Project based learning to develop a laboratory kit: Examining 3Hs (Hearts-on, Heads-on, Hands-on) activity

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Abstract. Project-based learning (PjBL) is a learning model that involves students in problem-solving activities and peaks to produce realistic value-added products. KIT is one of the products that can be made by students by using PjBL to achieve 3H (Hands, Heads, and Hearts-on) activity. This study is about PjBL that student can make a practical laboratory KIT on the theme of cigarettes to increase 3H activity. The method was quasi experiment with pretest posttest control group design. The research subject of this study was VIII grade class consisted of 34 students in the experiment classroom and 35 students in the control classroom. The study revealed that the improvement of 3H activity in the experimental classroom was higher than in the control classroom. Based on questionnaires and interview results, the student gave positive responses towards making project such as an practical laboratory KIT using PjBL. Thus, PjBL could rise 3H activity which is better than students who do not use PjBL. This study is expected to be developed to be used on other themes than cigarettes.

1. Introduction
Science education should be give an experience learning that developing skills of planning and scientific investigation, and use a knowledge before to understand nature phenomena. One method that can be applied is trough practical learning. Practical learning has many privilege, such as giving an experience to interact with subject matter, to observe, and to understand nature [1]. With practical learning can help the students to link between two knowledge domain, there are real object domain who can be observed and theoretical domain [2]. The purpose of this learning is for studying the subject matter integrated by student. To obtain the whole learning, integrated, and has an experience, then needed the three domains, there are cognitive (heads), affective (hearts) and practice (hands). This three domains will appear if learning with practical was held. However, in some schools, this learning has limitation regarding tools and material. Indeed, student often meet difficulty to obtaining the whole, integrated, and experience learning.

To solving this problems, several researchers have suggested the following strategies: using project based learning to impacted the learning domain [3-5], develop a laboratory kit for increasing mastery of student’s concept and science process skills [6], project based learning for examining hands, heads, and hearts education [7-9]. This suggested strategies are effective to use in class and with subject matter that never used a practical learning such as addictive substances that usually only explained by teacher [10]. However, several problem still persisted. The laboratory kit are complicated and sophisticated. Cognitive, affective, and practice usually separated for researched.
Here, the purpose of this study was to have a science laboratory kit on the theme of cigarettes that has been tried the effectiveness for increasing 3H (Hands, Heads, Hearts-on) activity through project based learning. Different to the other laboratory KIT. This science laboratory KIT was design and made by student with low-cost tools and materials so that this laboratory KIT can be used in or out class/laboratory.

2. Method
This study used a quasi experiment with pretest-posttest control group design. Two group had involved in this study, there are experiment and control group. In experiment group, student learned with project based learning and designing a laboratory KIT that has a theme of cigarette, and in the control group, student learned with group work. This research design shown in table 1.

| Subject | Pretest | Treatment | Posttest |
|---------|---------|-----------|----------|
| E       | O       | X         | O        |
| C       | O       | Y         | O        |

The research subject of this study was 8th grade class in junior high school in Bandung. The subject consisted of 34 students in the experiment classroom and 35 students in the control classroom.

The instrument that used on this study such as product assessment sheet, 3H activity observation sheet, process skill observation sheet, written test, self-assessment sheet and questionnaire. Product assessment sheet was used to value a laboratory KIT that student has designed. A laboratory KIT was scored by teacher and then categorized. 3H activity observation sheet was used to observed all student’s 3H activities together. Process skill observation sheet was used to value student’s hand-on activity, categorized the score and then compared. Written test was used to value student’s heads-on activity. Before used, this written test has been try first to produce an instrument that steady and valid. Self assessment sheet was used to value student’s hearts-on activity. Questionnaire was used to know student’s responses toward project based learning and designing a laboratory KIT.

3. Results and discussion
3.1. Project based learning and designing a laboratory KIT
The product that has produced by student was a laboratory KIT which has a theme of cigarette. This KIT was produced for identifying tar in cigarette smoke. Teacher made 10 groups of student and hope they will be produce a various KIT which has a similar purpose for identifying a tar. Students was freed in choosing the tools and materials.

