

1. Submitted online artikel (11 Maret 2021)
2. Bukti konfirmasi komentar reviewer 1, 2, dan 3 (28 April 2023)
3. Konfirmasi proofreading artikel (8 Mei 2021)
4. Bukti proofreading artikel (27 Mei 2021)
5. Konfirmasi artikel akan diterbitkan (29 Mei 2021)
6. Artikel Published (3 Juli 2021)

**1. Submitted online artikel (11 Maret 2021)**



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES) - Account Created in ScholarOne Manuscripts**

1 message

---

**Cypriot Journal of Educational Sciences (CJES)** <onbehalf@manuscriptcentral.com>

11 March 2021 at 20:49

Reply-To: cjes.editorial@gmail.com

To: m.rais@unm.ac.id

11-Mar-2021

Dear Dr. Rais:

Welcome to the Cypriot Journal of Educational Sciences (CJES) - ScholarOne Manuscripts site for online submission and review.

Your USER ID for your account at <https://mc04.manuscriptcentral.com/cjes> is as follows:USER ID: [m.rais@unm.ac.id](mailto:m.rais@unm.ac.id)

If you are unsure of the password that you set when you created your account you should click the link below which will take you directly to the option for setting a new password.

[https://mc04.manuscriptcentral.com/cjes?URL\\_MASK=465daa3f2d38490697f1c9b7beff0377](https://mc04.manuscriptcentral.com/cjes?URL_MASK=465daa3f2d38490697f1c9b7beff0377)

Thank you for your participation.

Sincerely,

Cypriot Journal of Educational Sciences (CJES) Editorial Office

Log in to Remove This Account - [https://mc04.manuscriptcentral.com/cjes?URL\\_MASK=981c8883ed084173a3574bd53754c016](https://mc04.manuscriptcentral.com/cjes?URL_MASK=981c8883ed084173a3574bd53754c016)



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES) - Manuscript ID CJES-2021-0127**

1 message

---

**Cypriot Journal of Educational Sciences (CJES)** <onbehalf@manuscriptcentral.com>

11 March 2021 at 21:20

Reply-To: cjes.editorial@gmail.com

To: m.rais@unm.ac.id

11-Mar-2021

Dear Dr. Rais:

Your manuscript entitled "Comparing Project-Based Learning and Problem-Based Learning to Foster 21st Century Learning Skills in Agricultural Seaweed Product" has been successfully submitted online and is presently being given full consideration for publication in the Cypriot Journal of Educational Sciences (CJES).

Your manuscript ID is CJES-2021-0127.

Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at <https://mc04.manuscriptcentral.com/cjes> and edit your user information as appropriate.

You can also view the status of your manuscript at any time by checking your Author Center after logging in to <https://mc04.manuscriptcentral.com/cjes>.

Thank you for submitting your manuscript to the Cypriot Journal of Educational Sciences (CJES).

Sincerely,  
Cypriot Journal of Educational Sciences (CJES) Editorial Office



## COVER LETTER

Muhammad Rais  
Faculty of Engineering, Universitas Negeri Makassar, Indonesia  
[m.rais@unm.ac.id](mailto:m.rais@unm.ac.id)

March, 11 2021

**Dear Editor of Cypriot Journal of Educational Sciences**

We wish to submit an original research article entitled “**Comparing Project-Based Learning and Problem-Based Learning to Foster 21<sup>st</sup> Century Learning Skills in Agricultural Seaweed Product**” for consideration by Cypriot Journal of Educational Sciences. We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

In this paper, we investigated the effect of 1) learning strategy (project-based learning (PjBL) and problem-based learning (PBL)) on the ability of seaweed product diversification; 2) 21<sup>st</sup>-century learning skills (critical thinking, communication, collaboration, creativity (4Cs)) on the ability of seaweed product diversification, and 3) interaction between PjBL and PBL and 4Cs on ability of seaweed product diversification

We believe that this manuscript is appropriate for publication by Cypriot Journal of Educational Sciences. There are some novelties of the research finding. This study found that (1) there were significant differences in the students' ability to diversify seaweed between group which was taught with PjBL and the one with PBL ( $p < 0.05$ ), (2) there were differences in the ability of students' to diversify seaweed between the ones in the groups with different 21<sup>st</sup> century learning skills, ( $p < 0.05$ ), and (3) there was an interaction between learning strategies and 21<sup>st</sup> century learning skills towards the ability to diversify seaweed products ( $p < 0.05$ ). This study indicates that the implementation of PjBL brings a better effect compared to the implementation of PBL in fostering 21<sup>st</sup> century learning skill.

Please address all correspondence concerning this manuscript to me at [[m.rais@unm.ac.id](mailto:m.rais@unm.ac.id)].

Thank you for your consideration of this manuscript.

Sincerely,  
Muhammad Rais

# Comparing Project-Based Learning and Problem-Based Learning to Foster 21<sup>st</sup> Century Learning Skills in Agricultural Seaweed Product

---

## Abstract

This study examined the effect of 1) learning strategy (project-based learning (PjBL) and problem-based learning (PBL)) on the ability of seaweed product diversification; 2) 21<sup>st</sup>-century learning skills (critical thinking, communication, collaboration, creativity (4Cs)) on the ability of seaweed product diversification, and 3) interaction between PjBL and PBL and 4Cs on ability of seaweed product diversification. This study was a quasi-experiment with 2x4 factorial design, namely two learning strategies (PjBL and PBL) x 4 types of 21<sup>st</sup> century learning skills. The research subjects were college students of a public university (n = 70). Data were analysed using two-way ANOVA. The results indicated that (1) there were significant differences in the students' ability to diversify seaweed between group which was taught with PjBL and the one with PBL, (2) there were differences in the ability of students' to diversify seaweed between the ones in the groups with different 21<sup>st</sup> century learning skills, and (3) there was an interaction between learning strategies and 21<sup>st</sup> century learning skills towards the ability to diversify seaweed products. This study indicates that the implementation of PjBL brings a better effect compared to the implementation of PBL in fostering 21<sup>st</sup> century learning skill.

*Keywords:* project-based learning; problem-based learning; 21<sup>st</sup> century learning skills;

## 38 **1. Introduction**

39 Vocational education learning, especially agricultural technology education learning, needs to provide examples  
40 of problem-solving in real life ( Kricsfalussy et al., 2018; Lucas et al., 2012). Learning that can develop the ability to  
41 solve problems and manufacture real products are project-based learning (PjBL) (Bell, 2010; DeMink-Carthew &  
42 Olofson, 2020; Smith & Rayfield, 2016) and problem-based learning (PBL) (Diegel et al., 2019; Phungsuk et al.,  
43 2017). A few studies have evaluated PjBL in agricultural technology learning (Kibett & Kathuri, 2005; Smith &  
44 Rayfield, 2016), as well as PBL (Abbey et al., 2017; Parr & Edwards, 2004). However, these studies tend to study the  
45 two approaches separately. There is no research that combines the PjBL and PBL strategies in one study, which  
46 examines issues related to seaweed products diversification. As a result, there are not many scientific publications  
47 related to learning strategies in agriculture in Indonesia so that this research can be regarded as a research pioneer in  
48 this field.

49 In seaweed learning, there are two abilities that must be emphasized, namely the ability to formulate problems  
50 and the ability to make artefact products (Helle et al., 2006). Both aspects can be achieved by integrating PBL and  
51 PjBL learning strategies (Prince & Felder, 2006). Although the two approaches are different, both require some skills  
52 that must be mastered by students so that learning objectives can be achieved. The skills referred to in this case are  
53 critical thinking skills, creative, collaborative, and communication skills (Alismail & McGuire, 2015; Amran et al.,  
54 2019; Zabit, 2010). These four skills are generally known as 21<sup>st</sup> century skills, which are abbreviated as 4Cs ( Romero,  
55 2016). This research not only integrates the PjBL and PBL strategies in learning, but also focuses on examining 4Cs  
56 skills which are the condition variables in the application of the learning strategy. As a variable of learning conditions,  
57 21<sup>st</sup> century learning skills are different for each student. Therefore, measuring these skills at the beginning of learning  
58 is believed to facilitate the acquisition of ability of seaweed product diversification.

59 There are several previous studies that have reviewed and compared the PjBL and PBL methods in learning.  
60 Affandi & Sukyadi (2016) reviewed Project-Based Learning and Problem-Based Learning for EFL Students' Writing  
61 Achievement at the Tertiary Level. This study aims to 1) examine the effect of PjBL and PBL on writing achievement  
62 2) detect differences in writing skills in groups taught with PjBL and PBL, 3) obtain students' perceptions of writing  
63 skills based on PjBL and PBL methods. The results showed that the PjBL method was more influential in training  
64 students to learn through the problem solving process, developing critical thinking, building social and cooperative  
65 skills and increasing students' motivation and enjoyment in writing compared to the PBL method.

66 Another research conducted by Anasifa & Djukri (2017) aims to examine 1) the effect of project-based learning  
67 and problem-based learning in terms of students' creativity and critical thinking, 2) differences in the effects of PjBL  
68 and PBL based on creativity and critical thinking. The results show that (1) project-based learning and problem-based  
69 learning affect student's creativity and critical thinking, (2) there is a difference effect of project-based learning and  
70 problem-based learning on student's creativity, and (3) there is no difference effect of project-based learning and  
71 problem-based learning on student's critical thinking. Another research conducted by Husna, et al (2019) aims to  
72 examine the effect of project-based learning and problem-based learning on higher-order thinking skills. The results  
73 show that PjBL and PBL have the same effect in increasing higher-order thinking skills.

74 PjBL and PBL are two types of learning strategies that are equivalent and are based on constructivist learning  
75 theory. Not many studies have examined both of them and placed them as experimental studies on the learning of

76 seaweed, especially on seaweed product diversification. Besides, there has not been much research integrating these  
77 two types of learning strategies with 21<sup>st</sup> century learning skills. Therefore, the purposes of this study are to examine  
78 1) the influence of PjBL and PBL on the learning ability of seaweed product diversification, 2) the influence of 21<sup>st</sup>  
79 century learning skills on the learning ability of seaweed product diversification, and 3) the interaction pattern between  
80 PjBL and PBL with 21<sup>st</sup> century learning skills on the learning ability of seaweed product diversification.

### 81 *1.1 Concept of PjBL and PBL*

82 Based on various concepts, PjBL is defined as a learning model that assists students in solving real problems,  
83 critical, creative, and communicative. PjBL is based on learning and teaching paradigm that emphasizes the social and  
84 constructivist dimensions in carrying out teaching and learning activities (Gu & Wang, 2006). The application of PjBL  
85 in the learning process becomes very important to improve students' ability to think critically and to be independent in  
86 learning. As one of the constructivist learning, PjBL facilitates students to learn in the real situation, so that they can  
87 gain permanent knowledge. PjBL is a model that can organize projects in learning (Gülbahar & Tinmaz, 2006). PjBL  
88 provides opportunities for student-centered learning systems, more collaborative, students are actively involved in  
89 completing projects independently, working together in teams and integrating real problems (Paris & Paris, 2001;  
90 Rashotte et al., 2001).

91 Some earlier studies showed that PjBL is important to be applied. Johann et al. (2006) reported that 90% of  
92 students who followed learning which implemented PjBL were optimists to be able to implement PjBL in the working  
93 world and believe that they can increase their learning achievements. Besides that, survey study by Lasonen and  
94 Vesterinen (2000) showed that 78 % of students believed that curriculum with PjBL basis can prepare a student to  
95 enter the working world because they not only study about theory but also do practices in the field. The effectiveness  
96 of this PjBL was compared with PBL, which based on some references and implementations, those two learning  
97 strategies have a similar position in constructive learning strategies. Besides that, the effectiveness of learning of  
98 seaweed product diversification was examined under various learning conditions with different 21<sup>st</sup> century learning  
99 skills. In this context, the skills of 21<sup>st</sup> century learning that would be examined included: critical thinking,  
100 communication, collaboration, and creativity.

101 PBL as a control variable in this study is designed to develop ways of thinking, problem-solving, intellectual  
102 skills, learning to act like adults through real situations or simulations, and becoming independent learners (Arends,  
103 2015). Wheeler, Kelly, and Gale (2005) have defined PBL as learning based on thinking through real-life problems.  
104 PBL can improve technical skills, thinking, creative, having good social behaviour of student, so that it is increasingly  
105 applied in various disciplines (Hoidn & Kärkkäinen, 2014), included in the learning of seaweed product diversification.  
106 Abbey, Dowsett, and Sullivan (2017) applied a PBL strategy in horticultural production learning. The results show  
107 that PBL methods have better results in improving learning outcomes compared to traditional learning, students are  
108 more motivated, and have initiative in making decisions.

### 109 *1.2 21<sup>st</sup> century learning skills*

110 In various literatures, it is explained that 21<sup>st</sup> century skills are mentioned as knowledge, skills, work habits, and  
111 character traits that are believed to be significantly helping students to learn, work and live successfully in a variety of  
112 environments in the 21<sup>st</sup> century (Moyer, 2016; Queensland Curriculum and Assessment Authority, 2015; Rotherham  
113 & Willingham, 2009). In another perspective, the 21<sup>st</sup> century skills include several skills, namely skills to

114 communicate, to think critically, to build networks, to collaborate, to solve problems, to create, to innovate, to analyse  
115 and to evaluate (Santos, 2017).

116 In this study, four 21<sup>st</sup> century skills were examined, namely critical thinking, communication, collaboration,  
117 and creativity. Critical thinking skills are used when the information obtained requires more complex reasoning and  
118 ability of synthesis and analysis (Hixson et al. 2012). Communication skills become one of the most need 21<sup>st</sup> century  
119 learning skills. The essence is that students have sensitivity in transmitting information into valid and useful data.  
120 When working in teams, the ability to process important information is applied so that effectiveness in working can be  
121 effectively transformed. Hixson et al. (2012) identify communication skills as the ability to use data and media from  
122 various sources, both oral and written, to convey the message effectively. Collaborative skills are needed when students  
123 work in the real world. When in the learning process, students need a learning design that teaches the collaborative  
124 process of working in teams. The process of making diversified seaweed products requires collaborative work. It is  
125 intended that individuals with different expertise in the team can complement each other (Kym & Hvolby, 2010).

126 PjBL and PBL as a method variable and 21<sup>st</sup> century learning skills as moderating variables are intended to  
127 increase the internal validity of the research design. In addition, these two variables are assumed to influence in  
128 achieving the ability to seaweed products diversification as learning outcome variables. Thus, how the effect of  
129 learning strategies and 21<sup>st</sup> century learning skills on the learning outcomes of seaweed products diversification needs  
130 to be examined.

## 131 **2. Reseach Method**

### 132 *2.1. Research design*

133 This study employed the quasi-experimental design to find out the relationship between variables (Gall et al., 2003;  
134 Salkind, 2012). All groups in this study were given treatment, which in this case, the first group studied with PjBL  
135 while the second one was treated with PBL strategy. Therefore, the design of this experimental study was one of non-  
136 equivalent control group design versions (Tuckman & Harper, 2012) 2x4 factorial.

### 137 *2.2. Sample*

138 The research subjects were students in Agricultural Technology Education Department in a public university in  
139 the fifth semester of the academic year 2019-2020. The total number of students was 70 divided into classes A and B  
140 with 35 students each. Class A was taken as the experimental group while the class B as the control group. It followed  
141 one of the quasi-experimental characteristics that divide subjects, not on a random basis which in other words, the  
142 subject has been grouped according to existing classes (Salkind, 2012).

### 143 *2.3 Research procedure*

144 The experiments were carried out by performing scenarios of those two learning strategies. Both control and  
145 experimental classes were given the same treatment, which was to develop a paper about various seaweed product  
146 diversification. The PjBL consisted of five groups with five different seaweed product diversification. Similarly, the  
147 PBL also made a paper with the same topic in the formerly mentioned group. The instruments used in this study were  
148 grouped into two categories, namely (1) the instrument to measure the 21<sup>st</sup> century learning skills and (2) the instrument  
149 to assess the skills of seaweed product diversification. The first instrument adapted 21<sup>st</sup> Century *Competencies* (The

150 Ontario Ministry of Education, 2016), which consists of four skills namely: critical thinking, communication,  
 151 collaboration, and creativity. The second instrument used to measure the seaweed product diversification was in the  
 152 form of test, which assessed the students' knowledge about seaweed diversification. Data were collected with the  
 153 following steps: (1) conducting a test on the 21<sup>st</sup> century learning skills, (2) giving a protest to measure the knowledge  
 154 of seaweed diverse products, (3) implementing a learning intervention (experimental), and (4) providing a post-test.

155 *2.4. Data Analysis*

156 The analysis requirements test used data normality test and variant homogeneity tests. The data normality test  
 157 employed the Kolmogorov-Smirnov technique, while the variant homogeneity test utilized the Levene test. The data  
 158 normality test and the data homogeneity test aimed to fulfil the parametric assumptions. The data were analysed using  
 159 parametric statistical analysis, with the two-way analysis of variance (ANOVA) 2 x 4 factorial variance analysis had  
 160 the purpose to test the research hypothesis.

161 **3. Finding**

162 *1.1 The Description of 21<sup>st</sup> Century Learning Skills*

163 The description of data on the measurement of the 21<sup>st</sup> century leaning skills using the 21<sup>st</sup> Century Competencies  
 164 instruments on two research subjects is presented in Table 1. Table 1 shows that the group implementing the PjBL had  
 165 a smaller number of student with critical thinking skills which was only 14.29%, while the creativity possessed by  
 166 34.29% students was the highest number. Similarly, to the PBL group, students with the critical thinking skills had the  
 167 smallest number which was only 14.20% of them. The skill possessed by the biggest number of students was the  
 168 collaboration as there were 34.29% showed to have the skill.

169 Table 1. The description of the 21<sup>st</sup> century learning skills

<b>21<sup>st</sup> Century Learning Skills</b>	<b>PjBL (%)</b>	<b>PBL (%)</b>
<i>Critical Thinking</i>	14.29	14.29
<i>Communication</i>	22.86	25.71
<i>Collaboration</i>	28.56	34.29
<i>Creativity</i>	34.29	25.71
Total	100	100

170  
 171 Data about the students' understanding on seaweed diversified products after taught with PjBL and PBL are  
 172 presented in Table 2. Table 2 indicates that communication is the 21<sup>st</sup> century learning skills which got the highest  
 173 score in the group of PjBL with the average score of M=39.25. Other skills (collaboration, critical thinking, and  
 174 creativity) had balanced scores. On the other hand, the group implementing the PBL approach showed that the skill  
 175 with the highest score was the creativity (M=38.44).

