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EFFECTIVENESS OF THE INQF-BASED LEARNING ON A GENERAL PHYSICS FOR IMPROVING STUDENT'S LEARNING OUTCOMES

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Abstract. *This research aims to analyse effectiveness of the Indonesian National Qualification Framework (INQF)-based learning on General Physics to increase the sixth level student's Learning Outcomes (LOs) according to the INQF indicators and student's skills in using physics laboratory equipment. This research was conducted using two groups of students that consisted of 29 and 30 students. A preliminary test (pre-test) and a post-test were applied to the groups that assumed to have the same level of knowledge and skills. The data were analysed using the paired t-test, the n-gain, and the ANOVA. The results show that the INQF-based learning applied to the General Physics effective in increasing the student's LOs according to the INQF indicators. Moreover, the n-gain scores between the pre-test and the post-test can be categorized as moderate for the sixth level student's LOs and categorized as high for the student's skills in using the physics laboratory equipment.*

Key words: *INQF-based learning, general physics, student's learning outcomes.*

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Introduction

In this 21st century, there are several essential "student's skills, knowledge and expertise that should be mastered to succeed in work and life in the 21st century". An example of the required skills is the problem solving skills (Partnership for 21st Century Skills, 2009). Problem solving skills covering a wide range of capabilities, including procedural and non-procedural problem solving capabilities (Pretz, Naples, & Sternberg, 2003). In the context of General Physics learning, step by step of the problem solving skills are needed to be trained continuously for both the procedural and non-procedural problem solving. Moreover, problem solving in General Physics requires skills of using the physics laboratory equipment.

It is generally understood that in order to achieve the 21st century skills, it requires a certain qualification requirements (Griffin & Care, 2015). Qualification defined as a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcome (LOs) to given standards (Allais, 2014; James & Dorn, 2015). National qualifications system is related to the national recognition of learning and other mechanisms that links education and training to the labour market and civil society. It may include development and implementation of institutional arrangements and processes relating to quality assurance, assessment and appreciation (European Communities, 2008; Ure, 2015).

National qualifications framework (NQF) had been set up in three European countries: Ireland, France and the UK before 2005. It is reported in 2015 that the framework is currently being developed in 38 countries cooperating on the European qualifications framework. Some studies showed that the NQF had significant impact on education, training, and policies on working practices (James & Dorn, 2015; Chakroun, 2010; Gosling, 2011).

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Recently, Indonesia established a similar framework which is called Indonesian Qualification Framework (INQF; In Indonesian it becomes *Kerangka Kualifikasi Nasional Indonesia* (KKNI)). It was issued through the Presidential Decree No. 8 of 2012. The INQF aims to provide recognition of competence of work in accordance with the structure of employment in various sectors. The INQF is a level of qualification framework that aligns competence, equalization, and integration in the fields of education and vocational training, as well as work experience. The term qualification is defined as mastery of LOs conferring to a certain level in the INQF structure.

According to the INQF, there are nine qualifications from the lowest (level 1) to the highest (level 9). Levels 1-3 are all grouped as office operators, level 4-6 are grouped as office technicians or analysts and level 7 to level 9 are grouped as professional careers. The INQF structure categorizes undergraduate degree program in the field of education into the sixth level. The sixth level student's LOs are defined as follows: (i) able to apply their expertise and utilize Arts and Sciences (science and technology) in solving problems; (ii) mastering concepts in depth knowledge in their field and able to formulate a procedural problem solving; (iii) able to take right decisions based on analysis of information and data, and is able to provide guidance in selecting various alternative solutions independently or in groups; and (iv) responsible for their own work and accountable for achievement of organizational work (Jatmiko, Widodo, Martini, & Budiyanto, 2014).

In line with the INQF structure, the Minister of Education and Cultural Affairs issued Regulation of the Minister of Education and Culture No. 49 of 2014 on Higher National Education Standards. This regulation requires a learning process in a higher degree institution that leads to the achievement of LOs indicators of the INQF. Through the new standard, it is clear that the regulation gives no other choice for higher degree institutions in Indonesia for not implementing learning process that leads to achievement of LOs indicators according to the INQF.