Before designing a KIT, student given an explanation about how to identify a harmful substances in cigarette’s smoke with the complex tools and materials from a video. Teacher gave a task to student to make a KIT product with the same theme but with a simple tool and material and then can be used for practical about addictive substance in cigarette’s smoke.

Project based learning was used by teacher for conducting the students in order to be able to designing, making, and then using the product (laboratory KIT) well. The product valued by teacher and observer using product assessment sheet. The indicator that we assessed are: (1) novelty; (2) how products work; and (3) detail and synthesis [11]. The results can be seen in table 2.
Table 2. Result of student’s product assessment.

| No. | Indikator             | Persentase (%) |
|-----|-----------------------|----------------|
| 1   | Novelty               |                |
|     | original              | 57             |
|     | suprise               | 47             |
| 2   | How product worked    |                |
|     | logical               | 67             |
|     | useful                | 70             |
|     | valuable              | 67             |
|     | understandable        | 60             |
| 3   | Detail and Synthesis  |                |
|     | organic               | 67             |
|     | well crafted          | 73             |
|     | elegant               | 47             |
|     | TOTAL                 | 61.5           |

Findings shows that student doing well in designing a science laboratory KIT in the theme of cigarette through project based learning. Agree with the study before that project based learning is an inovative learning models that involved a project work where students can work independently for constructing their knowledge and culminate in the real product [12]. This product is a science laboratory KIT on the theme of cigarrete. Not only the teacher, but also the students can develop a well KIT or props. In line with the finding on student product assessment which has average score at 61.5% and it means students are in good category [13].

Findings in the third indicator is in an enough category on elegant sub-indicator, and this means a laboratory KIT that student made was aesthetic less. This is because the packaging was slobbery. The package of KIT and set of props as shown in figure 1 and figure 2.

3.2. The effect of science laboratory KIT on student’s 3H activities

The different of learning in experiment classroom and control classroom give an effects on student’s 3H activities. Learning that used in experiment and control classroom can help the students to increase 3H activities. Findings show that student’s 3H activities enhancement on experiment classroom was higher than on control classroom.
KIT was made in order to get a whole science learning experience. Combining hand, head, and heart with a suitable learning can make the students have long term memory in studying. The student’s learning experiences as shown in table 3.

Table 3. Student’s learning experience using a laboratory KIT to increase 3H activity.

| Depiction                  | Resources                                                                 | Activity                                                                 |
|----------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Hands-on                   | - Be active in class <br>- Using process skills                           | - The tasks prepared by teacher and student can explore a given theme actively <br>- Designing a laboratory KIT with the theme of cigarette <br>- Doing a trial for laboratory KIT <br>- Student presented the findings |
| Heads-on                   | - Asking questions, high curiosity on science <br>- Provocations for conflicts and contradictions prepared by teacher | - Finding relevant sources for design and make a laboratory KIT <br>- Discussion, question and answer <br>- Written test |
| Hearts-on                  | - Love of subject matter, related to science and being interested in science | - Playful contexts/materials provided by teacher <br>- Make a poster that the theme is the dangers of cigarettes smoke <br>- Self assessment |

On that depiction show that 3H activity in experiment classroom will be higher than control classroom. This can be seen from the various activities and various skill that appeared. In line with the studied before that showed of project based learning with teacher supported, 3H learning can make a context/material that has learned is more playful where the students are very actively and enthusiastic in studying of science [7].

3H activities has been researched separately. This aim is to know how far it is the different of hands-on, heads-on, and hearts-on activities in experiment classroom and control classroom. Hands-on was focused at process skills, heads-on was focused at critical thinking, and hearts-on was focused at emotions and attitudes.

3.2.1. Hands-on. Hands-on activity was focused at process skills. Student process skill was observed by observer using observation sheet. In experiment classroom, hands-on activity started to observed from designing project activity until presenting the product and result. In control classroom, the activity was started to observed from practical work activity until presenting a practical report. Findings show that hands-on activity in experiment classroom has a very good category with 89% and in the control classroom has a good category with 72%. Results show that hands-on activity in experiment classroom was higher than control classroom. The results of the study before show that with using a laboratory KIT will increasing a science process skill [6].