176  
 177 Table 2. The Results of Descriptive Analysis of Data about the Understanding on Seaweed Diversification Products

<b>Learning Strategies</b>	<b>21<sup>st</sup> Century Learning Skills</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
<i>Project Based Learning</i>	<i>Critical Thinking</i>	38.80	1.095	5

	<i>Collaboration</i>	38.90	0.994	10
	<i>Communication</i>	39.25	1.035	8
	<i>Creativity</i>	38.58	1.311	12
	<b>Total</b>	<b>38.86</b>	<b>1.115</b>	<b>35</b>
<i>Problem Based Learning</i>	<i>Critical Thinking</i>	37.20	1.095	5
	<i>Collaboration</i>	34.75	3.251	12
	<i>Communication</i>	37.33	1.414	9
	<i>Creativity</i>	38.44	1.667	9
	<b>Total</b>	<b>36.71</b>	<b>2.641</b>	<b>35</b>
<b>Total</b>	<i>Critical Thinking</i>	38.00	1.333	10
	<i>Collaboration</i>	36.64	3.230	22
	<i>Communication</i>	38.24	1.562	17
	<i>Creativity</i>	38.52	1.436	21
	<b>Total</b>	<b>37.79</b>	<b>2.283</b>	<b>70</b>

178

179 *1.2 The effect of learning strategies (PjBL and PBL) on the ability of seaweed product diversification*

180 The results of hypothesis test show the effect of learning strategies (PjBL and PBL) on seaweed product  
 181 diversification ability, the effect of 21<sup>st</sup> century learning skills on seaweed product diversification ability, and the effect  
 182 of interactions between learning strategies and 21<sup>st</sup> century learning skills on seaweed product diversification ability.  
 183 In detail, the results of the hypothesis test are summarized in Table 3. Table 3 shows that there was a difference on the  
 184 understanding on seaweed diversification product between students in the group of students taught using PjBL strategy  
 185 and students in the group treated with PBL strategy ( $p < 0.05$ ). The average score of students' understanding on  
 186 seaweed products diversification after taught using the strategy of PjBL was 38.86, which was significantly higher than  
 187 the results found in the group treated with PBL, which was only 36.71. This shows that the PjBL strategy has a higher  
 188 effect than the PBL strategy on seaweed product diversification ability.

189

190 Table 3. The results of the hypothesis test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	160.397 <sup>a</sup>	7	22.914	7.125	.000
Intercept	90707.475	1	90707.475	28205.501	.000
Learning Strategies	60.092	1	60.092	18.686	.000
21 <sup>st</sup> Century Learning Skills	35.518	3	11.839	3.681	.017
Learning Strategies * 21 <sup>st</sup> Century Learning Skills	43.419	3	14.473	4.500	.006
Error	199.389	62	3.216		
Total	100303.000	70			
Corrected Total	359.786	69			

a. R Squared = .446 (Adjusted R Squared = .383)

191

192 *1.3 The effect of 21<sup>st</sup> century learning skills on ability of seaweed product diversification*

193 Table 3 shows that there was a significant difference on students' understanding on seaweed products  
 194 diversification in-between students who had the 21<sup>st</sup> century learning skills, which includes critical thinking,  
 195 communication, collaboration, and creativity in Agricultural Technology Education Department in a public university  
 196 ( $p < 0.05$ ). The 21<sup>st</sup> century learning skills with the highest score in the PjBL group are communication skills, with a

197 mean score of 39.25 (Tabel 2). This means that in learning of seaweed products diversification with the PjBL strategy,  
 198 the most necessary 21<sup>st</sup> century learning skills are communication skills which consist of listening skill, digital literacy  
 199 skill, and communication in team skill. On the other hand, the other 21<sup>st</sup> century learning skills in general have almost  
 200 equal mean score, namely: critical thinking (38.80) collaboration (38.90), and creativity (38.58). This average score  
 201 shows that in PjBL strategy, students have 21<sup>st</sup> century learning skills that are evenly distributed in critical thinking,  
 202 collaboration, and creativity. Table 2 shows that 21<sup>st</sup> century learning skills with the highest score in PBL is creativity  
 203 (38.44). It shows that in learning to make diversified processed seaweed products, 21<sup>st</sup> century learning skills that most  
 204 develop in students are creativity, which consists of the ability to develop, to elaborate, to analyse and to evaluate  
 205 ideas. Other 21<sup>st</sup> century skills in PBL strategy, namely critical thinking skills (37.20) and communication (37.33) have  
 206 almost the same score, except for collaboration abilities (34.75) which have relatively smaller score. This shows that  
 207 students on PBL strategy have 21<sup>st</sup> century learning skills that are evenly distributed in critical thinking and  
 208 communication and smaller in collaboration.

209 Based on the results of the post-test using Tukey shown in Table 4, it was found that the collaboration and  
 210 communication skills of students differed significantly ( $p < 0.05$ ). In addition, 21<sup>st</sup> century abilities that differed  
 211 significantly were creativity and collaboration ( $p < 0.05$ ).

212  
 213

Table 4. Post-test results using Tukey on the 21<sup>st</sup> Century Learning Skills.

(I) 21 <sup>st</sup> Century Learning Skills	(J) 21 <sup>st</sup> Century Learning Skills	Mean Difference (I-J)	(I-Std. Error)	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Critical thinking	Collaboration	1.36	0.684	0.201	-.44	3.17
	Communication	-0.24	0.715	0.988	-2.12	1.65
	Creativity	-0.52	0.689	0.872	-2.34	1.30
Collaboration	Critical thinking	-1.36	0.684	0.201	-3.17	0.44
	Communication	-1.60*	0.579	0.037	-3.13	-0.07
	Creativity	-1.89*	.547	0.005	-3.33	-0.44
Communication	Critical thinking	0.24	0.715	0.988	-1.65	2.12
	Collaboration	1.60*	0.579	0.037	0.07	3.13
	Creativity	-0.29	0.585	0.960	-1.83	1.26
Creativity	Critical thinking	0.52	0.689	0.872	-1.30	2.34
	Collaboration	1.89*	0.547	0.005	.44	3.33
	Communication	0.29	0.585	0.960	-1.26	1.83

214

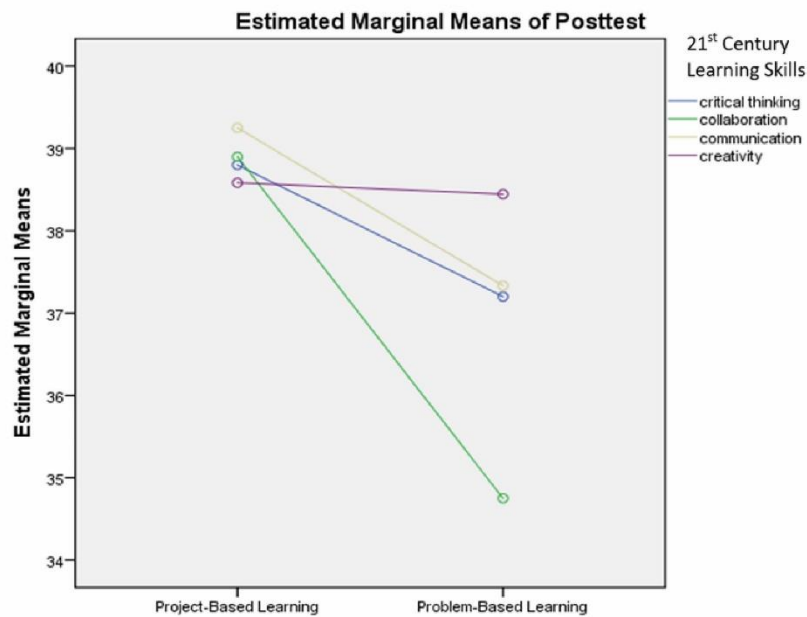
215 *1.4 Interactions pattern between learning strategies and 21<sup>st</sup> century learning skills on ability of seaweed product*  
 216 *diversification*

217 Table 3 shows that there was an interaction between the learning strategy and the 21<sup>st</sup> century learning skills  
 218 (critical thinking, communication, collaboration, and creativity) and the students' understanding on seaweed products  
 219 diversification at Agricultural Technology Education Department in a public university ( $p < 0.05$ ). The interaction  
 220 pattern between the learning strategy and the 21<sup>st</sup> century learning skills and students' understanding of seaweed  
 221 diversification products is presented in Figure 1. Figure 1 shows that the average ability of seaweed product  
 222 diversification of students in the group implementing PjBL methods were higher than that of students in the group



223 using the PBL model. The four lines touch each other so that it can be regarded that there is an effect of the interaction  
224 between the learning strategies and the 21<sup>st</sup> century learning skills on students' understanding of seaweed product  
225 diversification.

226  
227  
228  
229  
230  
231  
232



233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246

247 Figure 1. Interactions pattern between learning strategies and 21<sup>st</sup> century learning skills on ability of seaweed  
248 product diversification

#### 249 4. Discussion

250 The implementation of PjBL in the learning practices which targets the improvement of competency is a must.  
251 Various real practices have sufficiently provided empirical evidence that PjBL is effective in accommodating the  
252 learning skills. Esche (2002) reported that one of the factors advising the implementation of the PjBL is due to its  
253 ability to provide a learning background that can bring the real situation of the field in learning. In its application, one  
254 of the characteristics of PjBL is the existence of learning groups that allow students to work collaboratively, to  
255 communicate with each other to provide creative ideas and thoughts, to solve a problem, and to communicate  
256 interactively with other students in constructing new knowledge (Asan & Haliloglu, 2005; Blumenfeld et al., 2000;  
257 Marchaim, 2001; Yildirim, 2010).

258 In PjBL strategies, instructors act as facilitators, design learning activities and provide advice that substantially  
259 encourages the development of meaningful learning processes. The meaningful learning process is learning that is  
260 developed based on the concept of constructivism which emphasizes students as "active students", the central regulator  
261 of activities in mediating and controlling learning (Lasonen & Vesterinen, 2000). Constructivism characterizes  
262 learning as forming meaning, developing thought. In short, PjBL provides a conducive learning environment so that it  
263 can help improve student skills in accordance with the constructivist learning traits. Thus, learning activities are not  
264 just learning to accept and memorize concepts, but rather to interpret a concept.

265 This research found that there are differences in the ability to diversify seaweed products between groups of  
266 students who were taught using PjBL strategies and groups of students treated with PBL in Agricultural Technology  
267 Education Department. The effect of PjBL strategy was compared to PBL strategy was due to the ability of the PjBL  
268 strategy to provide learning opportunities for students to work in teams, to plan, to organize, to negotiate, and to  
269 convert thought ideas into real work that is projected experimentally. In contrast, in PBL, the opportunity to identify,  
270 analyse, and solve problems in groups, and activities to construct knowledge and explore information sources, are  
271 synthesized in groups and set forth in the form of innovative and reflective concepts undertaken by the team, but not  
272 converted into an experimental project. This aspect distinguishes it from PjBL. When the synthesized concepts are  
273 outlined in the form of practical work such as making and designing products, then in this case, PBL only reaches the  
274 stage of product development concepts. The findings of this study are in line with previous research which found that  
275 PjBL leads to the achievement of knowledge competencies and skills in working procedures (Esche, 2002; Grey &  
276 Antonacopoulou, 2004; Sabry & Baldwin, 2003).

277 The effectiveness of this research is that the learning atmosphere can encourage project groups to take place  
278 vigorously, and through observations, students seemed to enjoy learning methods that were developed based on PjBL  
279 scenarios. Students critically express ideas in collaborative groups, start from constructing essential questions, planning  
280 a project, making project implementation schedules, working on, analysing, evaluating project results, to exchanging  
281 information between groups through the presentation of project results about seaweed products diversification. In the  
282 presentation session, each group is trained to think critically in responding to problems, provide solutions to each other.  
283 The most important thing from this process is how students communicate ideas into a unity such as creativity,  
284 communication, critical thinking, and collaborative as a characteristic of 21<sup>st</sup> century learning skills.

285 Here are the essences of meaningful learning. PjBL provides chances for students to create and carry out a project  
286 to find new information from various sources of information. In this context, PjBL helps investigations that lead to  
287 solving more contextual problems in society. The products developed in the learning of seaweed products  
288 diversification are ice cream, red nori food, traditional food of *terang bulan* and *cendol*, and pudding. In theory  
289 perspective, 21<sup>st</sup> century learning skills in the form of critical thinking, collaboration, communication, and creativity  
290 have influence on the ability of seaweed product diversification. The results of hypothesis testing indicated that there  
291 were differences in the ability of seaweed products diversification between students who had different 21<sup>st</sup> century  
292 learning skills. In other words, 21<sup>st</sup> century learning skills have significant influence on the ability of seaweed product  
293 diversification.

294 In certain cases, sometimes students who have communication and collaboration skills can superiorly influence the  
295 ability of seaweed product diversification compared to students who have critical thinking and creativity learning skills

296 on the same learning strategy. Likewise with the learning skills of creativity and communication, sometimes students  
297 who have both learning skills are superior to students who have critical thinking and collaboration learning skills.  
298 Students with critical thinking skills have the ability to use a number of reasoning according to the situation, think  
299 systematically, linking one part with another so that they are able to produce products. Students with collaboration  
300 skills are able to work in teams effectively, and value team members' contributions based on their individual  
301 responsibilities. Students with communication skills are able to communicate effectively both verbally and non-  
302 verbally, and communicate in a variety of environments. Students with creativity ability are able to generate new ideas,  
303 elaborate, and evaluate their own ideas to explore a better learning opportunities (National Education Association,  
304 2020).

305 Ability of seaweed product diversification is easier to be mastered by students who have communication and  
306 collaboration skill. This is due to the characteristics of students with communication and collaboration skills is in  
307 accordance with the competencies needed in the seaweed product diversification, namely effective cooperation, mutual  
308 understanding, and communicative interactions. The ability to make processed seaweed products such as ice cream,  
309 red nori food, traditional food of *terang bulan*, and *cendol*, and pudding is in higher cognitive domain. Thus, in making  
310 diversified seaweed products, it requires the ability to work in teams, responsibilities, assign roles and communicate  
311 with various environments and sources of information, media and technology.

312 Soh, Arsad, and Osman (2010) and Musonda (2019) have reported that 21<sup>st</sup> century skills influence the learning  
313 outcomes. These results support the results of this study. Therefore, (Bao & Koenig, 2019) emphasize that future  
314 education needs to integrate 21<sup>st</sup> century skills into the curriculum. The aim is that 21<sup>st</sup> century learning skills can be  
315 systematically implemented and become a habit that accompanies the learning process. The findings in this study  
316 provide a conclusion that differences in 21<sup>st</sup> century learning skills significantly influence the ability of seaweed  
317 product diversification. This happens because each student has different cognitive ability to think critically, to  
318 communicate, to solve problems, and creativity in making processed seaweed products. In addition, grouping students  
319 with homogeneous learning skills has a more significant effect than grouping students heterogeneously. For the next  
320 implementation in the classroom, conducting experiments by placing groups of students with heterogeneous 21<sup>st</sup>  
321 century learning skills need to be considered.

322 Theoretically and empirically, PjBL and PBL as learning strategies variables and 21<sup>st</sup> century learning skills as  
323 learning conditions variables strong have strong interaction effect on ability of seaweed product diversification. Thus,  
324 it can be assumed that the effect of PjBL is moderated by differences in 21<sup>st</sup> century learning skills. It can be said that  
325 the effect of learning strategies (PjBL and PBL) on ability of seaweed product diversification is strengthened by  
326 differences in 21<sup>st</sup> century learning skills (4Cs). The effect of PjBL and PBL strategies on ability of seaweed product  
327 diversification applies strongly to each group of 21<sup>st</sup> century learning skills (4Cs). The results showed that there was  
328 an interaction pattern between learning strategies and 21<sup>st</sup> century skill on ability of seaweed product diversification.  
329 This means that the influence of PjBL and PBL on ability of seaweed product diversification applies strongly to each  
330 group of 21<sup>st</sup> century learning skills (4Cs).

331 **5. Conclusion**

332 Based on the findings and discussion which is referred to the study purposes, it is concluded that: 1) there are  
333 effects of learning strategies on students' ability of seaweed product diversification, 2) there are effects of the 21<sup>st</sup>  
334 century learning skills on students' ability of seaweed product diversification, 3) there are effects of interaction between  
335 learning strategy and the 21<sup>st</sup> century learning skills on students' ability of seaweed product diversification. The  
336 presence of influence of PjBL, PBL, and 21<sup>st</sup> century learning skills on ability of seaweed product diversification  
337 provides a compelling reason so that in vocational learning, integration of these two learning strategies is needed by  
338 paying attention to 21<sup>st</sup> century learning skills aspects. Both learning strategies are applied from constructivist learning  
339 theory and 21<sup>st</sup> century learning skills are the competencies for each student as a provision of life skills in the learning  
340 environment, and social environment.

341 **Acknowledgments**

342 This work was supported by Professorship Acceleration Grant Scheme, Universitas Negeri Makassar with the  
343 contract number: SP.DIPA-042.01:2.400964/2019. We thank you very much to Prof. Dr. Ir. Husain Syam, M.TP as a  
344 Rector of Universitas Negeri Makassar for his assistance.

345 **Declaration of interest statement**

346 The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or  
347 publication of this article.

348 **References**

- 349 Abbey, Lord, Dowsett, E., & Sullivan, J. (2017). Use of problem-based learning in the teaching and learning of  
350 horticultural production. *Journal of Agricultural Education and Extension* ,23(1): 61–78.  
351 <https://doi.org/10.1080/1389224x.2016.1202846>
- 352 Affandi, A., & Sukyadi, D. (2016). Project-based learning and problem-based learning for EFL students' writing  
353 achievement at the tertiary level. *Rangsit Journal of Educational Studies*, 3(1), 23-40.
- 354 Alismail, H. A., & McGuire, P. (2015). 21St Century Standards and Curriculum: Current Research and Practice.  
355 *Journal of Education and Practice*, 6(6), 150–155.
- 356 Amran, A., Perkasa, M., Satriawan, M., Jasin, I., & Irwansyah, M. (2019). Assessing students 21st century attitude and  
357 environmental awareness: promoting education for sustainable development through science education. *Journal*  
358 *of Physics: Conference Series*, 1157/2: 22025. <https://doi.org/10.1088/1742-6596/1157/2/022025>
- 359 Anazifa, R. D., & Djukri, D. (2017). Project-Based Learning and Problem-Based Learning: Are They Effective to  
360 Improve Student's Thinking Skills?. *Jurnal Pendidikan IPA Indonesia*, 6(2), 346-355.
- 361 Arends, R. I. (2015). *Learning to Teach 10th ed.* McGraw-Hill Education.
- 362 Asan, A., & Haliloglu, Z. (2005). Implementing Project Based Learning in Computer Classroom. *Turkish Online*  
363 *Journal of Educational Technology - TOJET*, 4/3, 68–81.
- 364 Bao, L., & Koenig, K. (2019). Physics education research for 21st century learning. *Disciplinary and Interdisciplinary*  
365 *Science Education Research*, 1/2, 1–12. <https://doi.org/10.1186/s43031-019-0007-8>

366 Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. *The Clearing House: A Journal of*  
367 *Educational Strategies, Issues and Ideas*, 83/2, 39–43.

