Study on the Learning Effectiveness in Project Research by Students of a Higher Vocational School from the Perspective of Integration of Positive Emotions into PBL - A Case Study of the Project on Motor Vehicle Fuel Saving

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Abstract

This study explored the learning effectiveness of project research by students of a higher vocational school from the perspective of integrating positive emotions into Problem-based Learning (PBL), and took 80 Grade-3 students from two classes of a higher vocational school in Taiwan, who attended the Project Research Course, as its subjects, and conducted a one-year study of a "Project of Creation of Innovative Fuel Saving Equipment for Motor Vehicles". The project design integrated positive emotions into PBL as a learning strategy and implemented a course on fuel saving for the students, where teachers served as helpers and supervised the learning progress. This study adopted experimental methodology to conduct verification and investigation and analyze the students' performance. Furthermore, it summarized the quantitative statistical analysis results of the questionnaire and reached the following conclusions: (1) The students in the experimental group who attended the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, were significantly superior to those of the control group in terms of learning effectiveness in fuel saving education. (2) The course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, positively and significantly improved the attitude toward motor vehicle fuel saving of the students of the higher vocational school. (3) The course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, positively and significantly improved the behavioral intention of motor vehicle fuel saving of the students of the higher vocational school. (4) The course on motor vehicle fuel saving, as based on the
integration of positive emotions into PBL, had positive and significant impact on the mental flow experience of project competition of the students of the higher vocational school. Based on the conclusions, this study proposed suggestions regarding teaching and future relevant studies.

**Key Words:** Problem-based Learning (PBL), literacy of fuel saving, positive emotions, mental flow
1. Introduction

1.1 Research Motives

Over the past decade, due to Taiwan’s educational policy on the expansion of general high school, the number of general high schools rose rapidly; however, the supporting measures are insufficient, leading to a decline of the quality and number of high school students. Huang (2014) argued that the registration rates of first-choice higher vocational schools of several districts were higher than those of first-choice high schools. Therefore, it is the crucial responsibility of educators to address the issues, meaning that education does not fit certain jobs or fill the gap between education and job requirements.

Traditional teaching models are mostly one-way communication, and students must complete their homework independently; however, such models lead to low absorption efficiency and interaction frequency, and stifle the thinking abilities of students. Nowadays, the development of information technology has an increasing impact on education, meaning stale teaching models are discarded, while fresh methods are brought forth, in order to improve the learning interest and outcome of students via different teaching methods. Hence, it is an important topic for educators to introduce different teaching theories and teaching strategies.

In view of this, this study integrates positive emotions into PBL, as practical skills for technical and vocational students are extremely significant. “Learning by doing” can be adopted to cultivate students' abilities in teamwork, self-study, reflection, and independent problem solving, in order to boost students’ confidence and learning motives. Teachers and students can discuss learning topics, progress, processes, problems, and skills to complete work and achieve results via online learning platforms.

1.2 Research Purposes

This study integrates positive emotions into PBL to design a project of motor vehicle fuel saving, and its research purposes are described, as follows:

(1) It explores the influence of the integration of positive emotions into PBL regarding the education of motor vehicle fuel saving for the students of the higher vocational school.
(2) It probes into the impact of the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, regarding students’ attitudes toward vehicle fuel saving of the higher vocational school.
(3) It studies the impact of the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, regarding students’ behavioral intention of vehicle fuel saving of the higher vocational school.
(4) It discusses the influence of the integration of positive emotions into the PBL course of motor vehicle fuel saving, as based on the mental flow experience of the students’ of the higher
vocational school.

2. Literature Review

2.1 Positive Emotions

In the past, Psychology emphasized that guiding students to negative emotions may have immediate negative effects. Negative emotions, such as anger, may lead to aggressive behavior (Bicskei, Lankau, & Bizer, 2016), affect their thinking, and make them less flexible and rational. Positive emotions are conducive to individual decision-making (Isen, 2000), and can enhance creativity (Yeh, Lai, & Lin, 2016) and imagination (Liang, Chang, & Hsu, 2013). Furthermore, positive emotions can strengthen problem solving abilities and resistance to stress, boost physical and mental health and social interactions, and give full play to students’ potential (Karen, 2015). Concepts of Positive Psychology are introduced to students to motivate their positive emotions and improve their learning ability (Seligman, 2002; Seligman & Csikszentmihalyi, 2014), in order to enhance their confidence, learning ability, and creativity.