Studies related to the NQF in the field of education in several countries show that: (i) in Europe, the NQF is associated with the increase of the learning outcomes from input to output (Ure, 2015); (ii) in Chile, the NQF links to the formulation of principles and criteria for education instrument implementation for the qualification framework (Solís, Castillo, & Undurraga, 2013); and (iii) in Portugal, the NQF serves as an assessment tool which allows diagnosing and controlling the development of learning achievement (Stasiūnaitienė & Teresevičienė, 2006). In general, it showed that the NQF provided significant impact on the improvement of the learning outcome scores (Chakroun, 2010)

Series of researches related to the INQF on education field at the State University of Surabaya in Surabaya - Indonesia had been commenced since 2013. The research mainly focused on developing prototypes of the INQF-based curriculum to enhance professional and pedagogical competence of science education teachers. The work had successfully published a book entitled of "Book in prototyping INQF-based science education curriculum 1st Edition" in 2014 (Jatmiko, Widodo, Martini, & Budiyanto, 2014). Subsequently, a limited test (including 15 students) was done for the INQF-based learning on a General Physics for students in bachelor degree of science education program at the State University of Surabaya. The results had been reported in the article in a national seminar in Surabaya-Indonesia (Jatmiko, Widodo, Martini, & Budiyanto, 2015). Based on the results of the research described in the article, a book had been published entitled of "Book of Prototyping INQF-based Curriculum for the science education curriculum 2nd Edition". The second edition book equipped with: (a) examples of the learning tools for the general physics research that based on the INQF and (b) learning syntax (flow of instructional activities) according to the INQF sixth level of students' LOs indicators, i.e. (1) motivating, (2) presenting information and experimental groups/discussion sharing, (3) identifying and solving problems, (4) establishing and enriching, and (5) evaluating the use of science and technology (Jatmiko, Widodo, & Martini, 2015).

The sixth level INQF indicators covers (i) mastering concepts, (ii) formulating procedural problem-solving, (iii) formulating non-procedural problem-solving, and (iv) decision making. The concept indicators may include: remembering (C1), comprehension (C2), applications (C3), analysis (C4), evaluation (C5), and creation (C6) (Krathwohl & Anderson, 2001; Bush, Daddysman, & Charnigo, 2014). On the other hand, procedural problem solving may include indicators such as: (i) observation, (ii) asking questions, (iii) making hypothesis, (iv) testing the hypothesis, (v) analysing the data and conclusions, and (vi) replicating research through the obtained correspondence between empirical and theoretical (Bradford, 2015). The non-procedural problem solving indicators are: (i) arguing that is defined as capability of reasoning in accordance with his/her experience and knowledge, (ii) strategic indication that is capability of selecting appropriate problem-solving strategies based on analysis, and (iii) solution evaluation that is considered as capability to evaluate solutions to problems logically correspond to the case description, analysis, and experimental data to support decision making (Snyder & Snyder, 2008). Lastly, the decision making comprises of ability in: (i) determining the objectives, (ii) identifying options, (iii) analysing the information, and (iv) making a choice (Campbell, Lofstrom, & Brian, 1997).

Problem of Research

The problem in this research is to analyse the effectiveness how the INQF-based learning on the General Physics can improve student's LOs according to the sixth level of INQF indicators. The INQF-based learning is said to be effective when the learning process is statistically able to achieve significant increase of student's scores after the pre-test and the post-test in terms of the sixth level student's LOs and skills. Effectiveness of student's LOs of the sixth level and the skills in utilizing the physics laboratory equipment is determined by the normalized gain scores (n-gain). n-gain = (score post-test - score pre-test)/(100 - score pre-test) (Hake, 1999). According to the following criteria: (1) if n-gain ≥ 0.7 (high), (2) if 0.3 < n-gain < 0.7 (moderate), dan (3) if n-gain ≤ 0.3 (low).

This research aims to analyse the effectiveness of the learning process against the student's LOs that have been defined according to the sixth level of the INQF and the skills in utilizing the physics laboratory equipment. Compared to the previous work (Jatmiko, Widodo, Martini, & Budiyanto, 2015), this research involves a greater number of research.

