IMPACT OF THE KKNI-BASED LEARNING ON GENERAL PHYSICS STUDY FOR IMPROVING STUDENT'S LEARNING OUTCOMES

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Abstract. This study aims to analyze the impact of the Indonesian National Qualification Framework (KKNI – Kerangka Kualifikasi Nasional Indonesia) to increased Learning Outcomes (LO) based on KKNI indicators in terms of knowledge and psychomotor skills aspects (case study: Indonesian students in the Universitas Negeri Surabaya (Unesa) as Physics Teacher Candidates for Junior High School Students). The study was conducted using the one group method comprises of pretest and posttest in two parallel classes, called implementation and replication class that are consisted of 29 and 30 students, respectively. The pretest and posttest:data were analyzed using the paired t-test, n-gain (<g>), and equality test of two averages as well as non-parametric analysis. The results show that: there is an impact of the KKNI-based learning on general physics to increase the LO ($p < 0.5$) in terms of knowledge and psychomotor skills aspects for both the implementation and the replication class. The increment of LO (<g>) on the implementation class and replication class are 0.52 and 0.56. They are both categorized as moderate for knowledge aspect. On the other hand, it achieves 0.76 and 0.77 that are categorized as high category psychomotor skills aspects. The impact of the LO increment for both classes in the knowledge and psychomotor skills aspects can be conlcluded that there is no different (as $p < 0.5$). In other words, it give consistent results for both classes.

Key words: learning, general physics, based on KKNI, increased LO, KKNI indicator.

Introduction

In this 21st century, student achievement is directed at learning and innovation skills. Among others, namely: problem solving skills, critical, and creative thinking (Partnership for 21st Century Skills, 2009; Griffin & Care, 2015). Meanwhile, it is genqerally understood that in order to achieve the 21st century skills it requires a certain qualification requirements (Griffin & Care, 2015). Qualification means a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcome (LO) to given standards (Allais, 2014; James & Dorn, 2015), national qualifications system are related to the national recognition of learning and other mechanisms that link education and training to the labour market and civil society. This includes the development and implementation of institutional arrangements and processes relating to quality assurance, assessment and appreciation (European Communities, 2008; Ure, 2015).

Before 2005, national qualifications frameworks (NQF) had been set up in three European countries: ireland, France and the UK. In 2015, the framework had been or is being developed in all 38 countries cooperating on the European qualifications framework. NQF is having an impact on education, training, and policies on working practices (James & Dorn, 2015; Chakroun, 2010; Gosling, 2011).

Recently, Indonesia established a NQF that is called Kerangka Kualifikasi National Indonesia (KKNI) that was issued through the Presidential Decree No. 8 of 2012. The KKNI aims to provide recognition of competence of work in accordance with the structure of employment in various sectors. The KKNI is a level of qualification framework that aligns competence, equalizes, and integrates the fields of education and vocational training, as well as work experience. Meanwhile, qualification is defined as mastery of LO according to its level in the KKNI.

According to the KKNI, there are nine qualifiers from the lowest l (level 1) to the highest (level 9). Levels 1-3 are all grouped into office operators; level 4-6 are grouped into office technicians or analysts; and level 7 to level 9 are grouped into professional careers. The KKNI categorized undergraduate degree program in the field of education into the sixth level with LOs defined as follows: (1) able to apply their expertise and take advantage of Arts and Sciences (science and technology) in solving problem; (2) mastering (Jatmiko, Widodo, Martini, & Budiyanto, 2014) theoretical concepts in depth knowledge in their field and able to formulate a procedural problem solving; (3) able to take the right decisions based on analysis of information and data, and is able to provide guidance in selecting various alternative solutions independently and groups; and (4) responsible for their own work and accountable for achievement of organization work.

In line with the KKNI, Minister of Education and Cultural Affairs issued Regulation of the Minister of Education and Culture No. 49 of 2014 on Higher National Education Standards (Permendikbud). This regulation required a learning process in the College lead to the achievement of LO indicators of the KKNI. Through this Permendikbud, it is clear that the regulation gives no other choice for universities in Indonesia, including at the Universitas Negeri Surabaya (Unesa) for not implementing learning process that lead to achievement of LO indicators according to the KKNI.

The results of studies related to the NQF in the field of education in several countries show that: (1) in Europe, NQF associated with increased learning outcomes from input to output, hence the qualification becomes more transparent (Ure, 2015); (2) in Chile, NQF links to the formulation of principles and criteria for education instrument implementation for the qualification framework (Solís, Castillo, & Undurraga, 2013); and (3) in Portugal, NQF serves as an assessment tool which allows diagnosing and controlling the development of learning achievement (Stasiûnaitienë & Teresevièienë, 2006). In addition, the results showed that the NQF provided significant impact on the learning outcomes (Chakroun, 2010)

Meanwhile, studies related to the KKNI on education in Unesa Indonesia has been commenced since 2013. The study mainly focused in developing prototype of the KKNI-based curriculum to enhance professional and pedagogical competence of science teachers. The work had published a book entitled of "Book of prototyping KKNI-based curriculum at Science Teacher Candidate Study Program (Bachelor Degree) Edition 1" in 2014 (Buku Prototipe Kurikulum Program S1 Pendidikan Sains Berorientasi KKNI Edisi 1. ISBN 978-602-1377-11-6. 2014). Subsequently, a limited test (including 15 students) was done for the KKNI-based courses like General Physics Studies for Science Teacher Candidate Study Program. The results had been reported in the article in a national seminar in Surabaya-Indonesia (Jatmiko, Widodo, Martini, & Budiyanto. 2015). "Pembelajaran Fisika Umum Berorientasi KKNI untuk Meningkatkan Hasil Belajar Pengetahuan dan Hasil Belajar Keterampilan Psikomotor". Prosiding Seminar Nasional, ISBN 978-602-0951-06-5/ISBN 978-602-0951-07-2, hal. 148 - 157). Based on the results of the study described above, in 2015 had been published a "Book of Prototyping KKNI-based Curriculum for the Science Teacher Candidates Study Program 2nd Edition". The second edition book equipped with learning syntax and examples of the learning tools for General Physics Study based on the KKNI (Jatmiko, Wahono, & Martini, 2015). To enhance the results of the limited trial, an examination with greater number of subjects and more perfect general physics learning tools had been done at the end of 2015. The learning syntax that was used had been formulated by (Jatmiko, Wahono, & Martini, 2015) including: (1) motivation, (2) information presentation and experimental groups/discussion sharing, (3) problem identification and problem solving, (4) establishment and enrichment, and (5) evaluation and utilization science and technology. The results of these trials is subsequently reported in this article.

In this paper, a study has been carried out to analyze the impact of general physics KKNI-based learning in terms of knowledge and psychomotor skills aspects for Science Teacher Candidates for Junior High School Study Program (Bachelor Degree) intake year of 2015, Unesa. To be more specific, this paper will analyze: (1) is there any impact on the KKNI-based learning to the LO indicators?, (2) How far the impact of the KKNI-based learning against the LO indicators?, and (3) How good is consistency of the KKNI-based learning on the LO indicators?

