/10.31258/jmp.7.1.p.54-67

[35]. Apriyani, L., Nurlaelah, I., & Setiawati, I. (2017). Penerapan model PBL untuk meningkatkan keterampilan berpikir kritis ditinjau dari kemampuan akademik siswa pada materi biologi. *Quagga: Jurnal Pendidikan dan Biologi*, *9*(01). https://doi.org/10.25134/quagga.v9i01.509

[36]. Horwitz, E. (2014). Becoming a language teacher: A practical guide to second language learning and teaching. *The CATESOL Journal*, *25*(1), 163-192.

[37]. Subramony, D. P. (2003). Dale's Cone revisited: Critically examining the misapplication of a nebulous theory to guide practice. *Educational technology*, *43*(4), 25-30.

[38]. Bedir, H. (2019). Pre-service ELT teachers' beliefs and perceptions on 21st century learning and innovation skills (4Cs). *Journal of Language and Linguistic Studies*, *15*(1), 231-246. https://doi.org/10.17263/jlls.547718

[39]. Sydorenko, V. (2020). Soft skills as an educational trend and a necessary development component for a vocational lifelong education teacher. *Fundamental and applied researches in practice of leading scientific schools*, *38*(2), 127-134.

[40]. Ercikan, K., & Oliveri, M. E. (2016). In search of validity evidence in support of the interpretation and use of assessments of complex constructs: Discussion of research on assessing 21st century skills. *Applied Measurement in Education*, *29*(4), 310-318. https://doi.org/10.1080/08957347.2016.1209210

[41]. Abdullah, M., & Osman, K. (2010). Scientific inventive thinking skills among primary students in Brunei. *Procedia-Social and Behavioral Sciences*, *7*, 294-301. https://doi.org/10.1016/j.sbspro.2010.10.041

[42]. Rahmawati, S., Budiyono, B., & Wardi, W. (2017). Pengembangan Modul Pembelajaran Digital Berbasis Visual Basic for Application (VBA) PowerPoint. *Indonesian Journal of Curriculum and Educational Technology Studies*, *5*(1), 33-41.

[43]. Diantari, L. P. E., Damayanthi, L. P. E., Sugihartini, N. S., & Wirawan, I. M. A. (2018). Pengembangan e-modul berbasis mastery learning untuk mata pelajaran KKPI kelas XI. *Jurnal Nasional Pendidikan Teknik Informatika: JANAPATI*, *7*(1), 33-47. https://doi.org/10.23887/janapati.v7i1.12166