Research Focus

The focus of the research is to analyse the impact of the INQF learning against the sixth level student's LOs according to INQF indicators. The problems include: (i) is there any significant increment (statistically) of the sixth level student's LOs and student's skills in using the physics laboratory equipment before and after employing the INQF-based learning?, (ii) how much do the sixth level student's LOs and the student's skills increase in using the physics laboratory equipment? and (iii) is there any increment difference of the sixth level student's LOs and the skills in using the physics laboratory equipment between group-1 and group-2?

Methodology of Research

General Background of Research

The research puts emphasis on analysing the effectiveness of the INQF-based learning by analysing the impact of the INQF-based learning on General Physics to the sixth level student's LOs and the student's skills in using the physics laboratory equipment with n-gain employed before and after the INQF-based learning. In this research, the effectiveness of the sixth level student's LOs and the student's skills in using the physics laboratory equipment is referred to the existence of significant (statistically) increment scores between the preliminary test (pre-test) and the post-test. When calculated by the n-gain, it can be categorized as low, moderate and high for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment.

Sample of Research

This research was conducted using two groups of students at Science study program, faculty of Mathematics and Science, The State University of Surabaya. The students took a General Physics subject during the odd semester in academic year 2015/2016. Furthermore, they were called group-1 and group-2. Those groups consisted of 29 and 30 students, respectively. The two groups held the same sixth level of student's LOs and student's skills in using the physics laboratory equipment.

Instrument and Procedures

This research can be classified as a quasi-experimental research. It was performed using the one group pre-test and post-test design, i.e., O1 X O2 (Fraenkel & Wallen, 2009). The two groups of the students were offered exactly the same pre-test before learning process was provided. The test instrument consisted of sixth level INQF indicators and the student's skills in using the physics laboratory equipment. After finalizing the pre-test, learning process of General Physics that based on the INQF was applied to the two groups of students. The learning process was conducted by utilizing learning tools such as syllabus, lesson plan, a student textbook, and student worksheets. In the previous work, these learning tools had been evaluated in terms of the content and the construction validities,

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which show validity scores (in the range 0-4) for syllabus: 3.58 (very valid), lesson plan: 3.86 (very valid), a student textbook: 3.18 (valid) and student works sheets: 3.95 (very valid) (Jatmiko, Wahono, & Martini, 2015). The learning process that was applied in the research was according to the following steps: (1) motivating, (2) presenting information and experimental groups/discussion sharing, (3) identifying and solving problems, (4) establishing and enriching, and (5) evaluating the use of science and technology (Jatmiko, Widodo, & Martini, 2015). Finally, after the learning process, the two groups were asked to work with a post-test. It should be reminded that we devised the same instrument for post-test as it was provided at the pre-test.

The sixth level of the student's LOs was measured using test instrument that consisted of: (i) mastering concepts, (ii) formulating procedural problem-solving, (iii) formulating non-procedural problem-solving, and (iv) decision making. Meanwhile, the student's skills in using the physics laboratory equipment were determined by performance test in terms of skills in measuring length, time, mass, temperature and ticker timer.

Data Analysis

In order to analyse the impacts of the INQF-based learning to the student's LOs, the scores of the pre-test and post-test that had been collected were analysed using the paired t-test or non-parametric analysis of Wilcoxon test. The selection of the testing methods depended on the fulfilment of the normality assumption for both pre-test and post-test scores. When the normality assumption for the scores are achieved, then the paired t-test will be applied. Otherwise, the non-parametric analysis will be used. Additionally, we utilized the n-gain analysis to examine the impact of the INQF-based learning against the student's LOs (Hake, 1998). The analysis was performed using the IBM SPSS Statistics 19 software.

Furthermore, to analyse the equality of the impact of the INQF-based learning against the sixth level student's LOs and the student's skills in using the physics laboratory equipment, we employed the analysis of variance (ANOVA) for both groups, i.e. the group-1 and group-2. The testing method depended on the fulfilment of the normality and equality of the two variance assumption for both group-1 and group-2 average of the n-gain.

Results of Research

The pre-test and the post-test mean scores of the two groups are presented in Figure 1. The grey bar representing the pre-test and the shaded bar signifying the post-test. The overall examination for the two groups in terms of the sixth level student's LOs is shown in Figure 1 and Table 1, while the student's skills in using the physics laboratory equipment is shown in Figure 1.