368 Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W., & Soloway, E. (2000). Creating Usable Innovations in  
369 Systemic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational*  
370 *Psychologist*, 35/3, 149–164. [https://doi.org/10.1207/S15326985EP3503\\_2](https://doi.org/10.1207/S15326985EP3503_2)

371 DeMink-Carthew, J., & Olofson, M. W. (2020). Hands-Joined Learning as a Framework for Personalizing Project-  
372 Based Learning in a Middle Grades Classroom: An Exploratory Study. *RMLE Online*, 43/2, 1–17.  
373 <https://doi.org/10.1080/19404476.2019.1709776>

374 Diegel, O., Nordin, A., & Motte, D. (2019). Teaching Design for Additive Manufacturing Through Problem-Based  
375 Learning. In *Additive Manufacturing – Developments in Training and Education* (pp. 139–149).  
376 [https://doi.org/10.1007/978-3-319-76084-1\\_10](https://doi.org/10.1007/978-3-319-76084-1_10)

377 Esche, S. K. (2002). Project-Based Learning (PBL) in a course on mechanisms and machine dynamics. *World*  
378 *Transactions on Engineering and Technology Education*, 1/2, 201–204.

379 Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An Introduction* (7th ed.). Pearson Education, Inc.

380 Grey, C., & Antonacopoulou, E. (2004). Essential Readings in Management Learning. In *Management Learning*.  
381 SAGE Publications.

382 Gu, L., & Wang, J. (2006). School-based Research and Professional Learning: An innovative model to promote teacher  
383 professional development in China. *Teaching Education*, 17/1, 59–73.  
384 <https://doi.org/10.1080/10476210500528079>

385 Gülbahar, Y., & Tinmaz, H. (2006). Implementing project-based learning and E-portfolio assessment in an  
386 undergraduate course. *Journal of Research on Technology in Education*, 38/3, 309–327.  
387 <https://doi.org/10.1080/15391523.2006.10782462>

388 Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in Post-Secondary Education – Theory, Practice  
389 and Rubber Sling Shots. *Higher Education*, 51/2, 287–314. <https://doi.org/10.1007/s10734-004-6386-5>

390 Hixson, N. K., Ravitz, J., & Whisman, A. (2012). *Extended Professional Development in Project-Based Learning:*  
391 *Impacts on 21st Century Teaching and Student Achievement*. West Virginia Department of Education, Division  
392 of Teaching and Learning, Office of Research.

393 Husna, H., & Gultom, T. (2019, December). The Effect of Project-Based Learning and Problem-Based Learning in the  
394 Order of Contextual Learning in Microbiology Lectures on the High Order Thinking Skills of Biology Students  
395 in FMIPA UNIMED. In *4th Annual International Seminar on Transformative Education and Educational*  
396 *Leadership (AISTEEL 2019)* (pp. 368-371). Atlantis Press.

397 Hoidn, S., & Kärkkäinen, K. (2014). *Promoting Skills for Innovation in Higher Education*. OECD Publishing

398 Johann, T. M., Koch, H., Chlosta, S., & Klandt, H. (2006). Project Seminar Business Plan Development – an Analysis  
399 of Integrative Project-Based. *Journal of Asia Entrepreneurship and Sustainability*. 2/2.

400 Kibett, J. K., & Kathuri, N. J. (2005). Effects of project-based learning on student performance of higher cognitive  
401 skills in secondary school agriculture. *Zimbabwe Journal of Educational Research*, 17/1, 30–38.  
402 <https://doi.org/10.4314/zjer.v17i1.26054>

403 Kricsfalusy, V., George, C., & Reed, M. G. (2018). Integrating problem- and project-based learning opportunities:

404 assessing outcomes of a field course in environment and sustainability. *Environmental Education Research*,  
405 24/4, 593–610. <https://doi.org/10.1080/13504622.2016.1269874>

406 Kym, F., & Hvolby, H. (2010). Effective teamworking: can functional flexibility act as an enhancing factor? An  
407 Australian case study. *Team Performance Management*, 16/1, 74–94.  
408 <https://doi.org/10.1108/13527591011028933>

409 Lasonen, J., & Vesterinen, P. (2000). *Work-Based Learning in Vocational Higher Education Programmes: A Finnish*  
410 *Case of Project-Based Learning*. Finland

411 Lucas, B., Spencer, E., & Claxton, G. (2012). *How to Teach Vocational Education : A Theory of Vocational Pedagogy*.  
412 City and Guilds Centre for Skills Development.

413 Marchaim, U. (2001). High-school student research at Migal science institute in Israel. *Journal of Biological*  
414 *Education*, 35/4, 178–182. <https://doi.org/10.1080/00219266.2001.9655774>

415 Moyer, L. A. (2016). *Engaging Students in 21st Century Skills through Non-Formal Learning*. Virginia Polytechnic  
416 Institute and State University.

417 Musonda, E. (2019). Effect of the 21 st Century Skills on the Performance of Students in Linear Transformations : A  
418 Case of Mukuba University, Kitwe District, Copperbelt Province, Zambia. *International Journal of Research*  
419 *and Innovation in Social Science (IJRISS)*, 3/9, 417–420.

420 National Education Association. (2020). *Preparing 21st Century Students for a Global Society: An Educator’s Guide*  
421 *to the “Four Cs”*. National Education Association.

422 The Ontario Ministry of Education. (2016). *21 Century Competencies - Towards Defining 21st Century Competencies*  
423 *for Ontario*. The Ontario Ministry of Education.

424 Paris, S. G., & Paris, A. H. (2001). Classroom Applications of Research on Self- Regulated Learning. *Educational*  
425 *Psychologist*, 36/2, 89–101. [https://doi.org/10.1207/s15326985ep3602\\_4](https://doi.org/10.1207/s15326985ep3602_4)

426 Parr, B., & Edwards, M. C. (2004). Inquiry-Based Instruction In Secondary Agricultural Education: Problem-Solving  
427 - An Old Friend Revisited. *Journal of Agricultural Education*, 45/4, 106–117.  
428 <https://doi.org/10.5032/jae.2004.04106>

429 Phungsuk, R., Viriyavejakul, C., & Ratanaolarn, T. (2017). Development of a problem-based learning model via a  
430 virtual learning environment. *Kasetsart Journal of Social Sciences*, 38/3, 297–306.  
431 <https://doi.org/10.1016/j.kjss.2017.01.001>

432 Prince, M. J., & Felder, R. M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and  
433 Research Bases. *Journal of Engineering Education*, 95/2, 123–138. [https://doi.org/10.1002/j.2168-](https://doi.org/10.1002/j.2168-9830.2006.tb00884.x)  
434 [9830.2006.tb00884.x](https://doi.org/10.1002/j.2168-9830.2006.tb00884.x)

435 Queensland Curriculum and Assessment Authority. (2015). *21<sup>st</sup> century skills for senior education: An analysis of*  
436 *educational trends*. The State of Queensland.

437 Rashotte, C. A., MacPhee, K., & Torgesen, J. K. (2001). The Effectiveness of a Group Reading Instruction Program  
438 with Poor Readers in Multiple Grades. *Learning Disability Quarterly*, 24/2, 119–134.  
439 <https://doi.org/10.2307/1511068>

440 Romero, M. (2016). Digital Game Design as a Complex Learning Activity for Developing the 4Cs Skills:  
441 Communication, Collaboration, Creativity and Critical Thinking. In A. De Gloria & R. Veltkamp (Eds.), *Games*

442           *and Learning Alliance. GALA 2015. Lecture Notes in Computer Science. Springer.*

443 Rotherham, A., & Willingham, D. (2009). 21st Century Skills: The Challenges Ahead. *Educational Leadership*, 67,

444           16–21.

445 Sabry, K., & Baldwin, L. (2003). Web-based learning interaction and learning styles. *British Journal of Educational*

446           *Technology*, 34/4, 443–454. <https://doi.org/10.1111/1467-8535.00341>

447 Salkind, N. J. (2012). *Exploring Research* (8th ed.). Pearson.

448 Santos, J. M. (2017). 21<sup>st</sup> Century Learning Skills: A Challenge in Every Classroom. *International Journal of Emerging*

449           *Multidisciplinary Research*, 1/1, 31–35.

450 Smith, K., & Rayfield, J. (2016). An Early Historical Examination of the Educational Intent of Supervised Agricultural

451           Experiences (SAEs) and Project-Based Learning in Agricultural Education. *Journal of Agricultural Education*,

452           57(2), 146–160. <https://doi.org/10.5032/jae.2016.02146>

453 Soh, T. M. T., Arsad, N. M., & Osman, K. (2010). The relationship of 21st century skills on students' attitude and

454           perception towards physics. *Procedia - Social and Behavioral Sciences*, 7, 546–554.

455           <https://doi.org/10.1016/j.sbspro.2010.10.073>

456 Tuckman, B. W., & Harper, B. E. (2012). *Conducting Educational Research* (6th ed.). Rowman & Littlefield

457           Publishers.

458 Wheeler, S., Kelly, P., & Gale, K. (2005). The influence of online problem-based learning on teachers' professional

459           practice and identity. *Alt-J*, 13/2, 125–137. <https://doi.org/10.3402/rlt.v13i2.10986>

460 Yildirim, N. (2010). Increasing effectiveness of strategic planning seminars through learning style. *Australian Journal*

461           *of Teacher Education*, 35/4, 12–24. <https://doi.org/10.14221/ajte.2010v35n4.2>

462 Zabit, M. N. M. (2010). Problem-Based Learning On Students Critical Thinking Skills In Teaching Business Education

463           In Malaysia: A Literature Review. *American Journal of Business Education (AJBE)*, 3/6, 19–32.

464           <https://doi.org/10.19030/ajbe.v3i6.436>

465



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES)**

1 message

---

**Hüseyin Uzunboylu** <onbehalf@manuscriptcentral.com>  
Reply-To: editor.cjes@gmail.com  
To: m.rais@unm.ac.id

19 March 2021 at 15:50

19-Mar-2021

CJES-2021-0127 - Comparing Project-Based Learning and Problem-Based Learning to Foster 21st Century Learning Skills in Agricultural Seaweed Product

Dear Dr. Rais:

Thank you very much for uploading the following manuscript to the Cypriot Journal of Educational Sciences submission system. One of our editors will be in touch with you soon.

The following points were confirmed during submission:

CJES is an open access journal with publishing fees of 500 EURO for an article processing charge (APC) (see <https://un-pub.eu/ojs/index.php/cjes/apc> for details). If you think you cannot pay this amount, please withdraw your article immediately. Please confirm if you can pay. Let's start the referee process of your article. We are waiting for your confirmation to start the referee process.

This manuscript, if accepted, will be published under an open access Creative Commons CC BY license (<https://creativecommons.org/licenses/by/4.0/>), and I agree to pay the Article Processing Charges as described on the journal webpage (<https://un-pub.eu/ojs/index.php/cjes/apc>). See <https://un-pub.eu/ojs/index.php/cjes/oap> for more information about open access publishing.

Please download the Copyright Form from <https://un-pub.eu/ojs/index.php/cjes/about/submissions> and fill in and sign, then scan and convert to PDF file and then submit it to me.

b. My manuscript is submitted on the understanding that it has not been published in or submitted to another peer-reviewed journal. Exceptions to this rule are papers containing material disclosed at conferences. I confirm that I will inform the journal editorial office if this is the case for my manuscript. I confirm that all authors are familiar with and agree with submission of the contents of the manuscript. The journal editorial office reserves the right to contact all authors to confirm this in case of doubt. I will provide email addresses for all authors and an institutional e-mail address for at least one of the co-authors, and specify the name, address and e-mail for invoicing purposes.



If you have any questions, please do not hesitate to contact the CJES editorial office at [editor.cjes@gmail.com](mailto:editor.cjes@gmail.com).

You can follow progress of your manuscript at the following link (login required): <https://mc04.manuscriptcentral.com/cjes>

Please confirm and sent to back me your reply.

Kind regards,

CJES Editorial Office  
E-Mail: [editor.cjes@gmail.com](mailto:editor.cjes@gmail.com)

**2. Bukti konfirmasi komentar reviewer 1, 2, dan 3  
(28 April 2023)**



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES) - Decision on Manuscript ID CJES-2021-0127**

1 message

---

**Hüseyin Uzunboylu** <onbehalf@manuscriptcentral.com>  
Reply-To: editor.cjes@gmail.com  
To: m.rais@unm.ac.id

28 April 2021 at 22:25

28-Apr-2021

Dear Dr. Rais:

Manuscript ID CJES-2021-0127 entitled "Comparing Project-Based Learning and Problem-Based Learning to Foster 21st Century Learning Skills in Agricultural Seaweed Product" which you submitted to the Cypriot Journal of Educational Sciences (CJES), has been reviewed. The comments of the reviewer(s) are included at the bottom of this letter.

The reviewer(s) have recommended publication, but also suggest some minor revisions to your manuscript. Therefore, I invite you to respond to the reviewer(s)' comments and revise your manuscript.

To revise your manuscript, log into <https://mc04.manuscriptcentral.com/cjes> and enter your Author Center, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision.

You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.

\*\*\* PLEASE NOTE: This is a two-step process. After clicking on the link, you will be directed to a webpage to confirm. \*\*\*

[https://mc04.manuscriptcentral.com/cjes?URL\\_MASK=026d3683145d48b0b11e9840140d6f38](https://mc04.manuscriptcentral.com/cjes?URL_MASK=026d3683145d48b0b11e9840140d6f38)

You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript using a word processing program and save it on your computer. Please also highlight the changes to your manuscript within the document by using the track changes mode in MS Word or by using bold or colored text.

Once the revised manuscript is prepared, you can upload it and submit it through your Author Center.

When submitting your revised manuscript, you will be able to respond to the comments made by the reviewer(s) in the space provided. You can use this space to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the reviewer(s).

**IMPORTANT:** Your original files are available to you when you upload your revised manuscript. Please delete any redundant files before completing the submission.

Because we are trying to facilitate timely publication of manuscripts submitted to the Cypriot Journal of Educational Sciences (CJES), your revised manuscript should be

submitted by 28-May-2021. If it is not possible for you to submit your revision by this date, we may have to consider your paper as a new submission.

Once again, thank you for submitting your manuscript to the Cypriot Journal of Educational Sciences (CJES) and I look forward to receiving your revision.

Sincerely,

Prof. Dr. Hüseyin Uzunboylu  
Editor-in-Chief, Cypriot Journal of Educational Sciences (CJES)  
[editor.cjes@gmail.com](mailto:editor.cjes@gmail.com)

#### Editor Comments

During the preparation of your manuscript for publication, there are some requirements listed below to improve your manuscript. Please pay attention to these requirements, revise your manuscript based on EDITOR AND REVIEWERS' comments and send with proofreading certificate and similarity report:

PLEASE HIGHLIGHT THE PLACES YOU REVISED IN THE ARTICLE WITH YELLOW.

- 1) Your paper must be edited by an ENGLISH NATIVE PERSON. After you have corrected your paper, you may make it in the center of Proofreading-Editing that imposes a special rate for the journal author/s. [www.proofreading-editing.eu](http://www.proofreading-editing.eu).
- 2) Please use only the English language in the Manuscript. Including your name and affiliation information.
- 3) Your references should be written according to APA 7 Editing (American Psychological Association). All references must be given a DOI or (if not available) URL link. The link provided below may be helpful for you.  
[https://owl.purdue.edu/owl/research\\_and\\_citation/apa\\_style/apa\\_formatting\\_and\\_style\\_guide/apa\\_changes\\_7th\\_edition.html](https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/apa_changes_7th_edition.html)
- 4) Please exclude the reference(s) which is/are not used in your paper.
- 5) The abstract should be written as a continuous paragraph with 120-150 words and recapitulative state the background of the research, purpose, methodologies, major conclusions and its contributions to the field. It should emphasize new or important aspects of the study.
- 6) Ensure that all the in-text citations are included in the reference list (correspondence between in-text citations and your reference list).
- 7) If available, please add the DOI number of the cited references. If there is no DOI number, please provide the link to the URL.
- 8) The manuscript file must be in MS Word format only (not PDF) and should be formatted ready for submission, in journal "Full-Paper-Template-for- After Review-Process" which can be downloaded from the link: <https://un-pub.eu/ojs/index.php/cjes/about/submissions>.
- 9) Please include all these main titles in your Manuscript (Introduction, Method, Results, Discussion, Conclusion, Recommendations).
- 10) Please double check the title (not more than 12 words), author(s)' names and affiliations and authors' contact information, and references.
- 11) Please read the article procession charge page of the web site <https://un-pub.eu/ojs/index.php/cjes/apc> and then carry out necessary actions.
- 12) Please fill in the complete information of the authors on the journal website. The Authors name, University, faculty, department, city, country, email and orcid ([www.orcid.org](http://www.orcid.org)) information must be filled out completely.
- 13) All authors must be a member of Orcid ([www.orcid.org](http://www.orcid.org)) and Publons ([www.publons.com](http://www.publons.com)) academic websites, and include all required information. If you are a member,

please update., All authors, please visit <https://publons.com/journal/104595/cypriot-journal-of-educational-sciences> and click on the button ENDORSE THIS JOURNAL. Publons is part of Clarivate Analytics, and it is good to have endorsements.

14) During the editing process, we use iThenticate or Turnitin plagiarism software. It is recommended that the authors scan with iThenticate plagiarism or other free plagiarism software of their manuscripts and send us the similarity report (documents with above 10% rating will not be published).

We plan to publish your article in the forthcoming issue. Please make the necessary corrections within 10 days.

Reviewer(s)' Comments to Author:

Reviewer: 1

Comments to the Author  
(There are no comments.)

Reviewer: 2

Comments to the Author  
Please see the attached file

Reviewer: 3

Comments to the Author

- 1) The abstract should be rewritten. The journal should be rewritten according to the information on the Author Guidelines page. Statistical signs or numbers should not be used.
- 2) The introduction of the article should be discussed in two parts as Theoretical / Conceptual framework and Related Research.
- 3) The research gap should be determined and the need for research should be expressed.
- 4) Treat the discussion part as a separate main topic.
- 5) Write the references according to APA 7 style.
- 6) There are grammar errors in the article. Proofreading must be done.

### **3. Konfirmasi proofreading artikel (8 Mei 2021)**



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

## Proofreading Article

4 messages

---

**Muhammad Rais UNM** <m.rais@unm.ac.id>

8 May 2021 at 10:49

To: taeg.proofreading@gmail.com

### Dear The Academic Event Group (TAEG)

I'm Muhammad Rais, now I am submitting my article in the Cypriot Journal, and I am suggested to proofread my article in the The Academic Event Group (TAEG).

Along with this email, I attached the article. I'm looking forward to hearing from you

Best Regards

---

 **Manuscript for Review.docx**  
129K

---

**TAEG Proofreading** <taeg.proofreading@gmail.com>

8 May 2021 at 14:44

To: Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

### Dear Author,

Thank you for your email.