Research Methodology

General Background of Research

This work is classified as a quasi experimental research using replication. The purpose of this study is to analyze the impact of the KKNI-based learning towards LO in terms of knowledge and psychomotor skills aspects on general physics studies of undergraduate students on Physics Teacher Candidates for Junior High School in Unesa. The main purpose of this study is to analyze: (1) the impact of the KKNI-based learning towards LO, (2) the degree of the impact of the learning process, and (3) how good is the consistency.

Sample of Research

In this work, we used number of samples or research subjects that consisted of 59 teacher candidates students in Science Education Study Program (i.e., two groups of people including one group that comprised of 29 students for implementation class and one group of 30 students for replication class).

Instrument and Procedures

This study was designed using the One Group Pretest - Posttest Design: O1 X O2 (Fraenkel & Wallen, 2009). In this design, students were given a pretest on the first stage, then teaching process of the general physics based on the KKNI was conducted utilizing learning tools such as: syllabus, lesson plan, a student textbook, and student activity sheet. Finally, students were asked to do posttest. The test instrument used in the study are consisted of: conceptual knowledge, procedural and non-procedural problem solving, and decision making. Conceptual knowledge includes: remember (C1), comprehension (C2), applications (C3), analysis (C4), evaluation (C5), and creation (C6) (Krathwohl & Anderson, 2001; Bush, Daddysman, & Charnigo, 2014). Procedural problem solving may include: (1) observation, (2) ask questions, (3) make a hypothesis, (4) test the hypothesis, (5) to analyze the data and conclusions, and (6) to replicate the study through obtained correspondence between empirical and theoretical (Bradford, 2015). On the other hand, the non procedural problem solving includes: (1) arguing that is defined as capability of reasoning in accordance with his/her experience and knowledge, (2) strategic indication that is capability of selecting appropriate problem-solving strategies based on analysis, and (3) 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). The decision has four indicators that are: (1) determining the objectives, (2) identifying options, (3) analyzing the information, and (4) making a choice (Campbell, Lofstrom, & Brian, 1997).

Data Analysis

In order to analyze the impacts of the KKNI-based learning against the LO indicators, the scores of pre-test and post test that had been collected were analyzed using the paired t-test or non-parametric analysis of Wilcoxon test. The test was depended on the fulfillment of prerequisite normality test both for pre-test and post-test scores. In contrast, we utilized n-gain analysis (<g>) to analyze the impact of the KKNI-based learning against the LO indicators (Hake, 1998). The analysis was performed using the IBM SPSS Statistics 19 software.

Furthermore, to analyze the consistency of the impact of the KKNI-based learning against the LO indicators, we employed the equality test of two averages for both classes i.e., the implementation and replication classes in terms of knowledge and psychomotor skills. The analyses were performed using the independent t-test or non-parametric analysis Wilcoxon test. The test was depended on the fulfillment of prerequisite normality test both for pre-test and post-test scores. We also utilized equality test of the of two variances.

Research Results

The results for the implementation and replication classes in terms of pre-test and post-test mean score for the LO indicators in terms of knowledge and psychomotor skills aspects are shown in Figure 1, Table 1, and Figure 2.

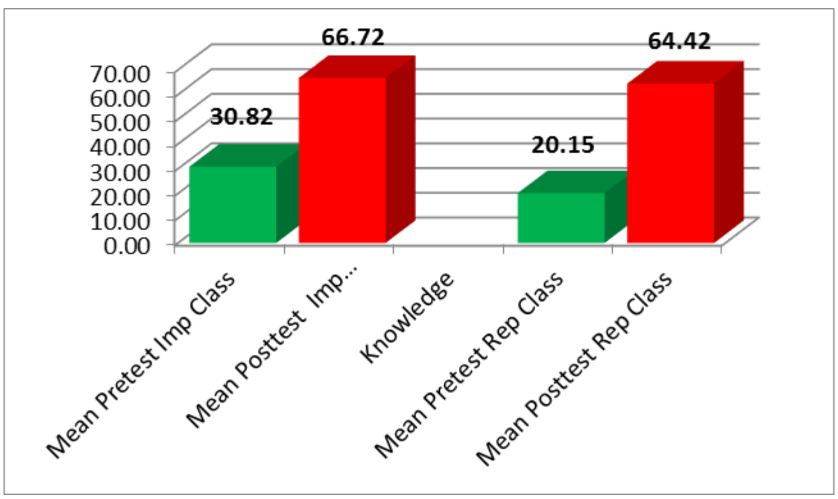

Figure 1. Average score of pre-test and post-test for implementation and replication classes, LO knowledge aspects.

Table 1. Average Score of the Pretest, Posttest, and <g> for the implementation and replication classes for the LO indicators of the KKNI in terms of knowledge aspect (kognitif).

Num.	**LO indicators for the KKNI (knowledge aspect)**	**IMPLEMENTATION CLASS**			**REPLICATION CLASS**		
		Average score for Pretest	Average score for Posttest	Average score for <g>	Average score for Pretest	Average score for Posttes	Average score for <g>
1.	Mastering Theoretical 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

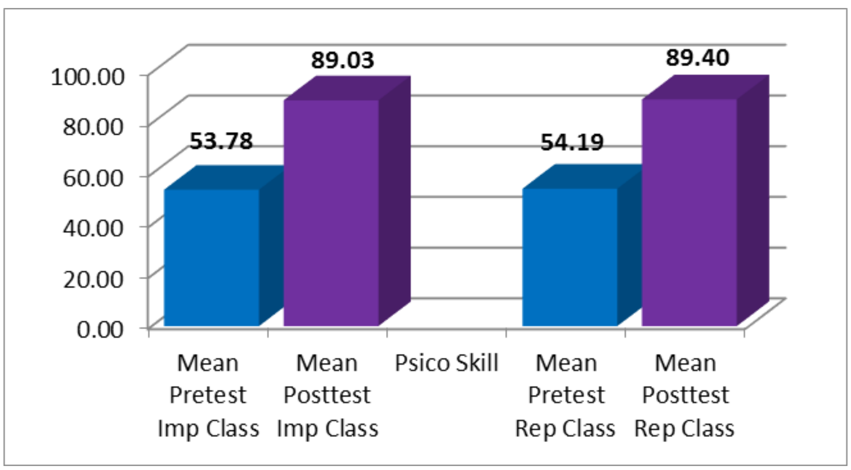

Figure 2. Average score of pre-test and post-test for implementation and replication classes, LO psychomotor skills aspects

Meanwhile, the average of <g> for the LO knowledge and psychomotor skills aspects for both of the implementation and replication classes are shown in Figure 3.