2.2 PBL

Wu (2002) asserted that the PBL teaching method centered on students, allowed them have group discussions and practices, and cultivated their problems in active learning, logic thinking, and problem solving. Some foreign scholars compared the learning motives of students under traditional lecturing education models and PBL teaching method, and proved that, compared with traditional lecturing education models, the PBL teaching method can better enhance students' learning motives (Hwang & Kim, 2006; Sungur & Tekkaya, 2006). Different from the "preventive" nature of traditional higher education, the PBL teaching method is appropriate for "real-time" education, and its most common and main teaching features include: hands-on operation, problem-based guidance to stimulate students’ active learning motives, and team work and cooperation strategies to solve problems. These features enable students to be more interdisciplinary and socialized, and when course contents are closer to real life, students have better performance (Yang, 2017).

Based on the above definitions, the PBL teaching method allows students to acquire skills, cultivates their ability to solve problems by active thinking, and turns students into self-directed learners, thus, the teaching objective of PBL is more than just the learning of knowledge, it includes ability cultivation.

2.3 Motor Vehicle Fuel Saving

As extreme climate issues around the world become more and more serious, it has been scientifically proved that, the tendencies of global warming and climate changes are caused by human activities, especially by carbon dioxide emitted from the burning of fossil fuels (Tsai,
Chung, and Lo, 2017). Lo (2013) proposed the definition of an energy-saving vehicle as, "An energy-saving vehicle is a land vehicle whose manufacturing and life cycle are low in energy consumption and pollution emission, which adopts non-fossil fuels as its main driving energy, and pursues the goals of green earth and sustainable and balanced development.” Thus, the design of fuel-saving motor vehicles can substantially decrease the consumption of fossil fuels, regard high fuel saving efficiency as its guideline, and adopt the principles of low exhaust emissions and low carbon footprint.

3. Research Design and Implementation

After review and analysis of literature regarding the integration of positive emotions into PBL and the literacy of motor vehicle fuel saving, this study has deeper understanding of the integration of positive emotions in PBL to "the course on project research of higher vocational school students” and "the competition on creation of innovative fuel saving equipment for motor vehicles". This study conducts research related to the cultivation of project research skills and the literacy enhancement of motor vehicle fuel saving of higher vocational school students, which are described, as follows:

3.1 Research Method

This study adopts experimental methodology to conduct verification and investigation, and analyzes the cultivation of project research skills and the literacy enhancement of motor vehicle fuel saving of higher vocational school students. Based on the integration of positive emotions into PBL, this study focuses on the implementation, assessment, and modification of the course, probes into the learning performance of students, employs a questionnaire survey, document collection, and focus group interviews to gain in-depth understanding of the hands-on operations of "the project on motor vehicle fuel saving", learns the outcome regarding students motor vehicle fuel saving literacy, and conducts analysis of the relevant influences.

3.2 Research Subjects

This study considers 80 Grade-3 students from two classes of a higher vocational school in Taiwan who attended the Project Research Course as its subjects. One class is used as the experimental group, while the other is the control group. The duration of the experimental teaching was one academic year.

3.3 Research Tools

Based on literature review and course attributes, this study develops the "Scale of Mental Flow Experience in the Innovative Creation Project" and "Scale of Literacy of Motor Vehicle Fuel Saving". The Scale of Literacy of Motor Vehicle Fuel Saving covers various dimensions, such as "cognition", "attitude", and "behavioral intention". After the first draft of the questionnaire was completed, 6 scholars and experts in the fields of positive emotions, motor
vehicles, and energy conservation were invited to analyze its validity and reliability according to its professional attributes. After modification, the draft was turned into the formal questionnaire.