First of all, I ask you to pay for the proofreading-editing fee. You need to pay for the proofreading of your article fee is **50 Euro**.

You can make your payment according to the number of words using the credit card system link below.

[https://www.globalcenter.info/payment/index.php?route=product/product&path=171&product\\_id=370](https://www.globalcenter.info/payment/index.php?route=product/product&path=171&product_id=370)

Also, you can transfer with the bank at the daily rate. You can find our bank details in the attachment.

- **It will be delivered 2 or 3 days after payment.**

**Note: After making your payment, please do not forget to send your receipt to me.**

Thank you in advance.

**Best regards**

[Quoted text hidden]

--

***Please like our social media accounts so that we can serve you better and be aware of developments.***

**Facebook:** <https://www.facebook.com/Proofreading-114451696861701>

<https://www.facebook.com/taegcenter>

**Instagram:** [https://www.instagram.com/taeg\\_center/](https://www.instagram.com/taeg_center/)

**Twitter:** [https://twitter.com/taeg\\_center](https://twitter.com/taeg_center)



---

**Muhammad Rais UNM** <m.rais@unm.ac.id>

To: TAEG Proofreading <taeg.proofreading@gmail.com>

11 May 2021 at 09:55

**Dear The Academic Event Group (TAEG)**

I transferred the payment (50 Euro). Along with this email, I attached the proof of payment

Thank you for your interest in Birleşik Dünya Yenilik Araştırma ve Yayıncılık Merkezi products. Your order has been received and will be processed once payment has been confirmed.

To view your order click on the link below:



[https://www.globalcenter.info/payment/index.php?route=account/order/info&order\\_id=3024](https://www.globalcenter.info/payment/index.php?route=account/order/info&order_id=3024)

#### Order Details

**Order ID:** 3024  
**Date Added:** 10/05/2021  
**Payment Method:** İş Bankası - (3D Pay) Kredi Kartına Peşin - Toplam: 50

**E-mail:** [m.rais@unm.ac.id](mailto:m.rais@unm.ac.id)  
**Telephone:** 081233200189  
**IP Address:** 125.162.210.136  
**Order Status:** Pending

#### Payment Address

Muhammad Rais  
 Univrsitas Negeri Makqsaar  
 Komp. Gerhama alaudin blok d no 11  
 Makassar 90221  
 Sulawesi Selatan  
 Indonesia

Product	Model	Quantity	Price	Total
Proofreading-Editing - WORDS: 6.000-6.499	Proofreading-editing	1	50.00€	50.00€
			<b>Sub-Total:</b>	50.00€
			<b>Total:</b>	50.00€

[Quoted text hidden]

**TAEG Proofreading** <taeg.proofreading@gmail.com>  
 To: Muhammad Rais UNM <m.rais@unm.ac.id>

11 May 2021 at 15:34

Thank you very much.

[Quoted text hidden]



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Reminder: Cypriot Journal of Educational Sciences (CJES)**

1 message

---

**Cypriot Journal of Educational Sciences (CJES)** <onbehalf@manuscriptcentral.com>

15 May 2021 at 13:36

Reply-To: cjes.editorial@gmail.com

To: m.rais@unm.ac.id

15-May-2021

Dear Dr. Rais:

Recently, you received a decision on Manuscript ID CJES-2021-0127, entitled "Comparing Project-Based Learning and Problem-Based Learning to Foster 21st Century Learning Skills in Agricultural Seaweed Product." The manuscript and decision letter are located in your Author Center at <https://mc04.manuscriptcentral.com/cjes>.

This e-mail is simply a reminder that your revision is due in two weeks. If it is not possible for you to submit your revision within two weeks, we will consider your paper as a new submission.

You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.

\*\*\* PLEASE NOTE: This is a two-step process. After clicking on the link, you will be directed to a webpage to confirm. \*\*\*

[https://mc04.manuscriptcentral.com/cjes?URL\\_MASK=92250ee4697146b5bfb97167c5edc624](https://mc04.manuscriptcentral.com/cjes?URL_MASK=92250ee4697146b5bfb97167c5edc624)

Sincerely,  
BIRLESİK DUNYA YENİLİK ARASTIRMA VE YAYINCILIK MERKEZİ  
Cypriot Journal of Educational Sciences (CJES) Editorial Office  
[cjes.editorial@gmail.com](mailto:cjes.editorial@gmail.com)



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES) - Manuscript ID CJES-2021-0127.R1**

1 message

---

**Cypriot Journal of Educational Sciences (CJES)** <onbehalf@manuscriptcentral.com>

16 May 2021 at 12:14

Reply-To: cjes.editorial@gmail.com

To: m.rais@unm.ac.id

16-May-2021

Dear Dr. Rais:

Your manuscript entitled "Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product" has been successfully submitted online and is presently being given full consideration for publication in the Cypriot Journal of Educational Sciences (CJES).

Your manuscript ID is CJES-2021-0127.R1.

Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at <https://mc04.manuscriptcentral.com/cjes> and edit your user information as appropriate.

You can also view the status of your manuscript at any time by checking your Author Center after logging in to <https://mc04.manuscriptcentral.com/cjes>.

Thank you for submitting your manuscript to the Cypriot Journal of Educational Sciences (CJES).

Sincerely,  
Cypriot Journal of Educational Sciences (CJES) Editorial Office



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**Cypriot Journal of Educational Sciences (CJES) - Decision on Manuscript ID CJES-2021-0127.R1**

---

**Hüseyin Uzunboylu** <onbehalf@manuscriptcentral.com>

20 May 2021 at 17:50

Reply-To: editor.cjes@gmail.com

To: m.rais@unm.ac.id

Cc: bdcenter.editorial@gmail.com

20-May-2021

Dear Dr. Rais:

It is a pleasure to conditionally accept your manuscript entitled "Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product" in its current form for publication in the Cypriot Journal of Educational Sciences (CJES).

The official letter of acceptance will be sent to you when you provide the following,

- 1) The final version of your article arranged according to the journal format,
- 2) Signed Copyright Form
- 3) Article Processing Charge document,
- 4) Less than 10% similarity report,
- 5) Proofreading Certificate.
- 6) Please fill in all the information in your ORCID ([www.orcid.org](http://www.orcid.org)) and Publons ([www.publons.com](http://www.publons.com)) account. We will check.
- 7) All authors must visit <https://publons.com/journal/104595/cypriot-journal-of-educational-sciences/> and click on the button Endorse this Journal.

Then, sent all requested documents to the Copy Editor ([bdcenter.editorial@gmail.com](mailto:bdcenter.editorial@gmail.com))

Thank you for your fine contribution. On behalf of the Editors of the Cypriot Journal of Educational Sciences (CJES), we look forward to your continued contributions to the Journal.


Sincerely,

Dr. Hüseyin Uzunboylu  
Editor-in-Chief, Cypriot Journal of Educational Sciences (CJES)  
[editor.cjes@gmail.com](mailto:editor.cjes@gmail.com)

---

**3 attachments**

 **Certificate of English Editing - 253.pdf**  
342K

 **CJES-2021-0127.docx**  
196K



**PDF\_Proof.PDF**  
325K



Muhammad Rais UNM <m.rais@unm.ac.id>

---

## Cypriot Journal of Educational Sciences (CJES)

1 message

---

**Hüseyin Uzunboylu** <onbehalf@manuscriptcentral.com>

21 May 2021 at 17:42

Reply-To: editor.cjes@gmail.com

To: m.rais@unm.ac.id

21-May-2021

CJES-2021-0127.R1 - Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product

Dear Dr. Rais:

Thank you for your email. You can pay by credit card using the link below.

[https://www.globalcenter.info/payment/index.php?route=product/product&path=169&product\\_id=374](https://www.globalcenter.info/payment/index.php?route=product/product&path=169&product_id=374)

If you cannot pay by credit card, you can pay by bank transfer and Western Union.

Please contact the [congress.infodesk@gmail.com](mailto:congress.infodesk@gmail.com) address for payment.

Best Regards,  
Administrative Editor

#### **4. Bukti proofreading artikel (27 Mei 2021)**



Muhammad Rais UNM &lt;m.rais@unm.ac.id&gt;

---

**CJES-2021-0127.R1**

---

**Muhammad Rais UNM** <m.rais@unm.ac.id>  
To: bdcenter.editorial@gmail.com  
Cc: Copyright Forms <editor.cjes@gmail.com>

27 May 2021 at 20:13

Dear Editorial Team of CJES

Along with this email, I attached some requested documents:






- 1) The final version of my article arranged according to the journal format,
- 2) Signed Copyright Form
- 3) Article Processing Charge document,
- 4) Less than 10% similarity report,
- 5) Proofreading Certificate.

Thank you for your kind attention

Best Regards

---

**5 attachments**

-  **Certificate of English Editing - 253.pdf**  
342K
-  **Manuscript CJES-2021-0127.docx**  
197K
-  **PAYMENT PROOF VIA CREDIT CARD.pdf**  
255K
-  **Turnitin Result\_Muhammad Rais's Article.pdf**  
2835K
-  **Copyright Agreement Form\_Muhammad Rais.pdf**  
327K



**Copyright Agreement Form**

Title of paper(*)	Comparing Project-Based Learning and Problem-Based Learning to Foster 21st Century Learning Skills in Agricultural Seaweed Product
Contact Author Name(*)	Muhammad Rais
Contact Author Institution(*)	Universitas Negeri Makassar
E-mail(*)	m.rais@unm.ac.id

My manuscript is submitted on the understanding that it has not been published in or submitted to another peer-reviewed journal. Exceptions to this rule are papers containing material disclosed at conferences. I confirm that I will inform the journal editorial office if this is the case for my manuscript. I confirm that all authors are familiar with and agree with submission of the contents of the manuscript. The journal editorial office reserves the right to contact all authors to confirm this in case of doubt. I will provide email addresses for all authors and an institutional e-mail address for at least one of the co-authors, and specify the name, address and e-mail for invoicing purposes.

Representation of all Authors



Muhammad Rais

Advancement of Science and Societies Life

# Proofreading Editing

[proofreading-editing.eu](http://proofreading-editing.eu)



## CERTIFICATE OF ENGLISH EDITING

This document certifies that the paper listed below has been edited to ensure that the language is clear and free of errors. The logical presentation of ideas and the structure of the paper were also checked during the editing process. The intent of the author's message was not altered in any way during the editing process. The quality of the edit has been guaranteed, with the assumption that our suggested changes have been accepted and have not been further altered without the knowledge of our editors.

### TITLE OF THE PAPER

“Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product”

### AUTHOR/S

**Muhammad Rais**

A handwritten signature in blue ink, appearing to read 'Pembe Mehmet'.

**Pembe Mehmet**

May 12, 2021

No: 253

### Contact

The Academic Event Group (TAEG)

Registration No: SLBT 375, Postal Address: P.O. 22912,1525 Nicosia, Cyprus.

Dispute: Subject to Nicosia (Cyprus) Jurisdiction only, in case of any dispute

[www.proofreading-editing.eu](http://www.proofreading-editing.eu) E-mail: [taeg.proofreading@gmail.com](mailto:taeg.proofreading@gmail.com) WhatsApp: +905428566055

Thank you for your interest in Birleşik Dünya Yenilik Araştırma ve Yayıncılık Merkezi products. Your order has been received and will be processed once payment has been confirmed.

Order Details				
<b>Order ID:</b> 3086 <b>Date Added:</b> 27/05/2021 <b>Payment Method:</b> İş Bankası - (3D Pay) Kredi Kartına Peşin - Toplam: 500		<b>E-mail:</b> <a href="mailto:m.rais@unm.ac.id">m.rais@unm.ac.id</a> <b>Telephone:</b> 081233200189 <b>IP Address:</b> 36.72.78.164 <b>Order Status:</b> Pending		
Payment Address				
Muhammad Rais Universitas Negeri Makassar Kompleks. Gerhana Alaudin Blok D No 11 Makassar 90221 Sulawesi Selatan Indonesia				
Product	Model	Quantity	Price	Total
Cypriot Journal of Educational Sciences (CJES) - Submissions after June 23, 2020 - PAPER ID NUMBER: D CJES-2021-0127.R1 - FULL PAPER TITLE: Comparing project-ba.. - AUTHORS (Name, Surname): Muhammad Rais - RECEIPT NAME AND ADDRESS DETAILS: Dr. Hüseyin Uzunboyl..	Submissions after June 23, 2020 (CJES)	1	500.00€	500.00€
			<b>Sub-Total:</b>	500.00€
			<b>Total:</b>	500.00€

# Muhammad Rais's Article

*by* Muhammad Rais

---

**Submission date:** 27-May-2021 12:43AM (UTC-0500)

**Submission ID:** 1595076091

**File name:** Manuscript\_CJES-2021-0127.docx (194.43K)

**Word count:** 6191

**Character count:** 37495

## Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product

Muhammad Rais<sup>a\*</sup>, Universitas Negeri Makassar, Faculty of Engineering, Agricultural Technology Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0001-7690-6253>)  
Muhammad Yahya<sup>b</sup>, Universitas Negeri Makassar, Faculty of Engineering, Automotive Engineering Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0002-0034-8360>)  
Jamaluddin<sup>c</sup>, Universitas Negeri Makassar, Faculty of Engineering, Agricultural Technology Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0002-7189-8650>)  
Purnamawati<sup>d</sup>, Universitas Negeri Makassar, Faculty of Engineering, Electrical Engineering Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0001-8516-4167>)

### Suggested Citation:

First Author, Second Author & Third Author (2020). Type the title of your paper. *Cypriot Journal of Educational Science*. 0(0), 00-00.

Received from; revised from; accepted from.

Selection and peer review under responsibility of Prof. Dr. Huseyin Uzunboylu, Near East University, Cyprus.

©2020 United World Center of Research Innovation and Publication. All rights reserved.

### Abstract

This study examined the effect of 1) learning strategy [project-based learning (PjBL) and problem-based learning (PBL)] on the ability of seaweed product diversification; 2) 21st-century learning skills [critical thinking, communication, collaboration and creativity (4Cs)] on the ability of seaweed product diversification; and 3) the interaction between PjBL, PBL and 4Cs on the ability of seaweed product diversification. This study was a quasi-experiment with a 2 × 4 factorial design, namely two learning strategies (PjBL and PBL) × four types of 21st-century learning skills. The research subjects were college students of a public university (n = 70). Data were analysed using the two-way analysis of variance. The results indicated that (1) there were significant differences in students' ability to diversify seaweed between groups which were taught with PjBL and the one with PBL, (2) there were differences in the ability of students' to diversify seaweed between the ones in the groups with different 21st-century learning skills and (3) there was an interaction between learning strategies and 21st-century learning skills towards the ability to diversify seaweed products. This study indicates that the implementation of PjBL brings a better effect compared to the implementation of PBL in fostering 21st-century learning skill.

Keywords: Project-based learning; problem-based learning; 21st-century learning skills.

\* ADDRESS FOR CORRESPONDENCE: Muhammad Rais, Rais, Universitas Negeri Makassar, A.P. Pettarani Street, Makassar, 90222, Indonesia  
E-mail address: [m.rais@unm.ac.id](mailto:m.rais@unm.ac.id) / Tel.: +62-81233200189

## 1. Introduction

Vocational education learning, especially agricultural technology education learning, needs to provide examples of problem-solving in real life (Kricsfalussy, George & Reed, 2018; Lucas, Spencer & Claxton, 2012). The learning that can develop the ability to solve problems and manufacture real products are project-based learning (PjBL) (Bell, 2010; DeMink-Carthew & Olofson, 2020; Smith & Rayfield, 2016) and problem-based learning (PBL) (Diegel, Nordin & Motte, 2019; Phungsuk, Viriyavejakul & Ratanaolarn, 2017). A few studies have evaluated PjBL in agricultural technology learning (Kibett & Kathuri, 2005; Smith & Rayfield, 2016), as well as PBL (Abbey, Lord, Dowsett & Sullivan, 2017; Parr & Edwards, 2004). However, these studies tend to study the two approaches separately. There is no research that combines PjBL and PBL strategies in one study, which examines issues related to seaweed products diversification. As a result, there are not many scientific publications related to learning strategies in agriculture in Indonesia; so, this research can be regarded as a research pioneer in this field.

In seaweed learning, there are two abilities that must be emphasised, namely the ability to formulate problems and the ability to make artefact products (Helle, Tynjala & Olkinuora, 2006). Both aspects can be achieved by integrating PBL and PjBL learning strategies (Prince & Felder, 2006). Although the two approaches are different, both require some skills that must be mastered by students so that the learning objectives can be achieved. The skills referred to in this case are critical thinking skills, creative, collaborative and communication skills (Alismail & McGuire, 2015; Amran, Perkasa, Satriawan, Jasim & Irwansyah, 2019; Zabit, 2010). These four skills are generally known as 21st-century skills, which are abbreviated as 4Cs (Romero, 2016). This research not only integrates the PjBL and PBL strategies in learning, but also focuses on examining the 4Cs' skills which are the condition variables in the application of the learning strategy. As a variable of learning conditions, 21st-century learning skills are different for each student. Therefore, measuring these skills at the beginning of learning is believed to facilitate the acquisition of the ability of seaweed product diversification.

There are several previous studies that have reviewed and compared PjBL and PBL methods in learning. Affandi and Sukyadi (2016) reviewed PjBL and PBL for EFL students' writing achievement at the tertiary level. However, the study aimed to 1) examine the effect of PjBL and PBL on writing achievement; 2) detect differences in writing skills in groups taught with PjBL and PBL; and 3) obtain students' perceptions of writing skills based on PjBL and PBL methods. The results showed that the PjBL method was more influential in training students to learn through the problem-solving process by developing critical thinking, building social and cooperative skills and increasing students' motivation and enjoyment in writing compared to the PBL method.

Another research conducted by Anazifa and Djukri (2017) aimed to examine the effect of PjBL and PBL in terms of students' creativity and critical thinking and differences in the effects of PjBL and PBL based on creativity and critical thinking. The results show that (1) PjBL and PBL affect students' creativity and critical thinking; (2) there is a difference in the effect of PjBL and PBL on students' creativity; and (3) there is no difference in the effect of PjBL and PBL on students' critical thinking. Another research conducted by Husna and Gultom (2019) aimed to examine the effect of PjBL and PBL on higher order thinking skills. The results showed that PjBL and PBL have the same effect in increasing higher order thinking skills.

PjBL and PBL are two types of learning strategies that are equivalent and are based on constructivist learning theory. Not many studies have examined both of them and placed them as experimental studies on the learning of seaweed, especially on seaweed product diversification. Besides, there has not been much research integrating these two types of learning strategies with 21st-century learning skills. Therefore, the objectives of this study are to examine 1) the influence of PjBL



and PBL on the learning ability of seaweed product diversification; 2) the influence of 21st-century learning skills on the learning ability of seaweed product diversification, and 3) the interaction pattern between PjBL and PBL with 21st-century learning skills on the learning ability of seaweed product diversification.