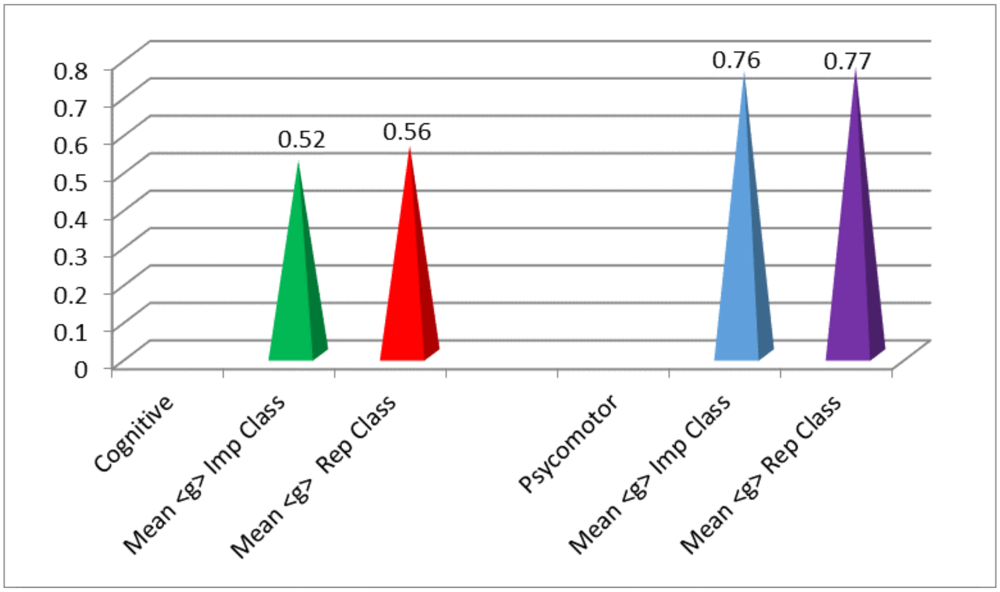

Figure 3. Average <g> LO knowledge and psychomotor skills aspects of the implementation and replication classes.

Figure 1 shows the increment mean score between pre-test and post-test in terms of knowledge for both implementation and replication clases over the LO indicators. The pre-test and post-test scores for the implementation class are 30.82 and 66.72, respectively; and 20.15 and 64.42, respectively for the replication class. It can also be seen in the same figure that there is an increase in terms of psychomotor skills. Average <g> in terms of knowledge for both implementation and replication classes shown in Figure 1 as well as Table 1 demonstrated that both of them can be categorized as moderate. Conversely, the average <g> of the psychomotor skills depicted in Figure 3 can be categorized as high.

It can be seen in Figure 2 that the average mean scores of the pre-test and post-test mean score for the implementation class of the psychomotor skills are 53.78 and 89.03, respectively; while for the replication for each class are: 54.19 and 89.40. Figure 3 demonstrates that the average <g> for the implementation and the replication clases in terms of knowledge are 0.52 and 0.56, respectively; and in terms of psychomotor skills shows average <g> as 0.76 and 0.77. Each of them can be considered as high scores.

For analyzing the impact of the LO in the KKNI-based learning in terms of knowledge aspects, we did a paired t-test. The summary of the paired t-test after the fulfillment of the normality assumptions for the pre-test and post-test are shown in Table 1 and Table 2.

Table 2. The results of knowledge paired t-test in implementation class

Paired Samples Test

		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	pretest - posttest	-1.43793	.31329	.05818	-1.55710	-1.31876	-24.716	28	.000

Table 3. The results of knowledge paired t-test in replication class

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-1.77033	.35962	.06566	-1.90462	-1.63605	-26.963	29	.000

It can be seen in Table 2 that the t score gives -24.716 for degrees of freedom, df = 28. The score is considered significance as 0.00 <0.05. It can be consluded that for the implementation class there is a significant impact of the KKNI-based learning to the LO indicators in the knowledge aspects at 5 %. Similarly, Table 3 shows the t score is -26.963 for degrees of freedom, df = 29, gives significance score as 0.00 <0.05. Therefore, there is a significance impact of the KKNI-based learning in the knowledge aspects at 5 % level for the replication class. In order to analyze the improvement of the LO on the implementation class in terms of psychomotor skills aspects, we carried out an examination utilizing the Wilcoxon test. In contrast, we performed a paired t-test for the replication class. Summary of the Wilcoxon test and the paired t-test for the pre-test and post-test psychomotor skills aspects for both implementation and replication classes are shown in Table 4 and Table 5.

Table 4. Wilcoxon test for psychomotor skills aspects in implementation class

Ranks

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	29[b]	15.00	435.00
	Ties	0[c]		
	Total	29		

a. posttest < pretest
b. posttest > pretest
c. posttest = pretest

Test Statistics[b]

	posttest - pretest
Z	-4.714[a]
Asymp. Sig. (2-tailed)	.000

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

Table 5. The results of paired t-test psychomotor skills on aspects in replication class

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-1.40933	.19654	.03588	-1.48272	-1.33594	-39.276	29	.000

Table 4 shows examination of the Z test. The test gives value of -4.714 with significance level 0.00 <0.05. It clearly indicates that there is impact on the KKNI-based learning to the LO indicators for the psychomotor skills for the implementation class. Similarly, Table 5 shows that the t test gives value of -39.276 with significance level 0.00 <0.05. It can be concluded that there is significant impact of the KKNI-based learning to the LO indicators for psychomotor skills aspect on the replication class.

Consistency of the impact KKNI-based learning to the LO indicators for both knowledge and psychomotor skills aspects was analyzed using the independent t-test to the implementation and replication classes. The results after the fulfillment 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 independent t-test on knowledge to the implementation and replication class

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.043	3	.014	1.688	.195
Within Groups	.211	25	.008		
Total	.254	28			

Table 7. The result of independent t-test results for psychomotor skills aspects implementation and replication class

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.012	3	.004	.833	.488
Within Groups	.120	25	.005		
Total	.132	28			

It is clear from Table 6 that the F test provides value of 1.688 with significance level 0.195 > 0.05. Hence, there is a strong indication that the impact of the KKNI-based learning to the LO indicators for the knowledge aspect is consistent with 5% significance level. Table 7 shows the F count is 0,833 with significance level 0.488> 0.05. Therefore, it can be concluded that there is consistency in terms of psychomotor skills aspects at the 5 % significance level.

Discussion

1. Improving LO knowledge aspect of KKNI

In accordance with the LO indicators of the KKNI on the sixth level qualification on the education fields, the LO indicators that should be achieved by the undergraduate program of the Teacher Candidates are including: (1) mastering theoretical concept, (2) formulating procedural problem solving, (3) formulating non-procedural problem solving, (4) decision making, and (5) responsibility on his own work (Presidential Decree No. 8 of 2012).

Based on the Figure 1 and Table 1, it can be concluded that before the KKNI-base learning process was done on the first semester, the students showed to have only low competence in terms of KKNI indicators. The average student competence 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 both implementation and replication class. Both of the achievement fell on the grade E (0 ≤ E <40), where grade E is the lowest and grade A is the highest. This might be because the students were not accustomed with the thinking activity that is ordained by the KKNI sixth level of qualification.