3.4 Research Process

This study aims to discuss the learning process, outcome, and effectiveness of the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, and plans and designs the PBL fuel saving course "Project of Creation of Innovative Fuel Saving Equipment for Motor Vehicles". The research process is shown in Figure 1.

First, through the review and analysis of literature regarding PBL and motor vehicle fuel saving, this study designs a course of motor vehicle fuel saving for higher vocational school students, which includes (1) writing a teaching plan on motor vehicle fuel saving, (2) development of the questionnaire on the learning effectiveness of education on motor vehicle fuel saving based on PBL, and (3) confirmation of the key points of PBL project observations and analysis. The teaching plan for motor vehicle fuel saving includes three parts: (a) three-week education on motor vehicle fuel saving, (b) 15-week hands-on application course—"Project of Creation of Innovative Fuel Saving Equipment for Motor Vehicles Based on the Integration of positive emotions into PBL", and (c) 18-week hands-on application course—"completion of equipment creation, repeated modifications and testing, publication of results, and statistical analysis". Positive emotions are integrated into PBL to cultivate students' basic knowledge and awareness of motor vehicle fuel saving.

In addition, this study introduces the PBL implementation process to guide students in applying theoretical knowledge related to motor vehicle fuel saving to design innovative fuel-saving equipment. Lastly, it implements a questionnaire on academic performance and presents the works of the students, in order to learn the design concepts and experiences of each group and promote peer exchange and learning. Moreover, this study invites experts and scholars in the fields of motor vehicle fuel saving and PBL to participate in the evaluation of the students' work, encourage and guide the students, and review the course plans on motor vehicle fuel saving and the design of PBL activities, which can serve as an importance reference for "teaching models for PBL-based education on motor vehicle fuel saving".
4. Data Analysis and Discussion

This study considers 80 Grade-3 students from two classes of a higher vocational school in Taiwan as its subjects. One class of 40 students is randomly selected as the experimental group, and the integration of positive emotions into PBL is applied to this group. The other class of 40 students serve as the control group, and the traditional teaching method is applied. After the one-year "Project Competition of Creation of Innovative Fuel Saving Equipment for Motor Vehicles", the self-report method is adopted to test the students' outcomes. A total of 80 questionnaire copies are distributed, and 80 valid questionnaires are collected, for a recovery rate of 100%. The following questions are proposed to verify if there were differences in the learning effectiveness of students who received education through different teaching methods.
Q1: Differences in learning effectiveness between the PBL teaching method and the traditional teaching method.

H1: PBL teaching is better than the traditional teaching method.

According to the test results of the learning effectiveness of the experimental and control groups, this study conducts descriptive statistics and one-way ANCOVA, and discusses the differences in the learning outcomes of the two groups of students after the influencing factors of the pre-test are excluded.

4.1 Pre-test—Analysis of differences in learning effectiveness of the two groups of students

Table 1 shows the descriptive statistics obtained by the pre-test of the two groups of students. The data demonstrate that t = .530 and p = .598 (> .05), indicating failure to reach a significant level and no significant differences in performances between the two groups in the pre-test. That is to say, the two groups have no significant differences in their basic abilities in motor vehicle fuel saving.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Average Mean</th>
<th>Standard Deviation</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PBL teaching</strong> (the experimental group)</td>
<td>40</td>
<td>62.80</td>
<td>16.31</td>
<td>.530</td>
</tr>
<tr>
<td><strong>Traditional teaching</strong> (the control group)</td>
<td>40</td>
<td>60.85</td>
<td>16.61</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Descriptive statistical analysis of the "cognitive" pre-test and post-test of literacy of motor vehicle fuel saving

Each test contains 25 questions, and each question is worth four points, for a total score of 100. First, before the exclusion of the influences of covariate, the descriptive statistics of the pre-test and post-test of the two groups are shown in Table 2.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-test</th>
<th>Post-test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PBL teaching</strong> (the experimental group)</td>
<td>40</td>
<td>62.80</td>
<td>16.31</td>
<td>75.00</td>
<td>13.12</td>
</tr>
<tr>
<td><strong>Traditional teaching</strong> (the control group)</td>
<td>40</td>
<td>60.85</td>
<td>16.61</td>
<td>66.70</td>
<td>13.17</td>
</tr>
</tbody>
</table>

Table 2 demonstrates that, the average score of the experimental group is higher than that of the control group in the pre-test (62.80>60.85); while the outcome of the post-test is (75.00>66.70). It was necessary to conduct statistical analysis via one-way ANCOVA to exclude the differences of the two groups when entering learning behavior and determine if the
two types of teaching methods would lead to significant differences in learning effectiveness.