### 1.1. Concept of PjBL and PBL

Based on various concepts, PjBL is defined as a learning model that assists students in solving real problems – critical, creative and communicative. PjBL is based on the learning and teaching paradigm that emphasises social and constructivist dimensions in carrying out teaching and learning activities (Gu & Wang, 2006). The application of PjBL in the learning process becomes very important to improve students' ability to think critically and to be independent in learning. As a constructivist learning, PjBL facilitates students to learn in the real situation, so that they can gain permanent knowledge. PjBL is a model that can organise projects in learning (Gulbahar & Tinmaz, 2006). PjBL provides opportunities for student-centred learning systems, more collaboration, students are actively involved in completing projects independently, working together in teams and integrating real problems (Paris & Paris, 2001; Rashotte, MacPhee & Torgesen, 2001).

Some earlier studies showed that PjBL is important to be applied. Johann et al. (2006) reported that 90% of the students who followed learning which implemented PjBL were optimists who were able to implement PjBL in the working world and believed that they can increase their learning achievements. Besides that, a survey study by Lasonen and Vesterinen (2000) showed that 78% of the students believed that curriculum with PjBL basis can prepare a student to enter the working world because they not only study about theory but also carry out practices in the field. The effectiveness of this PjBL was compared with PBL, which based on some references and implementations, these two learning strategies have a similar position in constructive learning strategies. Besides that, the effectiveness of learning of seaweed product diversification was examined under various learning conditions with different 21st-century learning skills. In this context, the skills of 21st-century learning that would be examined include critical thinking, communication, collaboration and creativity.

PBL as a control variable in this study is designed to develop ways of thinking, problem-solving, intellectual skills, learning to act like adults through real situations or simulations and to become independent learners (Arends, 2015). Wheeler, Kelly and Gale (2005) have defined PBL as learning based on thinking through real-life problems. PBL can improve technical skills, creative thinking and good social behaviour of students; so it is increasingly applied in various disciplines (Hoidn & Karkkainen, 2014), included in the learning of seaweed product diversification. Abbey et al. (2017) applied a PBL strategy in horticultural production learning. The results show that PBL methods have better results in improving learning outcomes compared to traditional learning, students are more motivated and take initiative in making decisions.

### 1.2. 21st-century learning skills

In various literatures, it is explained that 21st-century skills are knowledge, skills, work habits and character traits that are believed to be significantly helping students to learn, work and live successfully in a variety of environments in the 21st century (Moyer, 2016; Queensland Curriculum and Assessment Authority, 2015; Rotherham & Willingham, 2009). In another perspective, the 21st-century skills include several skills, namely skills to communicate, to think critically, to build networks, to collaborate, to solve problems, to create, to innovate, to analyse and to evaluate (Santos, 2017).

In this study, four 21st-century skills were examined, namely critical thinking, communication, collaboration and creativity. Critical thinking skills are used when the information obtained requires more complex reasoning and the ability to synthesise and analyse (Hixson, Ravitz & Whisman 2012). Communication skills have become one of the most needed 21st-century learning skills. The essence is

that students have sensitivity in transmitting information into valid and useful data. When working in teams, the ability to process important information is applied so that effectiveness in working can be effectively transformed. Hixson et al. (2012) identified communication skills as the ability to use data and media from various sources, both oral and written, to convey the message effectively. Collaborative skills are needed when students work in the real world. When in the learning process, students need a learning design that teaches the collaborative process of working in teams. The process of making diversified seaweed products requires collaborative work. It is intended that individuals with different expertise in the team can complement each other (Kym & Hvolby, 2010).

PjBL and PBL as method variables and 21st-century learning skills as moderating variables are intended to increase the internal validity of the research design. In addition, these two variables are assumed to influence in achieving the ability to seaweed products diversification as learning outcome variables. Thus, the effect of learning strategies and 21st-century learning skills on the learning outcomes of seaweed products diversification needs to be examined

## 2. Research Method

### 2.1. Research design

This study employed the quasi-experimental design to find out the relationship between variables (Gall, Gall & Borg, 2003; Salkind, 2012). All groups in this study were given treatment, which in this case, the first group studied with PjBL while the second one was treated with PBL strategy. Therefore, the design of this experimental study was one of non-equivalent control group design versions (Tuckman & Harper, 2012) a  $2 \times 4$  factorial.

### 2.2. Sample

The research subjects were students from the Agricultural Technology Education Department in a public university in the fifth semester of the academic year 2019–2020. The total number of students was 70 divided into classes A and B with 35 students each. Class A was taken as the experimental group, while class B was the control group. It followed one of the quasi-experimental characteristics that divide subjects not on a random basis, which in other words, the subjects were grouped according to the existing classes (Salkind, 2012).

### 2.3. Research procedure

The experiments were carried out by performing scenarios of the two learning strategies. Both control and experimental classes were given the same treatment, which was to develop a paper about various seaweed product diversifications. The PjBL consisted of five groups with five different seaweed product diversifications. Similarly, the PBL also made a paper with the same topic in the formerly mentioned group. The instruments used in this study were grouped into two categories, namely (1) the instrument to measure the 21st-century learning skills and (2) the instrument to assess the skills of seaweed product diversification. The first instrument adapted 21st Century Competencies (The Ontario Ministry of Education, 2016), which consists of four skills namely: critical thinking, communication, collaboration and creativity. The second instrument used to measure the seaweed product diversification was in the form of a test, which assessed students' knowledge about seaweed diversification. Data were collected with the following steps: (1) conducting a test on the 21st-century learning skills, (2) giving a pre-test to measure the knowledge of seaweed diverse products, (3) implementing a learning intervention (experimental) and (4) providing a post-test.

### 2.4. Data analysis

The analysis requirements test used data normality test and variant homogeneity tests. The data normality test employed the Kolmogorov–Smirnov technique, while the variant homogeneity test utilised the Levene test. The data normality test and the data homogeneity test aimed to fulfil the parametric assumptions. The data were analysed using parametric statistical analysis with the two-way analysis of variance and the  $2 \times 4$  factorial variance analysis had the purpose to test the research



hypothesis

**3. Finding**

9

**3.1. The description of 21st-century learning skills**

The description of data on the measurement of the 21st-century leaning skills using the 21st Century Competencies instruments on two research subjects is presented in Table 1. Table 1 shows that the group implementing the PjBL had a smaller number of student with critical thinking skills, which was only 14.29%, while the creativity possessed by 34.29% of the students was the highest number. Similar to the PBL group, students with critical thinking skills had the smallest number, which was only 14.20% of them. The skill possessed by the largest number of students was collaboration as there were 34.29% who seemed to have the skill.

Table 1. The description of the 21st-century learning skills

21st-century learning skills	PjBL(%)	PBL(%)
Critical thinking	14.29	14.29
Communication	22.86	25.71
Collaboration	28.56	34.29
Creativity	34.29	25.71
Total	100	100

Data about the students' understanding on seaweed diversified products after being taught with PjBL and PBL are presented in Table 2. Table 2 indicates that communication is the 21st-century learning skills which obtained the highest score in the group of PjBL with an average score of  $M = 39.25$ . Other skills (collaboration, critical thinking and creativity) had balanced scores. On the other hand, the group implementing the PBL approach showed that the skill with the highest score was creativity ( $M = 38.44$ ).

Table 2. The results of the descriptive analysis of data about the understanding on seaweed diversification products

Learning strategies	21st-century learning skills	Mean	Standard deviation	N
Project-based learning	Critical Thinking	38.80	1.095	5
	Collaboration	38.90	0.994	10
	Communication	39.25	1.035	8
	Creativity	38.58	1.311	12
	Total	38.86	1.115	35
Problem-based learning	Critical Thinking	37.20	1.095	5
	Collaboration	34.75	3.251	12
	Communication	37.33	1.414	9
	Creativity	38.44	1.667	9
	Total	36.71	2.641	35
Total	Critical Thinking	38.00	1.333	10
	Collaboration	36.64	3.230	22
	Communication	38.24	1.562	17
	Creativity	38.52	1.436	21
	Total	37.79	2.283	70

### 3.2. The effect of learning strategies (PjBL and PBL) on the ability of seaweed product diversification

The results of the hypothesis test show the effect of learning strategies (PjBL and PBL) on seaweed product diversification ability, the effect of 21st-century learning skills on seaweed product diversification ability and the effect of interactions between learning strategies and 21st-century learning skills on seaweed product diversification ability. In detail, the results of the hypothesis test are summarised in Table 3. Table 3 shows that there was a difference in the understanding on seaweed diversification product between students in the *group of students taught using PjBL strategy and students in the group treated with PBL strategy* ( $p \leq 0.05$ ). The average score of students' understanding on seaweed products diversification after being taught using the strategy of PjBL was 38.86, which was significantly higher than the results found in the group treated with PBL, which was only 36.71. This shows that the PjBL strategy has a higher effect than the PBL strategy on seaweed product diversification ability.

13  
Table 3. The results of the hypothesis test

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	160.397 <sup>a</sup>	7	22.914	7.125	.000
Intercept	90707.475	1	90707.475	28205.501	.000
Learning strategies	60.092	1	60.092	18.686	.000
21st-century learning skills	35.518	3	11.839	3.681	.017
Learning strategies * 21st-century learning skills	43.419	3	14.473	4.500	.006
Error	199.389	62	3.216		
Total	100303.000	70			
Corrected total	359.786	69			

<sup>a</sup>R Squared = 0.446 (Adjusted R Squared = 0.383).

### 10 3.3. The effect of 21st-century learning skills on the ability of seaweed product diversification

Table 3 shows that there was a significant difference on students' understanding on seaweed products' diversification between students who had the 21st-century learning skills, which includes critical thinking, communication, collaboration and creativity in the Agricultural Technology Education Department in a public university ( $p < 0.05$ ). The 21st-century learning skills with the highest score in the PjBL group are communication skills, with a mean score of 39.25 (Table 2). This means that in the learning of seaweed products diversification with the PjBL strategy, the most necessary 21st-century learning skills are communication skills which consist of listening, digital literacy and communication in team. On the other hand, the other 21st-century learning skills in general have an almost equal mean score, namely critical thinking (38.80), collaboration (38.90) and creativity (38.58). This average score shows that in PjBL strategy, students have 21st-century learning skills that are evenly distributed in critical thinking, collaboration and creativity. Table 2 shows that 21st-century learning skills with the highest score in PBL is creativity (38.44). It shows that in learning to make diversified processed seaweed products, 21st-century learning skills that most develop in students are creativity, which consists of the ability to develop, to elaborate, to analyse and to evaluate ideas. Other 21st-century skills in PBL strategy, namely critical thinking skills (37.20) and communication (37.33), have almost the same score, except for collaboration abilities (34.75), which had a relatively low score. This shows that students on

PBL strategy have 21st-century learning skills that are evenly distributed in critical thinking and communication and lower in collaboration.

Based on the results of the post-test using Tukey's test shown in Table 4, it was found that the collaboration and communication skills of students differed significantly ( $p < 0.05$ ). In addition, 21st-century abilities that differed significantly were creativity and collaboration ( $p < 0.05$ ).

Table 4. Post-test results using Tukey's test on 21st-century learning skills.

(I) 21st-century learning skills	(J) 21st-century learning skills	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Critical thinking	Collaboration	1.36	0.684	0.201	-0.44	3.17
	Communication	-0.24	0.715	0.988	-2.12	1.65
	Creativity	-0.52	0.689	0.872	-2.34	1.30
Collaboration	Critical thinking	-1.36	0.684	0.201	-3.17	0.44
	Communication	-1.60*	0.579	0.037*	-3.13	-0.07
	Creativity	-1.89*	0.547	0.005*	-3.33	-0.44
Communication	Critical thinking	0.24	0.715	0.988	-1.65	2.12
	Collaboration	1.60*	0.579	0.037*	0.07	3.13
	Creativity	-0.29	0.585	0.960	-1.83	1.26
Creativity	Critical thinking	0.52	0.689	0.872	-1.30	2.34
	Collaboration	1.89*	0.547	0.005*	0.44	3.33
	Communication	0.29	0.585	0.960	-1.26	1.83

### 3.4. Interaction patterns between learning strategies and 21st-century learning skills on the ability of seaweed product diversification

Table 3 shows that there was an interaction between the learning strategy and the 21st-century learning skills (critical thinking, communication, collaboration and creativity) and the students' understanding on seaweed products diversification at Agricultural Technology Education Department in a public university ( $p < 0.05$ ). The interaction pattern between the learning strategy and the 21st-century learning skills and students' understanding of seaweed diversification products is shown in Figure 1. Figure 1 shows that the average ability of seaweed product diversification of students in the group implementing PjBL methods was higher than that of students in the group using the PBL model. The four lines touch each other so that it can be regarded that there is an effect of the interaction between the learning strategies and the 21st-century learning skills on students' understanding of seaweed product diversification.

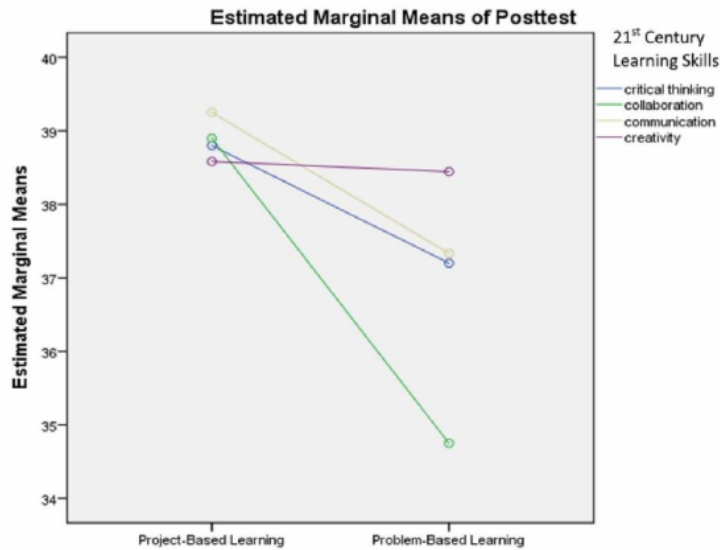


Figure 1. Interaction patterns between learning strategies and 21st-century learning skills on the ability of seaweed product diversification

#### 4. Discussion

The implementation of PjBL in the learning practices which targets the improvement of competency is a must. Various real practices have sufficiently provided empirical evidence that PjBL is effective in accommodating the learning skills. Esche (2002) reported that one of the factors advising the implementation of the PjBL is due to its ability to provide a learning background that can bring the real situation of the field in learning. In its application, one of the characteristics of PjBL is the existence of learning groups that allow students to work collaboratively, to communicate with each other to provide creative ideas and thoughts, to solve a problem and to communicate interactively with other students in constructing new knowledge (Asan & Haliloglu, 2005; Blumenfeld, Fishman, Krajcik, Marx & Soloway, 2000; Marchaim, 2001; Yildirim, 2010).

In PjBL strategies, instructors act as facilitators for design learning activities and provide advice that substantially encourages the development of meaningful learning processes. The meaningful learning process is learning that is developed based on the concept of constructivism which emphasises students as “active students”, the central regulator of activities in mediating and controlling learning (Lasonen & Vesterinen, 2000). Constructivism characterises learning as forming meaning and developing thought. In short, PjBL provides a conducive learning environment so that it can help improve student skills in accordance with the constructivist learning traits. Thus, learning activities are not just learning to accept and memorise concepts, but rather to interpret a concept.

This research found that there are differences in the ability to diversify seaweed products between groups of students who were taught using PjBL strategies and groups of students treated with PBL in the Agricultural Technology Education Department. The effect of the PjBL strategy compared to PBL strategy was due to the ability of the PjBL strategy to provide learning opportunities for students to work in teams, to plan, to organise, to negotiate and to convert thoughts and ideas into real work that is projected experimentally. On the contrary, in PBL, the opportunity to identify, analyse and solve problems in groups and activities to construct knowledge and explore information sources is



synthesised in groups and set forth in the form of innovative and reflective concepts undertaken by the team, but not converted into an experimental project. This aspect distinguishes it from PjBL. When the synthesised concepts are outlined in the form of practical work such as making and designing products, then in this case, PBL only reaches the stage of product development concepts. The findings of this study are in line with previous researches which found that PjBL leads to the achievement of knowledge competencies and skills in working procedures (Esche, 2002; Grey & Antonacopoulou, 2004; Sabry & Baldwin, 2003).

The effectiveness of this research is that the learning atmosphere can encourage project groups to take place vigorously, and through observations, students seemed to enjoy learning methods that were developed based on PjBL scenarios. Students critically express ideas in collaborative groups, start from constructing essential questions, planning a project, making project implementation schedules, working on, analysing, evaluating project results, to exchanging information between groups through the presentation of project results about seaweed products diversification. In the presentation session, each group is trained to think critically in responding to problems and provide solutions to each other. The most important thing from this process is how students communicate ideas into a unity such as creativity, communication, critical thinking and collaborative as a characteristic of 21st-century learning skills.

Here are the essences of meaningful learning. PjBL provides chances for students to create and carry out a project to find new information from various sources of information. In this context, PjBL helps investigations that lead to solving more contextual problems in society. The products developed in the learning of seaweed products diversification are ice cream, red nori food, traditional food of *terang bulan* and *cendol* and pudding. From the theory perspective, 21st-century learning skills in the form of critical thinking, collaboration, communication and creativity have influence on the ability of seaweed product diversification. The results of hypothesis testing indicated that there were differences in the ability of seaweed products diversification between students who had different 21st-century learning skills. In other words, 21st-century learning skills have a significant influence on the ability of seaweed product diversification.

In certain cases, sometimes students who have communication and collaboration skills can superiorly influence the ability of seaweed product diversification compared to students who have critical thinking and creativity learning skills on the same learning strategy. Likewise, with the learning skills of creativity and communication, sometimes students who have both learning skills are superior to students who have critical thinking and collaboration learning skills. Students with critical thinking skills have the ability to use a number of reasoning according to the situation, think systematically, linking one part with another so that they are able to produce products. Students with collaboration skills are able to work in teams effectively and value team members' contributions based on their individual responsibilities. Students with communication skills are able to communicate effectively, both verbally and non-verbally, and in a variety of environments. Students with creativity ability are able to generate new ideas, elaborate and evaluate their own ideas to explore better learning opportunities (National Education Association, 2020).

Ability of seaweed product diversification is easier to be mastered by students who have communication and collaboration skills. This is because the characteristics of students with communication and collaboration skills are in accordance with the competencies needed in the seaweed product diversification, namely effective cooperation, mutual understanding and communicative interactions. The ability to make processed seaweed products such as ice cream, red nori food, traditional food of *terang bulan* and *cendol* and pudding is in higher cognitive domain. Thus, in making diversified seaweed products, it requires the ability to work in teams, take responsibility, assign roles and communicate with various environments and sources of information, media and technology.