Results of the research was supported by low score data of national average test results on teacher competence (Celik, 2011) as well as preliminary study of the limited test that showed to have low score in terms of knowledge and psychomotor skills (Jatmiko & Martini, 2014). This means that the results of the TIMSS study between 1999 and 2011, which says that Indonesian childrens aged at junior high school were only able to identify a number of basic facts. They had not been able to communicate; and the results of PISA between 2003 to 2012 which said that Indonesian students have scientific knowledge is still limited and can be applied to multiple situations familiar, and present scientific explanations clearly without giving evidence due to science teachers junior high school in Indonesia which has competence low in scientific literacy, making it less able to understand scientific literacy to learners supported by empirical data (Jatmiko & Martini, 2014).

After the learning process of General Physics that based on KKNI is done, the undergraduate teacher candidate students are able to obtain mean score on the implementation classes as 66.72 and on the replication class as 64.42. 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 implementation class, and there is an increase in the mean score as much as 44.27 or 219.70 % in the replication class. The increase of the KKNI competency scores on these two classes is significant and consistent with the real level of 5 %, with <g> respectively to 0.52 and an implementation to replication class by 0.56; both are in the middle category. These results indicate that there is an impact learning based on KKNI against LO significantly, the magnitude of the degree of the impact of learning on the LO for both classes even though the figures were slightly different, but both are consistently significant at 5 % significance level, and both still are in the category the same, namely the meddle category.

Increasing competence according to the indicators of the KKNI is probably because the students of the Undergraduate Teacher Candidate in this study were trained and directed to achieve LO 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 has been constructed based on the KKNI 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 the results that have been achieved, it proofs that the learning syntax that was formulated according to the LO (Jatmiko Wahono & Martini, 2015) is supported by empirical data. The results can be summarized as follows: (1) problem based learning (PBL) that emphasizes problem-solving activities to acquire knowledge can improve the skills of critical thinking and problem solving skills (Zabit, 2010); (2) PBL format can be beneficial for students to improve: independent learning, critical thinking, problem solving, and communication skills (Senel, Ulucan, & Adilogullari, 2015). Additionally, 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; (3) 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; (4) students who have utilized 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; (5) the PBL models have proven to be beneficial for improving students' conceptual learning, knowledge, skills and values of science (Etherington, 2011); (6) 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 thouroughly as well as conceptual understanding by improving critical thinking skills (Çorlu & Çorlu, 2012).

2. Improving LO psychomotor skills aspect

In Figure 2, prior to the learning process that based on the KKNI, students of the Teacher Candidate in their first semester has average student competence, i.e., a score of 53.78 in the range 0-100 for the implementation class and 54.19 for the replication class. Both of the mean score are almost at the C grade ($55 \leq E < 60$) from range values E (the lowest) to A (the highest). This means that students almost have psychomotor skills to use or operate the measuring tools, including: length, time, mass, temperature, and tickertimer. This might be because students are accustomed to to do measurements using the gauge during their senior high school. The reason is supported by opinion of the Chinese philosopher named Confucius that in this modern times are vcategorized into five principles of active learning, which says “when I hear, see, discuss and do, I got the knowledge and skills” (McLeod, Barr, & Welch, 2015). After the learning process of the KKNI-based General Physics, the students for the implementation class achieve average score of 89.03, and students for replication class get 89.40 score. Both of the mean scores are similar although it is slightly different, namely A ($85 \leq A \leq 100$). This means that there is an increase in the average score of 35.25, or 65.54 % on the implementation class, and there was an increase in mean score of 35.21, or 64.98 % in the replication class. The increment of the KKNI competency scores for these two classes are significant and consistent at real level of 5 %, the <g> of the implementation class is 0.76 and 0.77 for the replication class. Both are at the high category. These results indicate that there is an impact of the KKNI-based learning to the LO indicators significantly, the degree of the impact in <g> are not significantly different (consistent) at the 5% significance level. Both are in the same category: at high category.

An increase in the psychomotor skills might be because the students have been trained and directed to achieve competence psychomotor skills, i.e., accustome to use or operate the measuring tools, including: length, time, mass, temperature, and tickertimer. Indicators of the psychomotor skills that have been realized in the learning tools has been implemented. The results are supported by: (1) PBL for the psychomotor development, where students are able to design related tools that improve their skills (Tanel & Erol, 2008); and (2) 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 LO in terms of knowledge and psychomotor skills aspects in this study is also consistent with studies that show: (1) improvement of the LO in terms of the knowledge and the psychomotor skills aspects is guaranteed when learning process utilizes the national qualifications framework concept (Krstović & Cepic, 2010); (2) improvement of the LO 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 and discussion above, conclusions can be formulated as follows:

Firstly, there is a significant impact of KKNI-based learning to the LO in terms of knowledge aspects as well as on the aspects of psychomotor skills for the students of Undergraduate study of the Teacher Candidate for Junior High School science courses in General Physics.

Secondly, the average of the impact on the improvement of the KKNI-based learning to the LO indicators for both the implementation and replication class in the knowledge aspect is categorized as modeate, and on the psychomotor skills on aspects is categorized as high.

Thirdly, the average of the impact on the improvement of the KKNI-based learning to the LO indicators for both the implementation and replication class in the knowledge and psychomotor skills aspect is consistent.

Limitations of Study

Given this research may be the initial on the impact of the learning based on KKNI for improving student's LO based on KKNI indicators aspects of knowledge and on psychomotor skills, in order to obtain consistent results then submitted suggestions as follows. First, it should be done similar research, but more emphasis on the impact of learning KKNI based on LO knowledge aspects for each indicator level of the 6th KKNI. Secondly, there should be a similar study with more number of subjects, on different topics, and use the replication classes more.

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IMPACT OF THE KKNI-BASED LEARNING ON GENERAL PHYSICS STUDY?? FOR IMPROVING STUDENT'S LEARNING OUTCOMES

What does it mean study?

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Abstract. This study aims to analyze the impact of the Indonesian National Qualification Framework (KKNI – Kerangka Kualifikasi Nasional Indonesia) to increased Learning Outcomes (LO) based on KKNI indicators in terms of knowledge and psychomotor skills aspects (case study: Indonesian students in the Universitas Negeri Surabaya (Unesa) as Physics Teacher Candidates for Junior High School Students). The study was conducted using the one group method comprises of pretest and posttest in two parallel classes, called implementation and replication class that are consisted of 29 and 30 students, respectively. The pretest and posttest:data were analyzed using the paired t-test, n-gain (<g>), and equality test of two averages as well as non-parametric analysis. The results show that: there is an impact of the KKNI-based learning on general physics to increase the LO (p <0.5) in terms of knowledge and psychomotor skills aspects for both the implementation and the replication class. The increment of LO (<g>) on the implementation class and replication class are 0.52 and 0.56. They are both categorized as moderate for knowledge aspect. On the other hand, it achieves 0.76 and 0.77 that are categorized as high category psychomotor skills aspects. The impact of the LO increment for both classes in the knowledge and psychomotor skills aspects can be conlcluded that there is no different (as p <0.5). In other words, it give consistent results for both classes.