4.3 One-way ANCOVA of the Experimental and the Control Groups

This study regards "the performances of the pre-test on the awareness of motor vehicle fuel saving" as the covariate and "different teaching methods" as the independent variable, and conducts one-way ANCOVA on the dependent variable of "the performances of the post-test on the awareness of motor vehicle fuel saving". Before conducting one-way ANCOVA, it is necessary to test whether or not the intra-group regression coefficient conforms to isomorphism, in order to confirm that the prediction slopes of the dependent variable via the covariate are the same, and results indicate that the entering behaviors of the two groups have no significant differences. See Table 3 for the test results.

Table 3: Summary of the Test of Isomorphism of Intra-Group Regression Coefficient of Different Teaching Methods with the Performances of Pre-Test as the Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Type-III Quadratic Sum</th>
<th>Degree of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified model</td>
<td>1633.222</td>
<td>3</td>
<td>544.407</td>
<td>3.129</td>
<td>.031</td>
</tr>
<tr>
<td>Intercept</td>
<td>30873.569</td>
<td>1</td>
<td>30873.569</td>
<td>177.475</td>
<td>.000</td>
</tr>
<tr>
<td>x before</td>
<td>227.788</td>
<td>1</td>
<td>227.788</td>
<td>1.309</td>
<td>.256</td>
</tr>
<tr>
<td>group</td>
<td>225.284</td>
<td>1</td>
<td>225.284</td>
<td>1.295</td>
<td>.259</td>
</tr>
<tr>
<td>group * x before</td>
<td>30.588</td>
<td>1</td>
<td>30.588</td>
<td>.176</td>
<td>.676</td>
</tr>
<tr>
<td>Error</td>
<td>13220.978</td>
<td>76</td>
<td>173.960</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>416432.000</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified total</td>
<td>14854.200</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. R square = .110 (modified R square = .075)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to Table 3 of the test results of isomorphism of intra-group regression coefficient (GROUP * x before), F = .176 (p = .676) does not reach a significant level, implying that the test of isomorphism of intra-group regression coefficient is passed. Next, this study conducts one-way ANCOVA, where the covariate is the performances of the pre-test on the awareness of motor vehicle fuel saving, while the dependent variable is the performances of the post-test on the awareness of motor vehicle fuel saving. The results are shown in Table 4.

Table 4: Summary of One-Way ANCOVA of Different Teaching Methods with the Performances of Pre-Test as the Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Type-III Quadratic Sum</th>
<th>Degree of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified model</td>
<td>1602.634*</td>
<td>2</td>
<td>801.317</td>
<td>4.656</td>
<td>.012</td>
</tr>
<tr>
<td>Intercept</td>
<td>30843.038</td>
<td>1</td>
<td>30843.038</td>
<td>179.218</td>
<td>.000</td>
</tr>
<tr>
<td>x before</td>
<td>224.834</td>
<td>1</td>
<td>224.834</td>
<td>1.306</td>
<td>.257</td>
</tr>
<tr>
<td>group</td>
<td>1440.202</td>
<td>1</td>
<td>1440.202</td>
<td>8.368</td>
<td>.005</td>
</tr>
<tr>
<td>Error</td>
<td>13251.566</td>
<td>77</td>
<td>172.098</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>416432.000</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified total</td>
<td>14854.200</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
According to the results of one-way ANCOVA for different teaching methods with the performances of pre-test as the covariate, as shown in Table 4, F = 8.368 (p = .005), which reaches a significant level. Through descriptive statistical analysis, after the experimental treatment, the learning effectiveness of both groups is improved. After one-way ANCOVA analysis, the scores on the learning effectiveness of both groups showed significant differences. Thus, H1 is valid. Moreover, the increase in the mean of learning effectiveness of the post-test of the experimental group is 8.3 points higher than that of the control group.