3.2.2. Heads-on. Heads-on activity was focused at thought. Thought according to sipos was critical thinking. Students required to always think critically on the phenomenon. Heads-on activity was studied by written test with critical thinking indicator by Ennis [14]. The form of written test was 12 questions of multiple choices with reasons.
Based on statistic test with t-test showed that heads-on activity in the two classroom significantly different. Findings show that n-gain scores of heads-on activity in the experiment classroom was higher than control classroom. Generally heads-on activity in experiment classroom was classified as medium with 0,45 and in control classroom was classified as low with 0,28. As shown in figure 3.

![Figure 3. Chart of Comparison Heads-on Activity N-gain score.](image)

With activities that actively in learning with laboratory KIT make student’s heads-on activity has increased. Question and answer that prepared by teacher make student very enthusiastic for finding the answer and relevant sources to studied. This made a student knowledge significantly increased [6].

3.2.3. Hearts-on. Hearts-on activity was studied trough self-assessment sheet. Results showed that hearts-on activity in experiment and control classroom in a good category. The different is in the score. Score of experiment classroom was higher than control classroom. As shown in figure 4.

![Figure 4. The differences score of hearts-on activity.](image)

There’s no striking different in Hearts-on activity because the learning in two class used a practical learning that usually make the student enthusiastic and interest to studied because of student have direct interaction with the subject matter. This in line with Hofstein and Mamlock that practical learning gived an experience to student to interacted with materials to observed and to understand universe [1]. Student’s responses were positive, that means students accepted study through project based learning to designing a science laboratory KIT.
4. Conclusion
Based on finding and discussion it was concluded that project based learning which involve the students to designing a science laboratory KIT on the theme of cigarettes can increased 3H activities. This study was concluded that (1) student can design a science laboratory KIT well, (2) enhancement of Student’s 3H activities through project based learning which involve the student designing a science laboratory KIT is higher than group work, (3) separately, student’s hands-on an heads-on activities increased significantly trough project based learning which involve the student designing a science laboratory KIT, while student’s hearts-on activity was no striking differences, (4) students gave a positive responses on using project based learning which involve the student designing a science laboratory KIT.

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References
[1] Hofstein A and Mamlock 2007 The laboratory in science education: the state of the art. Chemistry Education Research and Practice 8(2) 105-107
[2] Millar 2004 The Role of Practical Work in the Teaching and Learning of Science (Wasington: University of York)
[3] Faris A 2008 The impact of project-based learning on the students’ attitudes towards science among nine graders in Hamza independent school Online Submission 1-8
[4] Alacapinar F 2008 Effectiveness of Project Based Learning Eurasian Journal of Education Research 32 17-35
[5] Bicaki M and Gursoy F 2010 A study on the effectiveness of project-based education Int. Journal of Academic Research 2(5) 379-388
[6] Garabato M M and Barquilla M B 2012 A design and develop biology laboratory kit for rural high school student in philippines Biology Education for Social and sustainable Development (Rotterdam: Sense Publishers) pp 241-248
[7] Sipos Y 2008 Achieving transformative sustainability learning: engaging head, hands and heart Int. Journal of Sustainabilty in Higher Education 9(1) 68-86
[8] Singleton J 2015 Head, Heart and Hands Model for Transformative Learning: Place as Context for Changing Sustainability Values journal of sustainabilty of education 9(3)
[9] Inan H Z and Taskin I 2015 3H Education: Examining Hands-on, Heads-on, and Hearts-on early childhood science education Int. Journal of Science Education 37(12) 1994-1971
[10] Chang C S 2011 Integration of project-based learning strategy with mobile learning: Case study of mangrove wetland ecology exploration project Tamkay Journal of Science and Engineering. 14(3) 263-273
[11] Besemer S P1999 Confirmy The Three Factor Creative Product Analysis Matix Model in an America Sample Creativity Research 12(4) 287-296
[12] Helle L 2006 Project-based learning in post secondary education: Theory, practice, and rubber sling shots Higher Education 51 287-314
[13] Hake R R 1998 Interactive-engagement vs traditional methods, a six thousand-student survey of mechanic test data for introductory physics courses American Journal of Physics 66 pp 64-74
[14] Ennis R H 1996 critical thinking and communcication (USA: Prentice Hall Inc)