Abstract should not exceed 200 words

Key words: learning, general physics, based on KKNI, increased LO, KKNI indicator.

Please consistently use these terms. If you select 'research' or "study", you should exploit only one of them rather than interplayed usage. It is preferable to use the term "research"

Introduction

In this 21st century, student achievement is directed at learning and innovation skills. Among others, namely: problem solving skills, critical, and creative thinking (Partnership for 21st Century Skills, 2009; Griffin & Care, 2015). It would be much better, if the researcher started with his own comment, then support his view with citations and/or other adaptations

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

Before 2005, national qualifications frameworks (NQF) had been set up in three European countries: ireland, France and the UK. In 2015, the framework had been or is being developed in all 38 countries cooperating on the European qualifications framework. NQF is having an impact on education, training, and policies on working practices (James & Dorn, 2015; Chakroun, 2010; Gosling, 2011).

Recently, Indonesia established a NQF that is called Kerangka Kualifikasi National Indonesia (KKNI) that was issued through the Presidential Decree No. 8 of 2012. The KKNI aims to provide recognition of competence of work in accordance with the structure of employment in various sectors. The KKNI is a level of qualification framework that aligns competence, equalizes, and integrates the fields of education and vocational training, as well as work experience. Meanwhile, qualification is defined as mastery of LO according to its level in the KKNI.

According to the KKNI, there are nine qualifiers from the lowest l (level 1) to the highest (level 9). Levels 1-3 are all grouped into office operators; level 4-6 are grouped into office technicians or analysts; and level 7 to level 9 are grouped into professional careers. The KKNI categorized undergraduate degree program in the field of education into the sixth level with LOs defined as follows: (1) able to apply their expertise and take advantage of Arts and Sciences (science and technology) in solving problem; (2) mastering (Jatmiko, Widodo, Martini, & Budiyanto, 2014) theoretical concepts in depth knowledge in their field and able to formulate a procedural problem solving; (3) able to take the right decisions based on analysis of information and data, and is able to provide guidance in selecting various alternative solutions independently and groups; and (4) responsible for their own work and accountable for achievement of organization work.

In line with the KKNI, Minister of Education and Cultural Affairs issued Regulation of the Minister of Education and Culture No. 49 of 2014 on Higher National Education Standards (Permendikbud). This regulation required a learning process in the College lead to the achievement of LO indicators of the KKNI. Through this Permendikbud, it is clear that the regulation gives no other choice for universities in Indonesia, including at the Universitas Negeri Surabaya (Unesa) for not implementing learning process that lead to achievement of LO indicators according to the KKNI.

The results of studies related to the NQF in the field of education in several countries show that: (1) in Europe, NQF associated with increased learning outcomes from input to output, hence the qualification becomes more transparent (Ure, 2015); (2) in Chile, NQF links to the formulation of principles and criteria for education instrument implementation for the qualification framework (Solís, Castillo, & Undurraga, 2013); and (3) in Portugal, NQF serves as an assessment tool which allows diagnosing and controlling the development of learning achievement (Stasiûnaitienë & Teresevièienë, 2006). In addition, the results showed that the NQF provided significant impact on the learning outcomes (Chakroun, 2010)

Meanwhile, studies related to the KKNI on education in Unesa Indonesia has been commenced since 2013. The study mainly focused in developing prototype of the KKNI-based curriculum to enhance professional and pedagogical competence of science teachers. The work had published a book entitled of "Book of prototyping KKNI-based curriculum at Science Teacher Candidate Study Program (Bachelor Degree) Edition 1" in 2014 (Buku Prototipe Kurikulum Program S1 Pendidikan Sains Berorientasi KKNI Edisi 1. ISBN 978-602-1377-11-6. 2014). Subsequently, a limited test (including 15 students) was done for the KKNI-based courses like General Physics Studies for Science Teacher Candidate Study Program. The results had been reported in the article in a national seminar in Surabaya-Indonesia (Jatmiko, Widodo, Martini, & Budiyanto. 2015). "Pembelajaran Fisika Umum Berorientasi KKNI untuk Meningkatkan Hasil Belajar Pengetahuan dan Hasil Belajar Keterampilan Psikomotor". Prosiding Seminar Nasional, ISBN 978-602-0951-06-5/ISBN 978-602-0951-07-2, hal. 148 - 157). Based on the results of the study described above, in 2015 had been published a "Book of Prototyping KKNI-based Curriculum for the Science Teacher Candidates Study Program 2nd Edition". The second edition book equipped with learning syntax and examples of the learning tools for General Physics Study based on the KKNI (Jatmiko, Wahono, & Martini, 2015). To enhance the results of the limited trial, an examination with greater number of subjects and more perfect general physics learning tools had been done at the end of 2015. The learning syntax that was used had been formulated by (Jatmiko, Wahono, & Martini, 2015) including: (1) motivation, (2) information presentation and experimental groups/discussion sharing, (3) problem identification and problem solving, (4) establishment and enrichment, and (5) evaluation and utilization science and technology. The results of these trials is subsequently reported in this article.

In this paper do not write about the paper , a study has been carried out to analyze the impact of general physics KKNI-based learning process? Or course? in terms of knowledge and

psychomotor skills aspects for Science Teacher Candidates for Junior High School Study Program (Bachelor Degree is it a university?) intake year of 2015, Unesa. To be more specific, this paper will analyze: (1) is there any impact on the KKNI-based learning to the LO indicators?, (2) How far the impact of the KKNI-based learning against the LO indicators?, and (3) How good is consistency of the KKNI-based learning on the LO indicators? Unacceptable….the paper itself is not able to analyze. This is the role of researcher. Next, do not use future tense.
Your abstract should use present tense when referring to results and conclusions and past tense when referring to methods and measurements taken. Do not use future tense.

What is the problem? Are there any existing solutions? What is its main limitation? And what do you hope to achieve?

Research Methodology

General Background of Research

This work is classified as a quasi experimental research using replication. The purpose of this study is to analyze the impact of the KKNI-based learning towards LO in terms of knowledge and psychomotor skills aspects on general physics studies of undergraduate students on Physics Teacher Candidates for Junior High School in Unesa. The main purpose of this study is to analyze: repetition (1) the impact of the KKNI-based learning towards LO, (2) the degree of the impact of the learning process, and (3) how good is the consistency. Of what?

The research aim and some specific research questions should be presented before the methodology.
Introduction usually presents authors' short overview of the concrete problem what is supposed to be solved during reported original research. Let us hope that there will be much more concrete material in following text!

Sample of Research

In this work research , we used an impersonal style should be used number of samples ~~or research subjects~~ that consisted of 59 teacher candidates students pre-service teachers? in Science Education Study Program (i.e., two groups of people including one group that comprised of 29 students for implementation class and one group of 30 students for replication class????).
The research lacks rigour. The sample is poorly described; validity and reliability are completely absent.