Analysis of the learning effectiveness in motor vehicle fuel saving of the higher vocational school students from the dimensions of "attitude" and "behavioral intention"

Regarding the learning effectiveness in motor vehicle fuel saving of the students from the dimensions of "attitude" and "behavioral intention", this study performs t-test analysis of the dependent samples of the pre-test and the post-test to learn if the students’ learning effectiveness in the dimensions of "attitude" and "behavioral intention" is improved. See Table 5 for the analysis results. The t-value of attitude toward fuel saving is -21.68, while that of behavior intention of fuel saving is -12.69. Both the means of attitude and behavioral intention of fuel saving in the post-test are higher than those in the pre-test and have significant differences. In summary, after the project, most of the students have significant and positive improvement in learning effectiveness in the dimensions of "attitude" and "behavioral intention" of motor vehicle fuel saving.

**Table 5: Summary of Dependent Sample t-test of the Dimension of Literacy of Motor Vehicle Fuel Saving**

<table>
<thead>
<tr>
<th>Item (N=80)</th>
<th>Type</th>
<th>Average Mean</th>
<th>Standard Deviation</th>
<th>Average Mean</th>
<th>Standard Deviation</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude (the experimental group)</td>
<td>Pre-test</td>
<td>1.91</td>
<td>.54</td>
<td>-2.38</td>
<td>.11</td>
<td>-21.68***</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>4.29</td>
<td>.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral intention (the experimental group)</td>
<td>Pre-test</td>
<td>2.11</td>
<td>.59</td>
<td>-1.84</td>
<td>.14</td>
<td>-12.69***</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>3.94</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ***p<.001

4.4 Analysis of dependent sample t-testing of the dimension of mental flow experience in the competition of the creation of innovative fuel saving equipment for motor vehicles

Dependent sample t-testing of the dimension of mental flow experience in the competition of the creation of innovative fuel saving equipment for motor vehicles is conducted, in order to learn if the mental flow experience of the students is enhanced after the project. As shown in Table 6, the t-value of mental flow experience of the competition is -12.00. The average of the post-test is greater than that of the pre-test, reaching a significant level. To sum up, after the
project, most of the students had significant and positive improvement in learning effectiveness in the dimension of mental flow experience.

Table 6: Summary of the Analysis of Dependent Sample T-Test of the Dimension of Mental Flow Experience in the Competition of Creation of Innovative Fuel Saving Equipment for Motor Vehicles

<table>
<thead>
<tr>
<th>Item (N=80)</th>
<th>Type</th>
<th>Average Mean</th>
<th>Standard Deviation</th>
<th>Average Mean</th>
<th>Standard Deviation</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBL teaching</td>
<td>Pre-test</td>
<td>2.26</td>
<td>.57</td>
<td>-1.39</td>
<td>.12</td>
<td>-12.00***</td>
</tr>
<tr>
<td>(the experimental group)</td>
<td>Post-test</td>
<td>3.65</td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ***p<.001

4.5 Analysis of the students' progress of creating innovative fuel-saving equipment

This section only describes the work of one group of students to learn their creation progress of innovative fuel-saving equipment, which can serve as a reference for future studies on the integration of positive emotions into PBL.

After literature collection and discussion of fuel saving, the students determined that a decrease in the idle running time of motor vehicles can effectively save fuel, thus, the topic of their project is "Innovative Design of Equipment of Automatic Flameout during Idle Running". This project planning allows the students to learn and effectively utilize Arduino single chip, and familiarize themselves with the applications of relevant sensors. Furthermore, through an enhanced course of program writing, the students completed the auto control settings of a temperature sensor, voltage sensor, and Hall speed sensor, as shown in Figure 2. In this way, the "Equipment of Automatic Flameout during Idle Running" has the function of automatically detecting engine status. When all the detected conditions meet the set values, as controlled by the Arduino single chip, a motor vehicle will have automatic flameout after idle running for five seconds, in order to achieve the target of fuel saving.