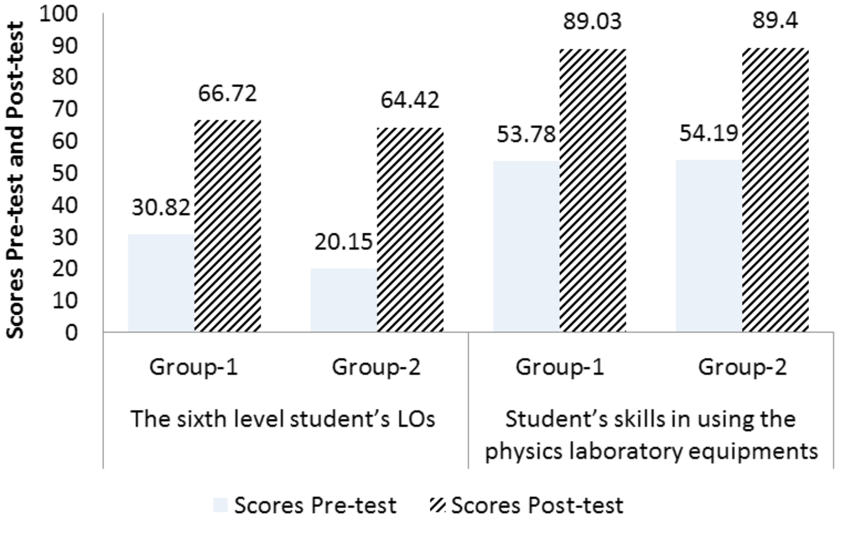

Figure 1: The mean scores of the student's pre-test and post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both the group-1 and the group-2.

Table 1. The mean scores of the pre-test, post-test, and the n-gain of the sixth level student's LOs for the group-1 and the group-2.

Numb	The sixth level student's LOs	Group-1			Group-2		
		Pre-test	Post-test	n-gain	Pre-test	Post-test	n-gain
1	Mastering concepts	24.68	65.19	0.53	36.85	68.97	0.55
2	Formulating procedural problem-solving	20.00	63.65	0.52	17.33	63.83	0.57
3	Formulating non- procedural problem-solving	27.16	64.22	0.51	40.73	71.55	0.56
4	Decision making	19.79	64.38	0.52	21.39	67.50	0.61

Mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment for the group-1 and the group-2 are shown in Figure 2.

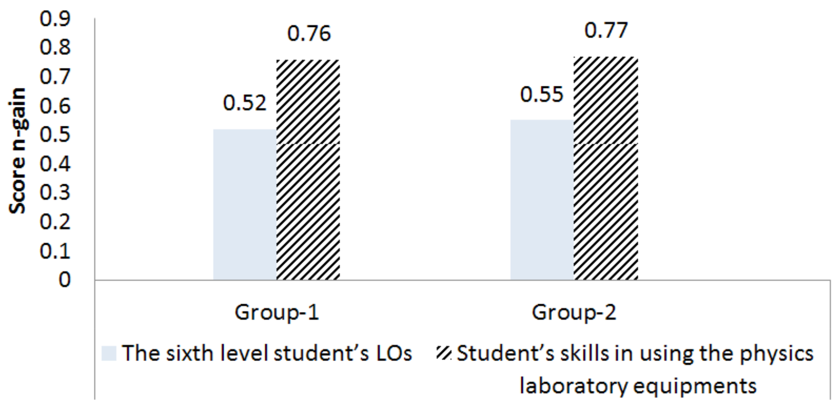

Figure 2. The mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment for the group-1 and the group-2.

Figure 1 shows that the mean score between the pre-test and the post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both groups-1 and group-2 is increasing. The average of the pre-test and the post-test scores for the group-1 are 30.82 and 66.72, respectively; while the average of the pre-test and the post-test scores for the group-2 are 20.15 and 64.42, respectively. The average of the pre-test, the post-test, and the n-gain in terms of the sixth level student's LOs for each INQF indicators for both groups-1 and group-2 are depicted in Figure 1 and detailed in Table 1. Figure 2 depicts the mean score of the n-gain for both group-1 and group-2 in terms of the student's LOs of the sixth level resulting 0.52 and 0.56, respectively. The mean scores of both groups in terms of the level student's LOs can be categorized as moderate.