Instrument and Procedures

This study was designed using the One Group Pretest - Posttest Design: O1 X O2 (Fraenkel & Wallen, 2009). In this design, students were given a pretest on the first stage, then teaching process of the general physics based on the KKNI was conducted utilizing learning tools such as: syllabus, lesson plan, a student textbook, and student activity sheet. Finally, students were asked to do posttest. The test instrument used in the study are consisted of: conceptual knowledge, procedural and non-procedural problem solving, and decision making. Conceptual knowledge includes: remember (C1), comprehension (C2), applications (C3), analysis (C4), evaluation (C5), and creation

(C6) (Krathwohl & Anderson, 2001; Bush, Daddysman, & Charnigo, 2014). Procedural problem solving may include: (1) observation, (2) ask questions, (3) make a hypothesis, (4) test the hypothesis, (5) to analyze the data and conclusions, and (6) to replicate the study through obtained correspondence between empirical and theoretical (Bradford, 2015). On the other hand, the non procedural problem solving includes: (1) arguing that is defined as capability of reasoning in accordance with his/her experience and knowledge, (2) strategic indication that is capability of selecting appropriate problem-solving strategies based on analysis, and (3) 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). The decision has four indicators that are: (1) determining the objectives, (2) identifying options, (3) analyzing the information, and (4) making a choice (Campbell, Lofstrom, & Brian, 1997).

Data Analysis

In order to analyze the impacts of the KKNI-based learning against the LO indicators, the scores of pre-test and post test that had been collected were analyzed using the paired t-test or non-parametric analysis of Wilcoxon test. The test was depended on the fulfillment of prerequisite normality test both for pre-test and post-test scores. In contrast, we utilized n-gain analysis (<g>) to analyze the impact of the KKNI-based learning against the LO indicators (Hake, 1998). The analysis was performed using the IBM SPSS Statistics 19 software.

Furthermore, to analyze the consistency of the impact of the KKNI-based learning against the LO indicators, we employed the equality test of two averages for both classes i.e., the implementation and replication classes in terms of knowledge and psychomotor skills. The analyses were performed using the independent t-test or non-parametric analysis Wilcoxon test. The test was depended on the fulfillment of prerequisite normality test both for pre-test and post-test scores. We also utilized equality test of the of two variances.

Research Results

The results for the implementation and replication classes in terms of pre-test and post-test mean score for the LO indicators in terms of knowledge and psychomotor skills aspects are shown in Figure 1, Table 1, and Figure 2.

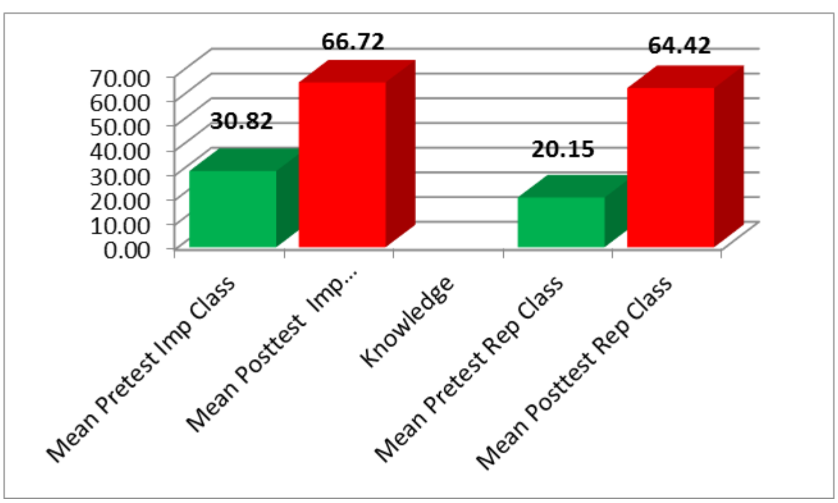

Figure 1. Average score of pre-test and post-test for implementation and replication classes, LO knowledge aspects. Unacceptable format

Table 1. Average Score of the Pretest, Posttest, and <g> for the implementation and replication classes for the LO indicators of the KKNI in terms of knowledge aspect (kognitif).

Num.	LO indicators for the KKNI (knowledge aspect)	IMPLEMENTATION CLASS			REPLICATION CLASS		
		Average score for Pretest	Average score for Posttest	Average score for <g>	Average score for Pretest	Average score for Posttes	Average score for <g>
1.	Mastering Theoretical 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

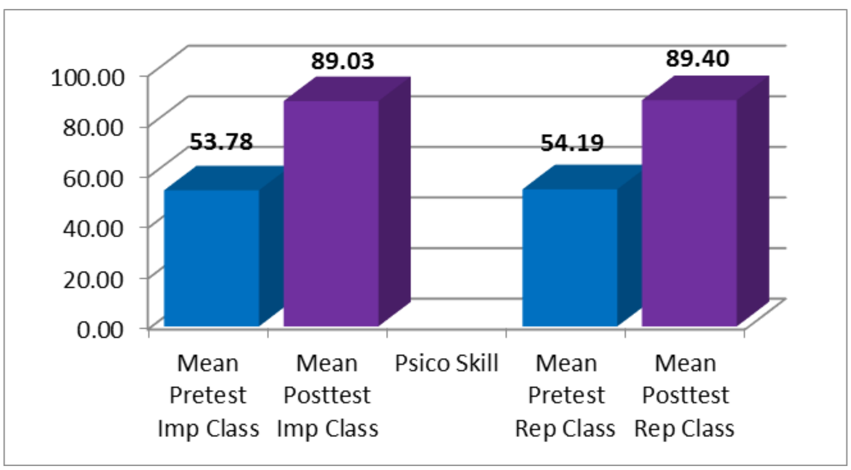

Figure 2. Average score of pre-test and post-test for implementation and replication classes, LO psychomotor skills aspects

Meanwhile, the average of <g> for the LO knowledge and psychomotor skills aspects for both of the implementation and replication classes are shown in Figure 3.