Additionally, the students improved their innovative design; by pressing both the accelerator and the brake, as well as the Arduino setting, one can quickly restart the motor vehicle to enhance the convenience of driving, as shown in Figure 3. During the process, the students learned how to correctly use a super capacitor (Faraday capacitor) to instantaneously output a large amount of current to support the battery at engine restart, and thus, extend the life of the battery.

The students believe that exhaust gas emissions from motor vehicles is one of the major causes of air pollution. As this equipment can effectively save fuel and reduce exhaust emissions, it contributes to green environments.
Figure 2: Circuit Diagram of Equipment of Automatic Flameout during Idle Running

Figure 2  Circuit diagram of equipment of automatic flameout during idle running
5. Conclusion and Analysis

5.1 Conclusion

After the above discussion and analysis, this study reached the following conclusions:

(1) After the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, the students of the experimental group have significantly better learning effectiveness in motor vehicle fuel saving than those of the control group. The statistical analysis results of the cognitive questionnaire of this study demonstrate that, after the course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, the Grade-3 higher vocational school students of the experimental group have significantly better learning effectiveness in awareness of motor vehicle fuel saving than those of the control group. Moreover, the former had positive feedback on basic knowledge on motor vehicles, the design and concept of motor vehicles, and the influence of motor vehicles on the environment. The differences in learning effectiveness between the both groups reached a significant level; in a pleasant atmosphere, students actively participated in the learning of motor vehicle fuel saving.

(2) The course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, positively and significantly improved the students’ attitude toward motor vehicle fuel saving.

The results of this study indicate that, after the course on motor vehicle fuel saving via different teaching methods, most students become actively concerned about the topic of fuel
energy, and hold positive attitudes and outlook of value, which effectively improves their attitude toward motor vehicle fuel saving and mutual support in learning among students.

(3) The course on motor vehicle fuel saving, as based on the integration of positive emotions into PBL, positively and significantly improved the students’ behavioral intentions of motor vehicle fuel saving.

The research results demonstrate that, after the course of motor vehicle fuel saving via different teaching methods, most students have significant improvement in correctly and economically using fuel and changing and influencing the behavior of others. Guided by this project, the students have effective improvement in their behavioral intention and overall performance of motor vehicle fuel saving.

(4) The integration of positive emotions into PBL has positive and significant impact on the mental flow experience in the project competition of higher vocational school students.

The statistical analysis results of the questionnaire on mental flow experience of this study show that, the project has positive and significant influence on the mental flow experience of most Grade-3 students. During equipment creation and project learning, the students could happily complete their work.

5.2 Suggestions

Based on the research results, this study proposed the following suggestions for future teaching of the practical courses, as based on the integration of positive emotions into PBL:

(1) Schools should actively promote the teaching of practical courses, as based on the integration of positive emotions into PBL.

This study finds that, most students expressed positive affirmation on the teaching of practical courses, as based on the integration of positive emotions into PBL. Therefore, during curriculum planning, schools should integrate positive emotions into courses, provide more positive teaching cases and positive thinking strategies, give students positive energy, and offer a learning environment with positive emotions, in order that students can learn happily.

(2) Schools should cultivate teachers’ positive thinking ability and enhance their energy and teaching effectiveness.

The integration of positive emotions in course teaching can effectively strengthen the learning effectiveness of students. Thus, it is suggested that teachers should make plans to improve their positive thinking ability and quality, such as, problem guidance, inspiring speeches, control of class activities, enhancement of basic professional abilities, constantly accumulation of PBL teaching, and learn from the experiences of scholars and experts. Moreover, through further education, teachers can improve their positive emotion literacy and teaching ability, meaning they can gain self-improvement and reflection, and adopt positive
thinking and positive attitudes in order to guide students to positive learning and inspire students' potentials.

References


Yang, C. (2017). Integrate Problem-Based Learning, Project-Based Learning and Flipped Classroom to Enhance Students’ Active Learning in General Education Courses. *Journal of General Education: Concept & Practice, 5*(2), 1-40.