It is clearly seen in Figure 1 that the pre-test and post-test mean scores for the group-1 of the student's skills in using the physics laboratory equipment achieves 53.78 and 89.03, respectively. For the group-2, the mean scores are 54.19 and 89.40. On the other hand, Figure 2 demonstrates the mean score of the n-gain in terms of the student's skills in using the physics laboratory equipment shows 0.76 and 0.77 for the group-1 and the group-2, respectively. The mean scores of both groups in terms of the student's skills in using the physics laboratory equipment can be categorized as high (Hake, 1999).

For analysing the impact of the student's LOs in the INQF-based learning in terms of the sixth level student's LOs, we used a paired t-test statistical measurement. The summary of the paired t-test after the fulfilment of the normality assumptions for both pre-test and post-test is shown in Table 1 and Table 2.

This section should be reworked because you mixed the used terms of inquiring and discussion not defined before. Thus, the result of this section is confused, almost not clear.

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Table 2. The results of the sixth level student's LOs paired t-test in group-1

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pre-test-Post-test	29	-1.438	-0.313	28	-24.716	< 0.0001

$^{*}p < 0.05$ *(2-tailed)*

Table 3. The results of the sixth level student's LOs paired t-test in group-2

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pre-test-Post-test	30	-1.770	-0.360	29	-26.963	< 0.0001

$^{*}p < 0.05$ *(2-tailed)*

It can be seen in Table 2 that the t score gives value of -24.716 for degrees of freedom, df = 28. The score is considered as significant, because of $p < 0.05$. Therefore, it can be concluded there is a significant impact (statistically) of the INQF-based learning for the group-1 in the sixth level student's LOs at significance level of 5%. Similarly, Table 3 shows the t score of -26.963 for the degrees of freedom, df = 29, gives significance score as $p < 0.05$. Hence, there is a significance impact statistically of the INQF-based learning in the sixth level student's LOs at significant level of 5% for the group-2.

In order to analyse the improvement of the sixth level student's LOs for the group-1 in terms of student's skills in using the physics laboratory equipment, we carried out an examination utilizing the Wilcoxon test. In contrast, we performed a paired t-test for the group-2. Summaries of the Wilcoxon test and the paired t-test for the pre-test and post-test in terms of the student's skills in using the measuring equipment for both group-1 and group-2 are shown in Table 4 and Table 5.

Table 4. Wilcoxon test for the student's skills in using the physics laboratory equipment in group-1

Paired Samples Test

	N	Z	p
Pre-test - Post-test	29	-4.714	< 0.0001

$^{*}p < 0.05$ *(2-tailed)*

Table 5. The results of paired t-test for the skills in using the physics laboratory equipment in group-2

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pre-test - Post-test	30	-1.409	-0.196	29	-39.276	< 0.0001

$^{*}p < 0.05$ *(2-tailed)*

Table 4 shows the Wilcoxon test for the student's skills in using the physics laboratory equipment. Examination of the third column reveals that the Z test gives value of -4.714 with significance level $p < 0.05$. It clearly indicates that there is impact on the INQF-based learning to the student's skills in using the physics laboratory equipment for the group-1. Similarly, Table 5 shows that the t test gives value of -39.276 with significance level p=0.14E-14-<0.05. Based on the table, it can be admitted that there is a significant impact of the INQF-based learning to the student's skills in using the physics laboratory equipment on the group-2.

Furthermore, equality of the impact INQF-based learning for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment is analysed using ANOVA to the group-1 and group-2. The results after the fulfilment of the normality assumption as well as the equality of two variances are shown in Table 6 and Table 7.

Table 6. The results of ANOVA for the sixth level student's LOs to the group-1 and group-2

ANOVA

	Sum of Squares	Mean Square	df	F	p
Between Groups	0.043	0.014	3	1.688	0.195
Within Groups	0.211	0.008	25		
Total	0.254		28		

$^{*}p<0.05$

Table 7. The results of ANOVA for the skills in using the physics laboratory equipment in group-1 and group-2

ANOVA

	Sum of Squares	Mean Square	df	F	p
Between Groups	0.012	0.004	3	0.833	0.488
Within Groups	0.120	0.005	25		
Total	0.132		28		

$^{*}p<0.05$

It is clearly seen from Table 6 that the F-test provides value of 1.688 with significance level p=0.195 > 0.05. Hence, there is a strong indication that the impact of the INQF-based learning to the sixth level student's LOs for the groups is not different at the 5% significance level. Table 7 shows the F count is 0,833 with significance level p=0.488 > 0.05. Therefore, it can be concluded that there is no difference in terms of the student's skills in using the physics laboratory equipment at the 5% significance level.