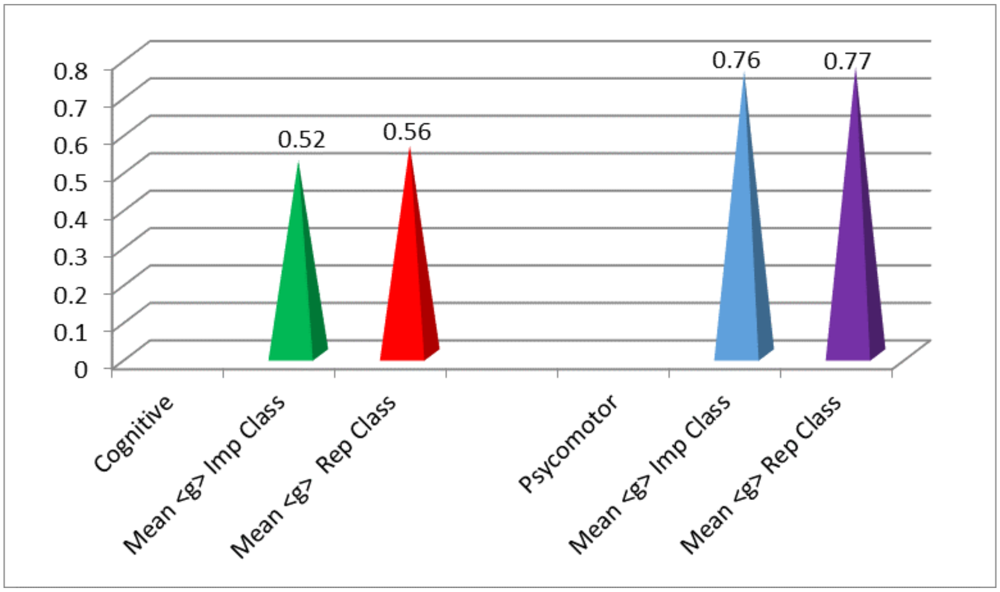

Figure 3. Average <g> LO knowledge and psychomotor skills aspects of the implementation and replication classes.

You should present the results in words with the help of tables, charts and graphs to make your research results clear and easy to understand. However, you should remember that you **write** a research paper; you do not **draw** a paper. The text is primary. The graphics support the text.

All diagrams must be in black and white, clear and grammatically correct

Figure 1 shows the increment mean score between pre-test and post-test in terms of knowledge for both implementation and replication clases over the LO indicators. The pre-test and post-test scores for the implementation class are 30.82 and 66.72, respectively; and 20.15 and 64.42, respectively for the replication class. It can also be seen in the same figure that there is an increase in terms of psychomotor skills. Average <g> in terms of knowledge for both implementation and replication classes shown in Figure 1 as well as Table 1 demonstrated that both of them can be categorized as moderate. Conversely, the average <g> of the psychomotor skills depicted in Figure 3 can be categorized as high.

It can be seen in Figure 2 that the average mean scores of the pre-test and post-test mean score for the implementation class of the psychomotor skills are 53.78 and 89.03, respectively; while for the replication for each class are: 54.19 and 89.40. Figure 3 demonstrates that the average <g> for the implementation and the replication clases in terms of knowledge are 0.52 and 0.56, respectively; and in terms of psychomotor skills shows average <g> as 0.76 and 0.77. Each of them can be considered as high scores.

For analyzing the impact of the LO in the KKNI-based learning in terms of knowledge aspects, we did a paired t-test. The summary of the paired t-test after the fulfillment of the normality assumptions for the pre-test and post-test are shown in Table 1 and Table 2.

Table 2. The results of knowledge paired t-test in implementation class directly transported from the staistical program

Paired Samples Test

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**			

				Lower	Upper			
Pair 1	pretest - posttest	-1.43793	.31329	.05818	-1.55710	-1.31876	-24.716	28	.000

Table 3. The results of knowledge paired t-test in replication class

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-1.77033	.35962	.06566	-1.90462	-1.63605	-26.963	29	.000

It can be seen in Table 2 that the t score gives -24.716 for degrees of freedom, df = 28. The score is considered significance as 0.00 <0.05. It can be consluded that for the implementation class there is a significant impact of the KKNI-based learning to the LO indicators in the knowledge aspects at 5 %. Similarly, Table 3 shows the t score is -26.963 for degrees of freedom, df = 29, gives significance score as 0.00 <0.05. Therefore, there is a significance impact of the KKNI-based learning in the knowledge aspects at 5 % level for the replication class. In order to analyze the improvement of the LO on the implementation class in terms of psychomotor skills aspects, we carried out an examination utilizing the Wilcoxon test. In contrast, we performed a paired t-test for the replication class. Summary of the Wilcoxon test and the paired t-test for the pre-test and post-test psychomotor skills aspects for both implementation and replication classes are shown in Table 4 and Table 5.

Table 4. Wilcoxon test for psychomotor skills aspects in implementation class

Ranks

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	29[b]	15.00	435.00
	Ties	0[c]		
	Total	29		

a. posttest < pretest
b. posttest > pretest
c. posttest = pretest

Test Statistics[b]

	posttest - pretest
Z	-4.714[a]
Asymp. Sig. (2-tailed)	.000

Ranks

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	29[b]	15.00	435.00
	Ties	0[c]		
	Total	29		

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

Table 5. The results of paired t-test psychomotor skills on aspects in replication class

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-1.40933	.19654	.03588	-1.48272	-1.33594	-39.276	29	.000

Table 4 shows examination of the Z test. The test gives value of -4.714 with significance level 0.00 <0.05. It clearly indicates that there is impact on the KKNI-based learning to the LO indicators for the psychomotor skills for the implementation class. Similarly, Table 5 shows that the t test gives value of -39.276 with significance level 0.00 <0.05. It can be concluded that there is significant impact of the KKNI-based learning to the LO indicators for psychomotor skills aspect on the replication class.

Consistency of the impact KKNI-based learning to the LO indicators for both knowledge and psychomotor skills aspects was analyzed using the independent t-test to the implementation and replication classes. The results after the fulfillment 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 independent t-test on knowledge to the implementation and replication class

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.043	3	.014	1.688	.195
Within Groups	.211	25	.008		
Total	.254	28			

Table 7. The result of independent t-test results for psychomotor skills aspects implementation and replication class

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.012	3	.004	.833	.488
Within Groups	.120	25	.005		
Total	.132	28			

It is clear from Table 6 that the F test provides value of 1.688 with significance level 0.195 > 0.05. Hence, there is a strong indication that the impact of the KKNI-based learning to the LO indicators for the knowledge aspect is consistent with 5% significance level. Table 7 shows the F count is 0,833 with significance level 0.488> 0.05. Therefore, it can be concluded that there is consistency in terms of psychomotor skills aspects at the 5 % significance level.

Discussion

1. Improving LO knowledge aspect of KKNI

In accordance with the LO indicators of the KKNI on the sixth level qualification on the education fields, the LO indicators that should be achieved by the undergraduate program of the Teacher Candidates are including: (1) mastering theoretical concept, (2) formulating procedural problem solving, (3) formulating non-procedural problem solving, (4) decision making, and (5) responsibility on his own work (Presidential Decree No. 8 of 2012).

Based on the Figure 1 and Table 1, it can be concluded that before the KKNI-base learning process was done on the first semester, the students showed to have only low competence in terms of KKNI indicators. The average student competence 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 both implementation and replication class. Both of the achievement fell on the grade E ($0 \leq E < 40$), where grade E is the lowest and grade A is the highest. This might be because the students were not accustomed with the thinking activity that is ordained by the KKNI sixth level of qualification.