Soh, Arsad and Osman (2010) and Musonda (2019) have reported that 21st-century skills influence the learning outcomes. These results support the results of this study. Therefore, Bao and Koenig (2019) emphasise that future education needs to integrate 21st-century skills into the curriculum. The aim is that 21st-century learning skills can be systematically implemented and become a habit that accompanies the learning process. The findings in this study provide a conclusion that differences in 21st-century learning skills significantly influence the ability of seaweed product diversification. This happens because each student has different cognitive abilities to think critically, to communicate, to solve problems and to be creative in making processed seaweed products. In addition, grouping students with homogeneous learning skills has a more significant effect than grouping students heterogeneously. For the next implementation in the classroom, conducting experiments by placing groups of students with heterogeneous 21st-century learning skills need to be considered.

Theoretically and empirically, PjBL and PBL as learning strategies variables and 21st-century learning skills as learning conditions variables have a strong interaction effect on the ability of seaweed product diversification. Thus, it can be assumed that the effect of PjBL is moderated by differences in 21st-century learning skills. It can be said that the effect of learning strategies (PjBL and PBL) on ability of seaweed product diversification is strengthened by differences in 21st-century learning skills (4Cs). The effect of PjBL and PBL strategies on the ability of seaweed product diversification applies strongly to each group of 21st-century learning skills (4Cs). The results showed that there was an interaction pattern between learning strategies and 21st-century skill on the ability of seaweed product diversification. This means that the influence of PjBL and PBL on ability of seaweed product diversification applies strongly to each group of 21st-century learning skills (4Cs)

## 5. Conclusion

Based on the findings and discussion with regard to the study's purposes, it is concluded that 1) there are effects of learning strategies on students' ability of seaweed product diversification; 2) there are effects of the 21st-century learning skills on students' ability of seaweed product diversification and 3) there are effects of interaction between learning strategy and the 21st-century learning skills on students' ability of seaweed product diversification. The presence of the influence of PjBL, PBL and 21st-century learning skills on the ability of seaweed product diversification provides a compelling reason so that in vocational learning, integration of these two learning strategies is needed by paying attention to 21st-century learning skills aspects. Both learning strategies are applied from constructivist learning theory and 21st-century learning skills are the competencies for each student as a provision of life skills in the learning environment, and social environment.

## Acknowledgements

This work was supported by the Professorship Acceleration Grant Scheme, Universitas Negeri Makassar with contract number: SP.DIPA-042.01:2.400964/2019. The authors thank to Prof. Dr. Ir. Husain Syam, M.TP (Rector of Universitas Negeri Makassar) for his assistance.

## Declaration of interest statement

The author(s) declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

## References

Abbey, Lord, Dowsett, E. & Sullivan, J. (2017). Use of problem-based learning in the teaching and learning of horticultural production. *Journal of Agricultural Education and Extension*, 23(1), 61–78. <https://doi.org/10.1080/1389224x.2016.1202846>

- Affandi, A. & Sukyadi, D. (2016). Project-based learning and problem-based learning for EFL students' writing achievement at the tertiary level. *Rangsit Journal of Educational Studies*, 3(1), 23–40.
- Alismail, H. A. & McGuire, P. (2015). 21st Century Standards and Curriculum: Current Research and Practice. *Journal of Education and Practice*, 6(6), 150–155.
- Amran, A., Perkasa, M., Satriawan, M., Jasin, I. & Irwansyah, M. (2019). Assessing students 21st century attitude and environmental awareness: promoting education for sustainable development through science education. *Journal of Physics: Conference Series*, 1157(2), 22025. <https://doi:10.1088/1742-6596/1157/2/022025>
- Anazifa, R. D. & Djukri, D. (2017). Project-Based Learning and Problem-Based Learning: Are They Effective to Improve Student's Thinking Skills? *Jurnal Pendidikan IPA Indonesia*, 6(2), 346–355.
- Arends, R. I. (2015). *Learning to teach* (10th ed.). New York: McGraw-Hill Education.
- Asan, A. & Haliloglu, Z. (2005). Implementing Project Based Learning in Computer Classroom. *Turkish Online Journal of Educational Technology – TOJET*, 4(3), 68–81.
- Bao, L. & Koenig, K. (2019). Physics education research for 21st century learning. *Disciplinary and Interdisciplinary Science Education Research*, 1(2), 1–12. <https://doi:10.1186/s43031-019-0007-8>
- Bell, S. (2010). Project-based learning for the 21st century: skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43.
- Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W. & Soloway, E. (2000). Creating Usable Innovations in Systemic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational Psychologist*, 35(3), 149–164. [https://doi:10.1207/S15326985EP3503\\_2](https://doi:10.1207/S15326985EP3503_2)
- DeMink-Carthew, J. & Olofson, M. W. (2020). Hands-joined learning as a framework for personalizing project-based learning in a middle grades classroom: an exploratory study. *RMLE Online*, 43(2), 1–17. <https://doi:10.1080/19404476.2019.1709776>
- Diegel, O., Nordin, A. & Motte, D. (2019). Teaching design for additive manufacturing through problem-based learning. In *Additive manufacturing – developments in training and education* (pp. 139–149). [https://doi:10.1007/978-3-319-76084-1\\_10](https://doi:10.1007/978-3-319-76084-1_10)
- Esche, S. K. (2002). Project-Based Learning (PBL) in a course on mechanisms and machine dynamics. *World Transactions on Engineering and Technology Education*, 1/2, 201–204.
- Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An Introduction* (7th ed.). Pearson Education, Inc.
- Grey, C., & Antonacopoulou, E. (2004). Essential Readings in Management Learning. In *Management Learning*. SAGE Publications.
- Gu, L., & Wang, J. (2006). School-based Research and Professional Learning: An innovative model to promote teacher professional development in China. *Teaching Education*, 17/1, 59–73. <https://doi.org/10.1080/10476210500528079>
- Gülbahar, Y., & Tinmaz, H. (2006). Implementing project-based learning and E-portfolio assessment in an undergraduate course. *Journal of Research on Technology in Education*, 38/3, 309–327. <https://doi.org/10.1080/15391523.2006.10782462>
- Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in Post-Secondary Education – Theory, Practice and Rubber Sling Shots. *Higher Education*, 51/2, 287–314. <https://doi.org/10.1007/s10734-004-6386-5>
- Hixson, N. K., Ravitz, J., & Whisman, A. (2012). *Extended Professional Development in Project-Based Learning: Impacts on 21st Century Teaching and Student Achievement*. West Virginia Department of Education, Division of Teaching and Learning, Office of Research.
- Husna, H., & Gultom, T. (2019, December). The Effect of Project-Based Learning and Problem-Based Learning in the Order of Contextual Learning in Microbiology Lectures on the High Order Thinking Skills of Biology Students in FMIPA UNIMED. In *4th Annual International Seminar on*



- Transformative Education and Educational Leadership (AISTEEL 2019)* (pp. 368-371). Atlantis Press.
- Hoidn, S., & Kärkkäinen, K. (2014). *Promoting Skills for Innovation in Higher Education*. OECD Publishing
- Johann, T. M., Koch, H., Chlosta, S., & Klandt, H. (2006). Project Seminar Business Plan Development – an Analysis of Integrative Project-Based. *Journal of Asia Entrepreneurship and Sustainability*, 2/2.
- Kibett, J. K., & Kathuri, N. J. (2005). Effects of project-based learning on student performance of higher cognitive skills in secondary school agriculture. *Zimbabwe Journal of Educational Research*, 17/1, 30–38. <https://doi.org/10.4314/zjer.v17i1.26054>
- Kricsfalusy, V., George, C., & Reed, M. G. (2018). Integrating problem- and project-based learning opportunities: assessing outcomes of a field course in environment and sustainability. *Environmental Education Research*, 24/4, 593–610. <https://doi.org/10.1080/13504622.2016.1269874>
- Kym, F., & Hvolby, H. (2010). Effective teamworking: can functional flexibility act as an enhancing factor? An Australian case study. *Team Performance Management*, 16/1, 74–94. <https://doi.org/10.1108/13527591011028933>
- Lasonen, J., & Vesterinen, P. (2000). *Work-Based Learning in Vocational Higher Education Programmes: A Finnish Case of Project-Based Learning*. Finland
- Lucas, B., Spencer, E., & Claxton, G. (2012). *How to Teach Vocational Education : A Theory of Vocational Pedagogy*. City and Guilds Centre for Skills Development.
- Marchaim, U. (2001). High-school student research at Migal science institute in Israel. *Journal of Biological Education*, 35/4, 178–182. <https://doi.org/10.1080/00219266.2001.9655774>
- Moyer, L. A. (2016). *Engaging Students in 21st Century Skills through Non-Formal Learning*. Virginia Polytechnic Institute and State University.
- Musonda, E. (2019). Effect of the 21 st Century Skills on the Performance of Students in Linear Transformations : A Case of Mukuba University, Kitwe District, Copperbelt Province, Zambia. *International Journal of Research and Innovation in Social Science (IJRISS)*, 3/9, 417–420.
- National Education Association. (2020). *Preparing 21st Century Students for a Global Society: An Educator's Guide to the "Four Cs"*. National Education Association.
- The Ontario Ministry of Education. (2016). *21 Century Competencies - Towards Defining 21st Century Competencies for Ontario*. The Ontario Ministry of Education.
- Paris, S. G., & Paris, A. H. (2001). Classroom Applications of Research on Self- Regulated Learning. *Educational Psychologist*, 36/2, 89–101. [https://doi.org/10.1207/s15326985ep3602\\_4](https://doi.org/10.1207/s15326985ep3602_4)
- Parr, B., & Edwards, M. C. (2004). Inquiry-Based Instruction In Secondary Agricultural Education: Problem-Solving - An Old Friend Revisited. *Journal of Agricultural Education*, 45/4, 106–117. <https://doi.org/10.5032/jae.2004.04106>
- Phungsuk, R., Viriyavejakul, C., & Ratanaolarn, T. (2017). Development of a problem-based learning model via a virtual learning environment. *Kasetsart Journal of Social Sciences*, 38/3, 297–306. <https://doi.org/10.1016/j.kjss.2017.01.001>
- Prince, M. J., & Felder, R. M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *Journal of Engineering Education*, 95/2, 123–138. <https://doi.org/10.1002/j.2168-9830.2006.tb00884.x>
- Queensland Curriculum and Assessment Authority. (2015). *21<sup>st</sup> century skills for senior education: An analysis of educational trends*. The State of Queensland.
- Rashotte, C. A., MacPhee, K., & Torgesen, J. K. (2001). The Effectiveness of a Group Reading Instruction Program with Poor Readers in Multiple Grades. *Learning Disability Quarterly*, 24/2, 119–134. <https://doi.org/10.2307/1511068>
- Romero, M. (2016). Digital Game Design as a Complex Learning Activity for Developing the 4Cs Skills:



- Communication, Collaboration, Creativity and Critical Thinking. In A. De Gloria & R. Veltkamp (Eds.), *Games and Learning Alliance. GALA 2015. Lecture Notes in Computer Science*. Springer.
- Rotherham, A., & Willingham, D. (2009). 21st Century Skills: The Challenges Ahead. *Educational Leadership*, 67, 16–21.
- Sabry, K., & Baldwin, L. (2003). Web-based learning interaction and learning styles. *British Journal of Educational Technology*, 34/4, 443–454. <https://doi.org/10.1111/1467-8535.00341>
- Salkind, N. J. (2012). *Exploring Research* (8th ed.). Pearson.
- Santos, J. M. (2017). 21<sup>st</sup> Century Learning Skills: A Challenge in Every Classroom. *International Journal of Emerging Multidisciplinary Research*, 1/1, 31–35.
- Smith, K., & Rayfield, J. (2016). An Early Historical Examination of the Educational Intent of Supervised Agricultural Experiences (SAEs) and Project-Based Learning in Agricultural Education. *Journal of Agricultural Education*, 57(2), 146–160. <https://doi.org/10.5032/jae.2016.02146>
- Soh, T. M. T., Arsad, N. M., & Osman, K. (2010). The relationship of 21st century skills on students' attitude and perception towards physics. *Procedia - Social and Behavioral Sciences*, 7, 546–554. <https://doi.org/10.1016/j.sbspro.2010.10.073>
- Tuckman, B. W., & Harper, B. E. (2012). *Conducting Educational Research* (6th ed.). Rowman & Littlefield Publishers.
- Wheeler, S., Kelly, P., & Gale, K. (2005). The influence of online problem-based learning on teachers' professional practice and identity. *Alt-J*, 13/2, 125–137. <https://doi.org/10.3402/rlt.v13i2.10986>
- Yildirim, N. (2010). Increasing effectiveness of strategic planning seminars through learning style. *Australian Journal of Teacher Education*, 35/4, 12–24. <https://doi.org/10.14221/ajte.2010v35n4.2>
- Zabit, M. N. M. (2010). Problem-Based Learning On Students Critical Thinking Skills In Teaching Business Education In Malaysia: A Literature Review. *American Journal of Business Education (AJBE)*, 3/6, 19–32. <https://doi.org/10.19030/ajbe.v3i6.436>

# Muhammad Rais's Article

## ORIGINALITY REPORT

8%

SIMILARITY INDEX

7%

INTERNET SOURCES

3%

PUBLICATIONS

2%

STUDENT PAPERS

## PRIMARY SOURCES

1	<a href="http://unipasby.ac.id">unipasby.ac.id</a> Internet Source	1%
2	<a href="http://pt.scribd.com">pt.scribd.com</a> Internet Source	1%
3	Submitted to Tennessee Technological University Student Paper	1%
4	<a href="http://www.nyla.org">www.nyla.org</a> Internet Source	1%
5	Isti Citra Wulandari, Nuri Dewi Muldayanti, Anandita Eka Setiadi. "Project and problem based learning on students' critical thinking skills at cell material", JP BIO (Jurnal Pendidikan Biologi), 2020 Publication	1%
6	<a href="http://www.tandfonline.com">www.tandfonline.com</a> Internet Source	<1%
7	<a href="http://event.ners.unair.ac.id">event.ners.unair.ac.id</a> Internet Source	<1%

8	<a href="http://karya-ilmiah.um.ac.id">karya-ilmiah.um.ac.id</a> Internet Source	<1 %
9	<a href="http://m.earticle.net">m.earticle.net</a> Internet Source	<1 %
10	<a href="http://www.rsisinternational.org">www.rsisinternational.org</a> Internet Source	<1 %
11	<a href="http://rke.abertay.ac.uk">rke.abertay.ac.uk</a> Internet Source	<1 %
12	<a href="http://docobook.com">docobook.com</a> Internet Source	<1 %
13	Patriciah W. Wambugu, Johnson M. Changeiywo. "Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement", EURASIA Journal of Mathematics, Science and Technology Education, 2008 Publication	<1 %
14	<a href="http://journals.sagepub.com">journals.sagepub.com</a> Internet Source	<1 %
15	<a href="http://link.springer.com">link.springer.com</a> Internet Source	<1 %
16	Submitted to Concordia University Student Paper	<1 %
17	<a href="http://ejournal.umm.ac.id">ejournal.umm.ac.id</a> Internet Source	<1 %

18

mail.lansingchristianfoundation.org

Internet Source

<1 %

---

19

www.mtwp.net

Internet Source

<1 %

---

Exclude quotes  On

Exclude matches  < 12 words

Exclude bibliography  On

# Muhammad Rais's Article

---

GRADEMARK REPORT

---

FINAL GRADE

**/0**

GENERAL COMMENTS

**Instructor**

---

PAGE 1

---

PAGE 2

---

PAGE 3

---

PAGE 4

---

PAGE 5

---

PAGE 6

---

PAGE 7

---

PAGE 8

---

PAGE 9

---

PAGE 10

---

PAGE 11

---

PAGE 12

---

PAGE 13

---

## Comparing project-based learning and problem-based learning to foster 21st-century learning skills in agricultural seaweed product

Muhammad Rais<sup>a\*</sup>, Universitas Negeri Makassar, Faculty of Engineering, Agricultural Technology Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0001-7690-6253>)

Muhammad Yahya<sup>b</sup>, Universitas Negeri Makassar, Faculty of Engineering, Automotive Engineering Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0002-0034-8360>)

Jamaluddin<sup>c</sup>, Universitas Negeri Makassar, Faculty of Engineering, Agricultural Technology Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0002-7189-8650>)

Purnamawati<sup>d</sup>, Universitas Negeri Makassar, Faculty of Engineering, Electrical Engineering Education, A.P. Pettarani Street, 90222, Makassar, Indonesia (<https://orcid.org/0000-0001-8516-4167>)

### Suggested Citation:

First Author, Second Author & Third Author (2020). Type the title of your paper. *Cypriot Journal of Educational Science*. 0(0), 00-00.

Received from; revised from; accepted from.

Selection and peer review under responsibility of Prof. Dr. Huseyin Uzunboylu, Near East University, Cyprus.

©2020 United World Center of Research Innovation and Publication. All rights reserved.

### Abstract

This study examined the effect of 1) learning strategy [project-based learning (PjBL) and problem-based learning (PBL)] on the ability of seaweed product diversification; 2) 21st-century learning skills [critical thinking, communication, collaboration and creativity (4Cs)] on the ability of seaweed product diversification; and 3) the interaction between PjBL, PBL and 4Cs on the ability of seaweed product diversification. This study was a quasi-experiment with a 2 × 4 factorial design, namely two learning strategies (PjBL and PBL) × four types of 21st-century learning skills. The research subjects were college students of a public university ( $n = 70$ ). Data were analysed using the two-way analysis of variance. The results indicated that (1) there were significant differences in students' ability to diversify seaweed between groups which were taught with PjBL and the one with PBL, (2) there were differences in the ability of students' to diversify seaweed between the ones in the groups with different 21st-century learning skills and (3) there was an interaction between learning strategies and 21st-century learning skills towards the ability to diversify seaweed products. This study indicates that the implementation of PjBL brings a better effect compared to the implementation of PBL in fostering 21st-century learning skill.

Keywords: Project-based learning; problem-based learning; 21st-century learning skills.

\* ADDRESS FOR CORRESPONDENCE: Muhammad Rais, Rais, Universitas Negeri Makassar, A.P. Pettarani Street, Makassar, 90222, Indonesia  
E-mail address: [m.rais@unm.ac.id](mailto:m.rais@unm.ac.id) / Tel.: +62-81233200189

## 1. Introduction

Vocational education learning, especially agricultural technology education learning, needs to provide examples of problem-solving in real life (Kricsfalusy, George & Reed, 2018; Lucas, Spencer & Claxton, 2012). The learning that can develop the ability to solve problems and manufacture real products are project-based learning (PjBL) (Bell, 2010; DeMink-Carthew & Olofson, 2020; Smith & Rayfield, 2016) and problem-based learning (PBL) (Diegel, Nordin & Motte, 2019; Phungsuk, Viriyavejakul & Ratanaolarn, 2017). A few studies have evaluated PjBL in agricultural technology learning (Kibett & Kathuri, 2005; Smith & Rayfield, 2016), as well as PBL (Abbey, Lord, Dowsett & Sullivan, 2017; Parr & Edwards, 2004). However, these studies tend to study the two approaches separately. There is no research that combines PjBL and PBL strategies in one study, which examines issues related to seaweed products diversification. As a result, there are not many scientific publications related to learning strategies in agriculture in Indonesia; so, this research can be regarded as a research pioneer in this field.