Discussion

The Sixth Level Student's Los Improvement

Based on the Figure 1 and Table 1, it can be observed that before the learning process was done, the students showed to have low scores. The mean scores of the sixth level student's LOs were below the standard score (i.e., 40), it was 30.82 on a score range of 0-100, and it gave a score of 20.15 for group-1 and group-2, respectively. Both of the achievements fell on the grade E (0 ≤ E <40). Grade E is considered as the lowest while grade A is considered the highest. Similarly, mean scores of the sixth level student's LOs for each INQF indicator were below the standard score 40. This might be because the students were not familiar with the thinking activities that are designed by the INQF sixth level of qualification.

The results of the research were supported by low score data of the national average test on teacher competence (Celik, 2011) as well as the preliminary research of our study showed to have low scores in terms of the sixth level student's LOs (Jatmiko & Martini, 2014). The results of this work can be related to the study that had been done by TIMSS research between 1999 and 2011, which elaborates the facts that Indonesian junior high school students were only able to identify a number of basic facts. It was found that they had not been able to communicate well. A similar result was done by PISA between 2003 and 2012. It was mentioned that Indonesian students have limited scientific knowledge. They can only apply knowledge to multiple familiar situations. Additionally, the students can only present clear scientific explanations without giving evidence. This might be due to that the science teachers of the junior high schools in Indonesia possess low competence in scientific literacy. Hence, the teachers were not able to explain clearly to the students. The study was supported by em-

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pirical data (Jatmiko & Martini, 2014).

In contrast, after the learning process of General Physics that based on INQF was done, the result shows that the undergraduate students are able to obtain a mean score of 66.72 for the group-1 and 64.42 for the group-2. Both of the mean scores are at almost the same value, although they are slightly different on grade of B- (65 ≤ E <70). This means that there is an increase in the average score as much as 35.90 or 116.48 % on the group-1, and there is an increase in the mean score as much as 44.27 or 219.70 % in the group-2. The increase of the sixth level student's LOs scores on these two groups is significant and there is no difference with significance level of 5%, with n-gain average of 0.52 and 0.56 for group-1 and group-2, respectively. Both can be categorized as moderate. These results indicate the existence of significant impact on the learning process that based on the INQF. The degree of impact, represented by the mean scores of the n-gain, for the learning process for both groups is consistently significant (statistically) at significance level of 5%, even though they are slightly different. Both of the n-gain can be categorized as moderate.

Increasing the sixth level student's LOs is probably because the students in this research were trained and directed to achieve LOs qualification levels of all six (Presidential Decree No. 8 of 2012). The indicators have been represented in the learning tools that have been implemented, which have been constructed based on the INQF indicators according to the mastering theoretical concepts (Krathwohl & Anderson, 2001); procedural problem solving skills (Bradford, 2015), non-procedural problem solving skills (Snyder & Snyder, 2008); and decision making skills (Campbell, Lofstrom, & Brian, 1997). Based on our examination in this research, it proofs that the learning steps that have been formulated in Jatmiko (Jatmiko, Widodo, & Martini, 2015) are supported by empirical data. The formulation mainly emphasizes on the problem solving activities.

The research results in this work verify various works in problem solving activities that can be summarized as follows: (i) the problem based learning (PBL) that emphasizes on problem-solving activities can improve the skills of critical thinking and problem solving skills (Zabit, 2010); (ii) the PBL format can be beneficial for students to improve: independent learning, critical thinking, problem solving, and communication skills (Senel, Ulucan, & Adilogullari, 2015). Additionally, the PBL program which involves a multidisciplinary student health is significantly positive effect on decision-making and a willingness to learn and a positive attitude are higher; (iii) the PBL learning strategy that focuses on the development and problem-solving groups, can improve the knowledge content, problem solving skills, and group dynamics (Goltz, Hietapelto, Reinsch, & Tyrell, 2007). Moreover, the results state that teams that are equipped with interpersonal skills and good problem solving are capable of making decisions effectively; (iv) students who have utilized the PBL achieve generic problem-solving scores higher than the control group significantly (Klegeris & Hurren, 2013). This is mainly because the PBL can be used to enhance troubleshooting skills, including design and problem-solving, decision-making, and analysis of system; (v) the PBL models have proven to be beneficial for improving students' conceptual learning, knowledge, skills and values of science (Etherington, 2011); (vi) Learning Cycle for Inquiry Concept (LCIC) Model, which aims to provide opportunities for teachers and students to develop and improve scientific skills. The model focusing on high-order thinking skills thoroughly as well as conceptual understanding by improving critical thinking skills (Corlu & Corlu, 2012).

Student's Skills in Using the Physics Laboratory Equipment Improvement

According to Figure 1, prior to the learning process, students have average student competence, i.e., a score of 53.78 in the range 0-100 for the group-1 and 54.19 for the group-2. Both of the mean scores are almost at the C grade (55 ≤ E <60) from range values E (the lowest) to A (the highest). These student's skills in using the physics laboratory equipment show less moderate skills in order to use or operate the measuring equipment, including: length, time, mass, temperature, and ticker timer. This might be because students are familiar in doing measurements using the gauge during their senior high school. The reason is supported by opinion of the Chinese philosopher, named Confucius that in these modern times are categorized into five principles of active learning, i.e., "when I hear, I see, I discuss and do, I get the knowledge and skills" (McLeod, Barr, & Welch, 2015). After the learning process of the INQF-based General Physics, the students for the group-1 achieve average score of 89.03, and students for group-2 get 89.40 score. Both of the mean scores are similar although it is slightly different, namely A (85 ≤ A ≤ 100). This means that there is an increase in the average score of 35.25, or 65.54% on group-1, and there was an increase in mean score of 35.21, or 64.98% in the group-2. The increment of the student's skills in using the physics laboratory equipment scores for these two groups is significant and there is no difference at real level of 5%, the n-gain of the group-1 is 0.76 and 0.77 for the group-2. Both are at the high category. These results indicate that there is an impact of the INQF-based learning to the student's skills in using the physics laboratory equipment significantly (statistically), the degree of the impact in n-gain there is no difference at the 5% significance level. Both are in the same category: at high category.

The increase in the student's skills in using the physics laboratory equipment might be because the students have been trained and directed to achieve the skills in using the physics laboratory equipment scores, i.e., familiarity to use or operate the measuring equipment, including: length, time, mass, temperature, and ticker timer. The indicators of the skills in using the physics laboratory equipment that has been realized in the learning tools and implemented. In this work, it can be seen that one of the learning process steps was formulated as problem identification and problem solving. It shows that the research results verify some other works, for example (i) PBL for the psychomotor development, where students are able to design related tools that improve their skills (Tanel & Erol, 2008) and (ii) PBL can improve psychomotor skills and academic achievement in individuals with mental and physical characteristics that are different (Sever & Oguz-Unver, 2013).

The increment of the sixth level student's LOs and the student's skills in using the physics laboratory equipment in this research is not different with the results in the previous work, which involves fewer number of research subjects (15 students) (Jatmiko, Widodo, Martini, & Budiyanto, 2015), as well as there is no difference with studies as follows: (1) improvement of the sixth level student's LOs and the student's skills in using the physics laboratory equipment is guaranteed when learning process utilizes the national qualification framework concept (Krstovic & Cepic, 2010); (2) improvement of the student's LOs can create significant contribution to transparency and international recognition of qualifications, especially through the strengthening of the concept and practice (Keevy, 2013).

Conclusions

Based on the research results and discussion above, the INQF-based learning on the General Physics can be considered effective to increase the sixth level student's LOs and student's skills in using physics laboratory equipment. The effectiveness of improving the sixth level student's LOs and the student's skills in using the physics laboratory equipment are based on as follows: (i) there is significant increment (statistically) on the sixth level student's LOs and the student's skills in using the physics laboratory equipment before and after employing the INQF-based learning, (ii) the increase of the n-gain scores can be categorized as moderate for the sixth level student's LOs and can be categorized as high for the student's skills in using the physics laboratory equipment, and (iii) the increment of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both group-1 and group-2 are not different.

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