In seaweed learning, there are two abilities that must be emphasised, namely the ability to formulate problems and the ability to make artefact products (Helle, Tynjala & Olkinuora, 2006). Both aspects can be achieved by integrating PBL and PjBL learning strategies (Prince & Felder, 2006). Although the two approaches are different, both require some skills that must be mastered by students so that the learning objectives can be achieved. The skills referred to in this case are critical thinking skills, creative, collaborative and communication skills (Alismail & McGuire, 2015; Amran, Perkasa, Satriawan, Jasin & Irwansyah, 2019; Zabit, 2010). These four skills are generally known as 21st-century skills, which are abbreviated as 4Cs (Romero, 2016). This research not only integrates the PjBL and PBL strategies in learning, but also focuses on examining the 4Cs' skills which are the condition variables in the application of the learning strategy. As a variable of learning conditions, 21st-century learning skills are different for each student. Therefore, measuring these skills at the beginning of learning is believed to facilitate the acquisition of the ability of seaweed product diversification.

There are several previous studies that have reviewed and compared PjBL and PBL methods in learning. Affandi and Sukyadi (2016) reviewed PjBL and PBL for EFL students' writing achievement at the tertiary level. However, the study aimed to 1) examine the effect of PjBL and PBL on writing achievement; 2) detect differences in writing skills in groups taught with PjBL and PBL; and 3) obtain students' perceptions of writing skills based on PjBL and PBL methods. The results showed that the PjBL method was more influential in training students to learn through the problem-solving process by developing critical thinking, building social and cooperative skills and increasing students' motivation and enjoyment in writing compared to the PBL method.

Another research conducted by Anazifa and Djukri (2017) aimed to examine the effect of PjBL and PBL in terms of students' creativity and critical thinking and differences in the effects of PjBL and PBL based on creativity and critical thinking. The results show that (1) PjBL and PBL affect students' creativity and critical thinking; (2) there is a difference in the effect of PjBL and PBL on students' creativity; and (3) there is no difference in the effect of PjBL and PBL on students' critical thinking. Another research conducted by Husna and Gultom (2019) aimed to examine the effect of PjBL and PBL on higher order thinking skills. The results showed that PjBL and PBL have the same effect in increasing higher order thinking skills.

PjBL and PBL are two types of learning strategies that are equivalent and are based on constructivist learning theory. Not many studies have examined both of them and placed them as experimental studies on the learning of seaweed, especially on seaweed product diversification. Besides, there has not been much research integrating these two types of learning strategies with 21st-century learning skills. Therefore, the objectives of this study are to examine 1) the influence of PjBL

and PBL on the learning ability of seaweed product diversification; 2) the influence of 21st-century learning skills on the learning ability of seaweed product diversification, and 3) the interaction pattern between PjBL and PBL with 21st-century learning skills on the learning ability of seaweed product diversification.

### *1.1. Concept of PjBL and PBL*

Based on various concepts, PjBL is defined as a learning model that assists students in solving real problems – critical, creative and communicative. PjBL is based on the learning and teaching paradigm that emphasises social and constructivist dimensions in carrying out teaching and learning activities (Gu & Wang, 2006). The application of PjBL in the learning process becomes very important to improve students' ability to think critically and to be independent in learning. As a constructivist learning, PjBL facilitates students to learn in the real situation, so that they can gain permanent knowledge. PjBL is a model that can organise projects in learning (Gulbahar & Tinmaz, 2006). PjBL provides opportunities for student-centred learning systems, more collaboration, students are actively involved in completing projects independently, working together in teams and integrating real problems (Paris & Paris, 2001; Rashotte, MacPhee & Torgesen, 2001).

Some earlier studies showed that PjBL is important to be applied. Johann et al. (2006) reported that 90% of the students who followed learning which implemented PjBL were optimists who were able to implement PjBL in the working world and believed that they can increase their learning achievements. Besides that, a survey study by Lasonen and Vesterinen (2000) showed that 78% of the students believed that curriculum with PjBL basis can prepare a student to enter the working world because they not only study about theory but also carry out practices in the field. The effectiveness of this PjBL was compared with PBL, which based on some references and implementations, these two learning strategies have a similar position in constructive learning strategies. Besides that, the effectiveness of learning of seaweed product diversification was examined under various learning conditions with different 21st-century learning skills. In this context, the skills of 21st-century learning that would be examined include critical thinking, communication, collaboration and creativity.

PBL as a control variable in this study is designed to develop ways of thinking, problem-solving, intellectual skills, learning to act like adults through real situations or simulations and to become independent learners (Arends, 2015). Wheeler, Kelly and Gale (2005) have defined PBL as learning based on thinking through real-life problems. PBL can improve technical skills, creative thinking and good social behaviour of students; so it is increasingly applied in various disciplines (Hoidn & Karkkainen, 2014), included in the learning of seaweed product diversification. Abbey et al. (2017) applied a PBL strategy in horticultural production learning. The results show that PBL methods have better results in improving learning outcomes compared to traditional learning, students are more motivated and take initiative in making decisions.

### *1.2. 21st-century learning skills*

In various literatures, it is explained that 21st-century skills are knowledge, skills, work habits and character traits that are believed to be significantly helping students to learn, work and live successfully in a variety of environments in the 21st century (Moyer, 2016; Queensland Curriculum and Assessment Authority, 2015; Rotherham & Willingham, 2009). In another perspective, the 21st-century skills include several skills, namely skills to communicate, to think critically, to build networks, to collaborate, to solve problems, to create, to innovate, to analyse and to evaluate (Santos, 2017).

In this study, four 21st-century skills were examined, namely critical thinking, communication, collaboration and creativity. Critical thinking skills are used when the information obtained requires more complex reasoning and the ability to synthesise and analyse (Hixson, Ravitz & Whisman 2012). Communication skills have become one of the most needed 21st-century learning skills. The essence is



that students have sensitivity in transmitting information into valid and useful data. When working in teams, the ability to process important information is applied so that effectiveness in working can be effectively transformed. Hixson et al. (2012) identified communication skills as the ability to use data and media from various sources, both oral and written, to convey the message effectively. Collaborative skills are needed when students work in the real world. When in the learning process, students need a learning design that teaches the collaborative process of working in teams. The process of making diversified seaweed products requires collaborative work. It is intended that individuals with different expertise in the team can complement each other (Kym & Hvolby, 2010).

PjBL and PBL as method variables and 21st-century learning skills as moderating variables are intended to increase the internal validity of the research design. In addition, these two variables are assumed to influence in achieving the ability to seaweed products diversification as learning outcome variables. Thus, the effect of learning strategies and 21st-century learning skills on the learning outcomes of seaweed products diversification needs to be examined

## **2. Research Method**

### *2.1. Research design*

This study employed the quasi-experimental design to find out the relationship between variables (Gall, Gall & Borg, 2003; Salkind, 2012). All groups in this study were given treatment, which in this case, the first group studied with PjBL while the second one was treated with PBL strategy. Therefore, the design of this experimental study was one of non-equivalent control group design versions (Tuckman & Harper, 2012) a  $2 \times 4$  factorial.

### *2.2. Sample*

The research subjects were students from the Agricultural Technology Education Department in a public university in the fifth semester of the academic year 2019–2020. The total number of students was 70 divided into classes A and B with 35 students each. Class A was taken as the experimental group, while class B was the control group. It followed one of the quasi-experimental characteristics that divide subjects not on a random basis, which in other words, the subjects were grouped according to the existing classes (Salkind, 2012).

### *2.3. Research procedure*

The experiments were carried out by performing scenarios of the two learning strategies. Both control and experimental classes were given the same treatment, which was to develop a paper about various seaweed product diversifications. The PjBL consisted of five groups with five different seaweed product diversifications. Similarly, the PBL also made a paper with the same topic in the formerly mentioned group. The instruments used in this study were grouped into two categories, namely (1) the instrument to measure the 21st-century learning skills and (2) the instrument to assess the skills of seaweed product diversification. The first instrument adapted 21st Century Competencies (The Ontario Ministry of Education, 2016), which consists of four skills namely: critical thinking, communication, collaboration and creativity. The second instrument used to measure the seaweed product diversification was in the form of a test, which assessed students' knowledge about seaweed diversification. Data were collected with the following steps: (1) conducting a test on the 21st-century learning skills, (2) giving a pre-test to measure the knowledge of seaweed diverse products, (3) implementing a learning intervention (experimental) and (4) providing a post-test.

### *2.4. Data analysis*

The analysis requirements test used data normality test and variant homogeneity tests. The data normality test employed the Kolmogorov–Smirnov technique, while the variant homogeneity test utilised the Levene test. The data normality test and the data homogeneity test aimed to fulfil the parametric assumptions. The data were analysed using parametric statistical analysis with the two-way analysis of variance and the  $2 \times 4$  factorial variance analysis had the purpose to test the research

hypothesis

### 3. Finding

#### 3.1. The description of 21st-century learning skills

The description of data on the measurement of the 21st-century leaning skills using the 21st Century Competencies instruments on two research subjects is presented in Table 1. Table 1 shows that the group implementing the PjBL had a smaller number of student with critical thinking skills, which was only 14.29%, while the creativity possessed by 34.29% of the students was the highest number. Similar to the PBL group, students with critical thinking skills had the smallest number, which was only 14.20% of them. The skill possessed by the largest number of students was collaboration as there were 34.29% who seemed to have the skill.

Table 1. The description of the 21st-century learning skills

21st-century learning skills	PjBL(%)	PBL(%)
Critical thinking	14.29	14.29
Communication	22.86	25.71
Collaboration	28.56	34.29
Creativity	34.29	25.71
Total	100	100

Data about the students’ understanding on seaweed diversified products after being taught with PjBL and PBL are presented in Table 2. Table 2 indicates that communication is the 21st-century learning skills which obtained the highest score in the group of PjBL with an average score of  $M = 39.25$ . Other skills (collaboration, critical thinking and creativity) had balanced scores. On the other hand, the group implementing the PBL approach showed that the skill with the highest score was creativity ( $M = 38.44$ ).

Table 2. The results of the descriptive analysis of data about the understanding on seaweed diversification products

Learning strategies	21st-century learning skills	Mean	Standard deviation	N
Project-based learning	Critical Thinking	38.80	1.095	5
	Collaboration	38.90	0.994	10
	Communication	39.25	1.035	8
	Creativity	38.58	1.311	12
	Total	38.86	1.115	35
Problem-based learning	Critical Thinking	37.20	1.095	5
	Collaboration	34.75	3.251	12
	Communication	37.33	1.414	9
	Creativity	38.44	1.667	9
	Total	36.71	2.641	35
Total	Critical Thinking	38.00	1.333	10
	Collaboration	36.64	3.230	22
	Communication	38.24	1.562	17
	Creativity	38.52	1.436	21
	Total	37.79	2.283	70

### 3.2. The effect of learning strategies (PjBL and PBL) on the ability of seaweed product diversification

The results of the hypothesis test show the effect of learning strategies (PjBL and PBL) on seaweed product diversification ability, the effect of 21st-century learning skills on seaweed product diversification ability and the effect of interactions between learning strategies and 21st-century learning skills on seaweed product diversification ability. In detail, the results of the hypothesis test are summarised in Table 3. Table 3 shows that there was a difference in the understanding on seaweed diversification product between students in the *group of students taught using PjBL strategy and students in the group treated with PBL strategy* ( $p \leq 0.05$ ). The average score of students' understanding on seaweed products diversification after being taught using the strategy of PjBL was 38.86, which was significantly higher than the results found in the group treated with PBL, which was only 36.71. This shows that the PjBL strategy has a higher effect than the PBL strategy on seaweed product diversification ability.

Table 3. The results of the hypothesis test

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	160.397 <sup>a</sup>	7	22.914	7.125	.000
Intercept	90707.475	1	90707.475	28205.501	.000
Learning strategies	60.092	1	60.092	18.686	.000
21st-century learning skills	35.518	3	11.839	3.681	.017
Learning strategies * 21st-century learning skills	43.419	3	14.473	4.500	.006
Error	199.389	62	3.216		
Total	100303.000	70			
Corrected total	359.786	69			

<sup>a</sup>R Squared = 0.446 (Adjusted R Squared = 0.383).

### 3.3. The effect of 21st-century learning skills on the ability of seaweed product diversification

Table 3 shows that there was a significant difference on students' understanding on seaweed products' diversification between students who had the 21st-century learning skills, which includes critical thinking, communication, collaboration and creativity in the Agricultural Technology Education Department in a public university ( $p < 0.05$ ). The 21st-century learning skills with the highest score in the PjBL group are communication skills, with a mean score of 39.25 (Table 2). This means that in the learning of seaweed products diversification with the PjBL strategy, the most necessary 21st-century learning skills are communication skills which consist of listening, digital literacy and communication in team. On the other hand, the other 21st-century learning skills in general have an almost equal mean score, namely critical thinking (38.80), collaboration (38.90) and creativity (38.58). This average score shows that in PjBL strategy, students have 21st-century learning skills that are evenly distributed in critical thinking, collaboration and creativity. Table 2 shows that 21st-century learning skills with the highest score in PBL is creativity (38.44). It shows that in learning to make diversified processed seaweed products, 21st-century learning skills that most develop in students are creativity, which consists of the ability to develop, to elaborate, to analyse and to evaluate ideas. Other 21st-century skills in PBL strategy, namely critical thinking skills (37.20) and communication (37.33), have almost the same score, except for collaboration abilities (34.75), which had a relatively low score. This shows that students on

PBL strategy have 21st-century learning skills that are evenly distributed in critical thinking and communication and lower in collaboration.

Based on the results of the post-test using Tukey’s test shown in Table 4, it was found that the collaboration and communication skills of students differed significantly ( $p < 0.05$ ). In addition, 21st-century abilities that differed significantly were creativity and collaboration ( $p < 0.05$ ).

Table 4. Post-test results using Tukey’s test on 21st-century learning skills.

(I) 21st-century learning skills	(J) 21st-century learning skills	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Critical thinking	Collaboration	1.36	0.684	0.201	-0.44	3.17
	Communication	-0.24	0.715	0.988	-2.12	1.65
	Creativity	-0.52	0.689	0.872	-2.34	1.30
Collaboration	Critical thinking	-1.36	0.684	0.201	-3.17	0.44
	Communication	-1.60*	0.579	0.037*	-3.13	-0.07
	Creativity	-1.89*	0.547	0.005*	-3.33	-0.44
Communication	Critical thinking	0.24	0.715	0.988	-1.65	2.12
	Collaboration	1.60*	0.579	0.037*	0.07	3.13
	Creativity	-0.29	0.585	0.960	-1.83	1.26
Creativity	Critical thinking	0.52	0.689	0.872	-1.30	2.34
	Collaboration	1.89*	0.547	0.005*	0.44	3.33
	Communication	0.29	0.585	0.960	-1.26	1.83

3.4. Interaction patterns between learning strategies and 21st-century learning skills on the ability of seaweed product diversification

Table 3 shows that there was an interaction between the learning strategy and the 21st-century learning skills (critical thinking, communication, collaboration and creativity) and the students’ understanding on seaweed products diversification at Agricultural Technology Education Department in a public university ( $p < 0.05$ ). The interaction pattern between the learning strategy and the 21st-century learning skills and students’ understanding of seaweed diversification products is shown in Figure 1. Figure 1 shows that the average ability of seaweed product diversification of students in the group implementing PjBL methods was higher than that of students in the group using the PBL model. The four lines touch each other so that it can be regarded that there is an effect of the interaction between the learning strategies and the 21st-century learning skills on students’ understanding of seaweed product diversification.

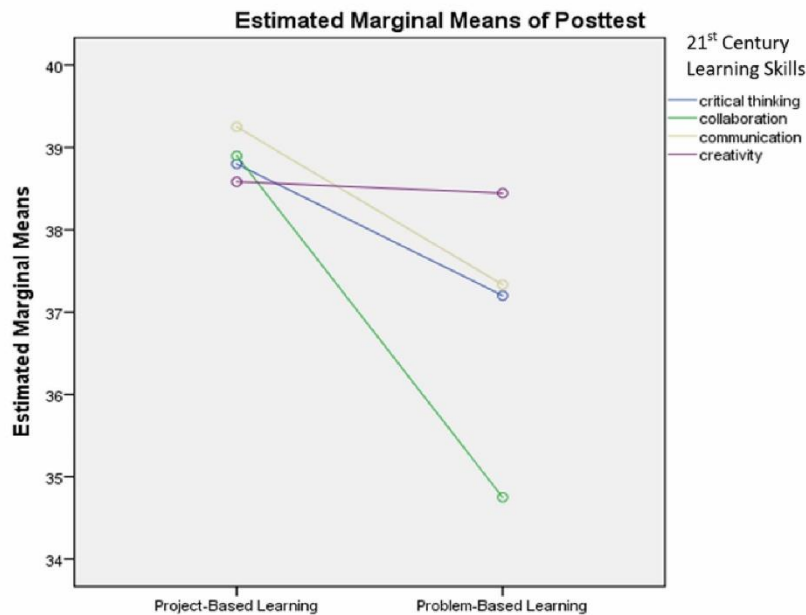


Figure 1. Interaction patterns between learning strategies and 21st-century learning skills on the ability of seaweed product diversification

#### 4. Discussion

The implementation of PjBL in the learning practices which targets the improvement of competency is a must. Various real practices have sufficiently provided empirical evidence that PjBL is effective in accommodating the learning skills. Esche (2002) reported that one of the factors advising the implementation of the PjBL is due to its ability to provide a learning background that can bring the real situation of the field in learning. In its application, one of the characteristics of PjBL is the existence of learning groups that allow students to work collaboratively, to communicate with each other to provide creative ideas and thoughts, to solve a problem and to communicate interactively with other students in constructing new knowledge (Asan & Haliloglu, 2005; Blumenfeld, Fishman, Krajcik, Marx & Soloway, 2000; Marchaim, 2001; Yildirim, 2010).

In PjBL strategies, instructors act as facilitators for design learning activities and provide advice that substantially encourages the development of meaningful learning processes. The meaningful learning process is learning that is developed based on the concept of constructivism which emphasises students as “active students”, the central regulator of activities in mediating and controlling learning (Lasonen & Vesterinen, 2000). Constructivism characterises learning as forming meaning and developing thought. In short, PjBL provides a conducive learning environment so that it can help improve student skills in accordance with the constructivist learning traits. Thus, learning activities are not just learning to accept and memorise concepts, but rather to interpret a concept.

This research found that there are differences in the ability to diversify seaweed products between groups of students who were taught using PjBL strategies and groups of students treated with PBL in the Agricultural Technology Education Department. The effect of the PjBL strategy compared to PBL strategy was due to the ability of the PjBL strategy to provide learning opportunities for students to work in teams, to plan, to organise, to negotiate and to convert thoughts and ideas into real work that is projected experimentally. On the contrary, in PBL, the opportunity to identify, analyse and solve problems in groups and activities to construct knowledge and explore information sources is

synthesised in groups and set forth in the form of innovative and reflective concepts undertaken by the team, but not converted into an experimental project. This aspect distinguishes it from PjBL. When the synthesised concepts are outlined in the form of practical work such as making and designing products, then in this case, PBL only reaches the stage of product development concepts. The findings of this study are in line with previous researches which found that PjBL leads to the achievement of knowledge competencies and skills in working procedures (Esche, 2002; Grey & Antonacopoulou, 2004; Sabry & Baldwin, 2003).

The effectiveness of this research is that the learning atmosphere can encourage project groups to take place vigorously, and through observations, students seemed to enjoy learning methods that were developed based on PjBL scenarios. Students critically express ideas in collaborative groups, start from constructing essential questions, planning a project, making project implementation schedules, working on, analysing, evaluating project results, to exchanging information between groups through the presentation of project results about seaweed products diversification. In the presentation session, each group is trained to think critically in responding to problems and provide solutions to each other. The most important thing from this process is how students communicate ideas into a unity such as creativity, communication, critical thinking and collaborative as a characteristic of 21st-century learning skills.

Here are the essences of meaningful learning. PjBL provides chances for students to create and carry out a project to find new information from various sources of information. In this context, PjBL helps investigations that lead to solving more contextual problems in society. The products developed in the learning of seaweed products diversification are ice cream, red nori food, traditional food of *terang bulan* and *cendol* and pudding. From the theory perspective, 21st-century learning skills in the form of critical thinking, collaboration, communication and creativity have influence on the ability of seaweed product diversification. The results of hypothesis testing indicated that there were differences in the ability of seaweed products diversification between students who had different 21st-century learning skills. In other words, 21st-century learning skills have a significant influence on the ability of seaweed product diversification.

In certain cases, sometimes students who have communication and collaboration skills can superiorly influence the ability of seaweed product diversification compared to students who have critical thinking and creativity learning skills on the same learning strategy. Likewise, with the learning skills of creativity and communication, sometimes students who have both learning skills are superior to students who have critical thinking and collaboration learning skills. Students with critical thinking skills have the ability to use a number of reasoning according to the situation, think systematically, linking one part with another so that they are able to produce products (Lestari et al., 2019; Sahril et al., 2021). Students with collaboration skills are able to work in teams effectively and value team members' contributions based on their individual responsibilities. Students with communication skills are able to communicate effectively, both verbally and non-verbally, and in a variety of environments. Students with creativity ability are able to generate new ideas, elaborate and evaluate their own ideas to explore better learning opportunities (National Education Association, 2020).

Ability of seaweed product diversification is easier to be mastered by students who have communication and collaboration skills. This is because the characteristics of students with communication and collaboration skills are in accordance with the competencies needed in the seaweed product diversification, namely effective cooperation, mutual understanding and communicative interactions. The ability to make processed seaweed products such as ice cream, red nori food, traditional food of *terang bulan* and *cendol* and pudding is in higher cognitive domain. Thus, in making diversified seaweed products, it requires the ability to work in teams, take responsibility, assign roles and communicate with various environments and sources of information, media and technology.

Soh, Arsad and Osman (2010) and Musonda (2019) have reported that 21st-century skills influence the learning outcomes. These results support the results of this study. Therefore, Bao and Koenig (2019) emphasise that future education needs to integrate 21st-century skills into the curriculum. The aim is that 21st-century learning skills can be systematically implemented and become a habit that accompanies the learning process. The findings in this study provide a conclusion that differences in 21st-century learning skills significantly influence the ability of seaweed product diversification. This happens because each student has different cognitive abilities to think critically, to communicate, to solve problems and to be creative in making processed seaweed products. In addition, grouping students with homogeneous learning skills has a more significant effect than grouping students heterogeneously. For the next implementation in the classroom, conducting experiments by placing groups of students with heterogeneous 21st-century learning skills need to be considered.

Theoretically and empirically, PjBL and PBL as learning strategies variables and 21st-century learning skills as learning conditions variables have a strong interaction effect on the ability of seaweed product diversification. Thus, it can be assumed that the effect of PjBL is moderated by differences in 21st-century learning skills. It can be said that the effect of learning strategies (PjBL and PBL) on ability of seaweed product diversification is strengthened by differences in 21st-century learning skills (4Cs). The effect of PjBL and PBL strategies on the ability of seaweed product diversification applies strongly to each group of 21st-century learning skills (4Cs). The results showed that there was an interaction pattern between learning strategies and 21st-century skill on the ability of seaweed product diversification. This means that the influence of PjBL and PBL on ability of seaweed product diversification applies strongly to each group of 21st-century learning skills (4Cs)

## 5. Conclusion

Based on the findings and discussion with regard to the study's purposes, it is concluded that 1) there are effects of learning strategies on students' ability of seaweed product diversification; 2) there are effects of the 21st-century learning skills on students' ability of seaweed product diversification and 3) there are effects of interaction between learning strategy and the 21st-century learning skills on students' ability of seaweed product diversification. The presence of the influence of PjBL, PBL and 21st-century learning skills on the ability of seaweed product diversification provides a compelling reason so that in vocational learning, integration of these two learning strategies is needed by paying attention to 21st-century learning skills aspects. Both learning strategies are applied from constructivist learning theory and 21st-century learning skills are the competencies for each student as a provision of life skills in the learning environment, and social environment.

## Acknowledgements

This work was supported by the Professorship Acceleration Grant Scheme, Universitas Negeri Makassar with contract number: SP.DIPA-042.01:2.400964/2019. The authors thank to Prof. Dr. Ir. Husain Syam, M.TP (Rector of Universitas Negeri Makassar) for his assistance.

## Declaration of interest statement

The author(s) declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

## References

Abbey, Lord, Dowsett, E. & Sullivan, J. (2017). Use of problem-based learning in the teaching and learning of horticultural production. *Journal of Agricultural Education and Extension*, 23(1), 61–78. <https://doi.org/10.1080/1389224x.2016.1202846>

- Affandi, A. & Sukyadi, D. (2016). Project-based learning and problem-based learning for EFL students' writing achievement at the tertiary level. *Rangsit Journal of Educational Studies*, 3(1), 23–40.
- Alismail, H. A. & McGuire, P. (2015). 21st Century Standards and Curriculum: Current Research and Practice. *Journal of Education and Practice*, 6(6), 150–155.
- Amran, A., Perkasa, M., Satriawan, M., Jasin, I. & Irwansyah, M. (2019). Assessing students 21st century attitude and environmental awareness: promoting education for sustainable development through science education. *Journal of Physics: Conference Series*, 1157(2), 22025. <https://doi:10.1088/1742-6596/1157/2/022025>
- Anazifa, R. D. & Djukri, D. (2017). Project-Based Learning and Problem-Based Learning: Are They Effective to Improve Student's Thinking Skills? *Jurnal Pendidikan IPA Indonesia*, 6(2), 346–355.
- Arends, R. I. (2015). *Learning to teach* (10th ed.). New York: McGraw-Hill Education.
- Asan, A. & Haliloglu, Z. (2005). Implementing Project Based Learning in Computer Classroom. *Turkish Online Journal of Educational Technology – TOJET*, 4(3), 68–81.
- Bao, L. & Koenig, K. (2019). Physics education research for 21st century learning. *Disciplinary and Interdisciplinary Science Education Research*, 1(2), 1–12. <https://doi:10.1186/s43031-019-0007-8>
- Bell, S. (2010). Project-based learning for the 21st century: skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43.
- Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W. & Soloway, E. (2000). Creating Usable Innovations in Systemic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational Psychologist*, 35(3), 149–164. [https://doi:10.1207/S15326985EP3503\\_2](https://doi:10.1207/S15326985EP3503_2)
- DeMink-Carthew, J. & Olofson, M. W. (2020). Hands-joined learning as a framework for personalizing project-based learning in a middle grades classroom: an exploratory study. *RMLE Online*, 43(2), 1–17. <https://doi:10.1080/19404476.2019.1709776>
- Diegel, O., Nordin, A. & Motte, D. (2019). Teaching design for additive manufacturing through problem-based learning. In *Additive manufacturing – developments in training and education* (pp. 139–149). [https://doi:10.1007/978-3-319-76084-1\\_10](https://doi:10.1007/978-3-319-76084-1_10)
- Esche, S. K. (2002). Project-Based Learning (PBL) in a course on mechanisms and machine dynamics. *World Transactions on Engineering and Technology Education*, 1/2, 201–204.
- Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An Introduction* (7th ed.). Pearson Education, Inc.
- Grey, C., & Antonacopoulou, E. (2004). Essential Readings in Management Learning. In *Management Learning*. SAGE Publications.
- Gu, L., & Wang, J. (2006). School-based Research and Professional Learning: An innovative model to promote teacher professional development in China. *Teaching Education*, 17/1, 59–73. <https://doi.org/10.1080/10476210500528079>
- Gülbahar, Y., & Tinmaz, H. (2006). Implementing project-based learning and E-portfolio assessment in an undergraduate course. *Journal of Research on Technology in Education*, 38/3, 309–327. <https://doi.org/10.1080/15391523.2006.10782462>
- Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-Based Learning in Post-Secondary Education – Theory, Practice and Rubber Sling Shots. *Higher Education*, 51/2, 287–314. <https://doi.org/10.1007/s10734-004-6386-5>
- Hixson, N. K., Ravitz, J., & Whisman, A. (2012). *Extended Professional Development in Project-Based Learning: Impacts on 21st Century Teaching and Student Achievement*. West Virginia Department of Education, Division of Teaching and Learning, Office of Research.
- Husna, H., & Gultom, T. (2019, December). The Effect of Project-Based Learning and Problem-Based Learning in the Order of Contextual Learning in Microbiology Lectures on the High Order Thinking Skills of Biology Students in FMIPA UNIMED. In *4th Annual International Seminar on*



- Transformative Education and Educational Leadership (AISTEEL 2019)* (pp. 368-371). Atlantis Press.
- Hoidn, S., & Kärkkäinen, K. (2014). *Promoting Skills for Innovation in Higher Education*. OECD Publishing
- Johann, T. M., Koch, H., Chlosta, S., & Klandt, H. (2006). Project Seminar Business Plan Development – an Analysis of Integrative Project-Based. *Journal of Asia Entrepreneurship and Sustainability*, 2/2.
- Kibett, J. K., & Kathuri, N. J. (2005). Effects of project-based learning on student performance of higher cognitive skills in secondary school agriculture. *Zimbabwe Journal of Educational Research*, 17/1, 30–38. <https://doi.org/10.4314/zjer.v17i1.26054>
- Kricsfalusy, V., George, C., & Reed, M. G. (2018). Integrating problem- and project-based learning opportunities: assessing outcomes of a field course in environment and sustainability. *Environmental Education Research*, 24/4, 593–610. <https://doi.org/10.1080/13504622.2016.1269874>
- Kym, F., & Hvolby, H. (2010). Effective teamworking: can functional flexibility act as an enhancing factor? An Australian case study. *Team Performance Management*, 16/1, 74–94. <https://doi.org/10.1108/13527591011028933>
- Lasonen, J., & Vesterinen, P. (2000). *Work-Based Learning in Vocational Higher Education Programmes: A Finnish Case of Project-Based Learning*. Finland
- Lestari, H., Usman, M., & Hasmawati, H. (2019). Kemampuan Berpikir Logis dan Penguasaan Kosa kata Bahasa Jerman. *Eralingua: Jurnal Pendidikan Bahasa Asing dan Sastra*, 3(2).
- Lucas, B., Spencer, E., & Claxton, G. (2012). *How to Teach Vocational Education : A Theory of Vocational Pedagogy*. City and Guilds Centre for Skills Development.
- Marchaim, U. (2001). High-school student research at Migal science institute in Israel. *Journal of Biological Education*, 35/4, 178–182. <https://doi.org/10.1080/00219266.2001.9655774>
- Moyer, L. A. (2016). *Engaging Students in 21st Century Skills through Non-Formal Learning*. Virginia Polytechnic Institute and State University.
- Musonda, E. (2019). Effect of the 21 st Century Skills on the Performance of Students in Linear Transformations : A Case of Mukuba University, Kitwe District, Copperbelt Province, Zambia. *International Journal of Research and Innovation in Social Science (IJRISS)*, 3/9, 417–420.
- National Education Association. (2020). *Preparing 21st Century Students for a Global Society: An Educator’s Guide to the “Four Cs”*. National Education Association.
- The Ontario Ministry of Education. (2016). *21 Century Competencies - Towards Defining 21st Century Competencies for Ontario*. The Ontario Ministry of Education.
- Paris, S. G., & Paris, A. H. (2001). Classroom Applications of Research on Self- Regulated Learning. *Educational Psychologist*, 36/2, 89–101. [https://doi.org/10.1207/s15326985ep3602\\_4](https://doi.org/10.1207/s15326985ep3602_4)
- Parr, B., & Edwards, M. C. (2004). Inquiry-Based Instruction In Secondary Agricultural Education: Problem-Solving - An Old Friend Revisited. *Journal of Agricultural Education*, 45/4, 106–117. <https://doi.org/10.5032/jae.2004.04106>
- Phungsuk, R., Viriyavejakul, C., & Ratanaolarn, T. (2017). Development of a problem-based learning model via a virtual learning environment. *Kasetsart Journal of Social Sciences*, 38/3, 297–306. <https://doi.org/10.1016/j.kjss.2017.01.001>
- Prince, M. J., & Felder, R. M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *Journal of Engineering Education*, 95/2, 123–138. <https://doi.org/10.1002/j.2168-9830.2006.tb00884.x>
- Queensland Curriculum and Assessment Authority. (2015). *21<sup>st</sup> century skills for senior education: An analysis of educational trends*. The State of Queensland.
- Rashotte, C. A., MacPhee, K., & Torgesen, J. K. (2001). The Effectiveness of a Group Reading Instruction Program with Poor Readers in Multiple Grades. *Learning Disability Quarterly*, 24/2, 119–134.

<https://doi.org/10.2307/1511068>

- Romero, M. (2016). Digital Game Design as a Complex Learning Activity for Developing the 4Cs Skills: Communication, Collaboration, Creativity and Critical Thinking. In A. De Gloria & R. Veltkamp (Eds.), *Games and Learning Alliance. GALA 2015. Lecture Notes in Computer Science*. Springer.
- Rotherham, A., & Willingham, D. (2009). 21st Century Skills: The Challenges Ahead. *Educational Leadership*, 67, 16–21.
- Sabry, K., & Baldwin, L. (2003). Web-based learning interaction and learning styles. *British Journal of Educational Technology*, 34/4, 443–454. <https://doi.org/10.1111/1467-8535.00341>
- Sahril, S., Auliyanti, S. N., & Nur, M. S. (2021). The Impact of Differentiated Instruction on Students' Performance in Critical Reading. *Eralingua: Jurnal Pendidikan Bahasa Asing dan Sastra*, 5(1), 275–283.
- Salkind, N. J. (2012). *Exploring Research* (8th ed.). Pearson.
- Santos, J. M. (2017). 21<sup>st</sup> Century Learning Skills: A Challenge in Every Classroom. *International Journal of Emerging Multidisciplinary Research*, 1/1, 31–35.
- Smith, K., & Rayfield, J. (2016). An Early Historical Examination of the Educational Intent of Supervised Agricultural Experiences (SAEs) and Project-Based Learning in Agricultural Education. *Journal of Agricultural Education*, 57(2), 146–160. <https://doi.org/10.5032/jae.2016.02146>
- Soh, T. M. T., Arsad, N. M., & Osman, K. (2010). The relationship of 21st century skills on students' attitude and perception towards physics. *Procedia - Social and Behavioral Sciences*, 7, 546–554. <https://doi.org/10.1016/j.sbspro.2010.10.073>
- Tuckman, B. W., & Harper, B. E. (2012). *Conducting Educational Research* (6th ed.). Rowman & Littlefield Publishers.
- Wheeler, S., Kelly, P., & Gale, K. (2005). The influence of online problem-based learning on teachers' professional practice and identity. *Alt-J*, 13/2, 125–137. <https://doi.org/10.3402/rlt.v13i2.10986>
- Yildirim, N. (2010). Increasing effectiveness of strategic planning seminars through learning style. *Australian Journal of Teacher Education*, 35/4, 12–24. <https://doi.org/10.14221/ajte.2010v35n4.2>
- Zabit, M. N. M. (2010). Problem-Based Learning On Students Critical Thinking Skills In Teaching Business Education In Malaysia: A Literature Review. *American Journal of Business Education (AJBE)*, 3/6, 19–32. <https://doi.org/10.19030/ajbe.v3i6.436>

**5. Konfirmasi artikel akan diterbitkan (29 Mei 2021)**



Muhammad Rais UNM <m.rais@unm.ac.id>

---

## CJES-2021-0127.R1

---

**Daniel Sekyere-Asiedu** <bdcenter.editorial@gmail.com>  
To: Muhammad Rais UNM <m.rais@unm.ac.id>

29 May 2021 at 19:42

Dear Muhammad,

I hope this email finds you well.

Your article would be added to the June issue all things being equal.

Thanks for your cooperation.

Best regards.  
Daniel Sekyere-Asiedu  
Copy-Editor

[Sehit İlmiye Sakir Sokak, No:9,](#)

[Gocmenkoy, Lefkosa, Kibris, 98010,](#)

Mersin 10, Turkey.

[bdcenter.editorial@gmail.com](mailto:bdcenter.editorial@gmail.com)

+905338366993

[Quoted text hidden]

**6. Artikel Publised (3 Juli 2021)**



Muhammad Rais UNM <m.rais@unm.ac.id>

---

## [CJES] New notification from Cypriot Journal of Educational Sciences

---

**BD-Center, Administrative Editor** <bdcenter.secretariat@gmail.com>  
Reply-To: "Prof. Dr. Huseyin Uzunboylu" <editor.cjes@gmail.com>  
To: Muhammad Rais <m.rais@unm.ac.id>

3 July 2021 at 05:53

You have a new notification from Cypriot Journal of Educational Sciences:

An issue has been published.

Link: <https://un-pub.eu/ojs/index.php/cjes/issue/current>

Prof. Dr. Huseyin Uzunboylu

The following message is being delivered on behalf of Cypriot Journal of Educational Sciences. \_\_\_\_\_

---