Results of the research was supported by low score data of national average test results on teacher competence (Celik, 2011) as well as preliminary study of the limited test that showed to have low score in terms of knowledge and psychomotor skills (Jatmiko & Martini, 2014). This means that the results of the TIMSS study between 1999 and 2011, which says that Indonesian childrens aged at junior high school were only able to identify a number of basic facts. They had not been able to communicate; and the results of PISA between 2003 to 2012 which said that Indonesian students have scientific knowledge is still limited and can be applied to multiple situations familiar, and present scientific explanations clearly without giving evidence due to science teachers junior high school in Indonesia which has competence low in scientific literacy, making it less able to understand scientific literacy to learners supported by empirical data (Jatmiko & Martini, 2014).

After the learning process of General Physics that based on KKNI is done, the undergraduate teacher candidate students are able to obtain mean score on the implementation classes as 66.72 and on the replication class as 64.42. 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 implementation class, and there is an increase in the mean score as much as 44.27 or 219.70 % in the replication class. The increase of the KKNI competency scores on these two classes is significant and consistent with the real level of 5 %, with <g> respectively to 0.52 and an implementation to replication class by 0.56; both are in the middle category. These results indicate that there is an impact learning based on KKNI against LO significantly, the magnitude of the degree of the impact of learning on the LO for both classes even though the figures were slightly different, but both are consistently significant at 5 % significance level, and both still are in the category the same, namely the meddle category.

Increasing competence according to the indicators of the KKNI is probably because the students of the Undergraduate Teacher Candidate in this study were trained and directed to achieve LO 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 has been constructed based on the KKNI 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 the results that have been achieved, it proofs that the learning syntax that was formulated according to the LO (Jatmiko Wahono & Martini, 2015) is supported by empirical data. The results can be summarized as follows: (1) problem based learning (PBL) that emphasizes problem-solving activities to acquire knowledge can improve the skills of critical thinking and problem solving skills (Zabit, 2010); (2) PBL format can be beneficial for students to improve: independent learning, critical thinking, problem solving, and communication skills (Senel, Ulucan, & Adilogullari, 2015). Additionally, 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; (3) 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; (4) students who have utilized 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; (5) the PBL models have proven to be beneficial for improving students' conceptual learning, knowledge, skills and values of science (Etherington, 2011); (6) 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 thouroughly as well as conceptual understanding by improving critical thinking skills (Çorlu & Çorlu, 2012).

2. Improving LO psychomotor skills aspect

In Figure 2, prior to the learning process that based on the KKNI, students of the Teacher Candidate in their first semester has average student competence, i.e., a score of 53.78 in the range 0-100 for the implementation class and 54.19 for the replication class. Both of the mean score are almost at the C grade (55 ≤ E <60) from range values E (the lowest) to A (the highest). This means that students almost have psychomotor skills to use or operate the measuring tools, including: length, time, mass, temperature, and tickertimer. This might be because students are accustomed to to do measurements using the gauge during their senior high school. The reason is supported by opinion of the Chinese philosopher named Confucius that in this modern times are vcategorized into five principles of active learning, which says “when I hear, see, discuss and do, I got the knowledge and skills” (McLeod, Barr, & Welch, 2015). After the learning process of the KKNI-based General Physics, the students for the implementation class achieve average score of 89.03, and students for replication class get 89.40 score. Both of the mean scores are similar although it is slightly different, namely A ($85 \leq A \leq 100$). This means that there is an increase in the average score of 35.25, or 65.54 % on the implementation class, and there was an increase in mean score of 35.21, or 64.98 % in the replication class. The increment of the KKNI competency scores for these two classes are significant and consistent at real level of 5 %, the <g> of the implementation class is 0.76 and 0.77 for the replication class. Both are at the high category. These results indicate that there is an impact of the KKNI-based learning to the LO indicators significantly, the degree of the impact in <g> are not significantly different (consistent) at the 5% significance level. Both are in the same category: at high category.

An increase in the psychomotor skills might be because the students have been trained and directed to achieve competence psychomotor skills, i.e., accustome to use or operate the measuring tools, including: length, time, mass, temperature, and tickertimer. Indicators of the psychomotor skills that have been realized in the learning tools has been implemented. The results are supported by: (1) PBL for the psychomotor development, where students are able to design related tools that improve their skills (Tanel & Erol, 2008); and (2) 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 LO in terms of knowledge and psychomotor skills aspects in this study is also consistent with studies that show: (1) improvement of the LO in terms of the knowledge and the psychomotor skills aspects is guaranteed when learning process utilizes the national qualifications framework concept (Krstović & Cepic, 2010); (2) improvement of the LO 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 and discussion above, conclusions can be formulated as follows:

Firstly, there is a significant impact what does it mean significant? of KKNI-based learning to the LO in terms of knowledge aspects as well as on the aspects of psychomotor skills for the students of Undergraduate study of the Teacher Candidate for Junior High School science courses in General Physics.

Secondly, the average of the impact on the improvement of the KKNI-based learning to the LO indicators for both the implementation and replication class in the knowledge aspect is categorized as modeate, and on the psychomotor skills on aspects is categorized as high.

Thirdly, the average of the impact on the improvement of the KKNI-based learning to the LO indicators for both the implementation and replication class in the knowledge and psychomotor skills aspect is consistent.

Conclusions should be reworked. They are not in line with a research

Bring out the significance of your research. Show how you’ve brought closure to the research problem, and point out remaining gaps in knowledge by suggesting issues for further research

Limitations of Study

Given this research may be the initial on the impact of the learning based on KKNI for improving student's LO based on KKNI indicators aspects of knowledge and on psychomotor skills, in order to obtain consistent results then submitted suggestions as follows. First, it should be done similar research, but more emphasis on the impact of learning KKNI based on LO knowledge aspects for each indicator level of the 6th KKNI. Secondly, there should be a similar study with more number of subjects, on different topics, and use the replication classes more.

Acknowledgements

Our gratitude to the Government of the Republic of Indonesia through the Ministry of Research and Technology of Higher Education, especially DP2M on funding this research. Acknowledgements is also submitted to the Universitas Negeri Surabaya that had provided research opportunities.

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unfortunately there is nothing from physics in the article. Physics is mentioned only as a study subject for future teachers. One can take everything instead of physics.

The manuscript is in **dire need** of proofreading to improve its English

1.	Is the article original, and does it contribute something new to the field? (Importance of article / Relevance and Appeal to national / international scholarly community)	**Excellent**	**Good**	**Moderate**	**Poor**
2.	Statement of problem (s) / aim (s) / objective (s)	**Excellent**	**Good**	**Moderate**	**Poor**

3.	Theoretical basis / Theoretical framework / Literature review / Clarification of concepts	**Excellent**	**Good**	**Moderate**	**Poor**
4.	Appropriateness of the research plan and design (if applicable) /Appropriateness of data-collection and procedure /Data analysis /Trustworthiness/ reliability and validity	**Excellent**	**Good**	**Moderate**	**Poor**
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6.	Data presentation / Discussion (Are the results clearly and correctly presented? Are they consistent with the methodology?)	**Excellent**	**Good**	**Moderate**	**Poor**
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10.	Is the language fluent and precise?	**Excellent**	**Good**	**Moderate**	**Poor**
11.	Is article significantly international in nature to be of value to global audience? /underline/ (Of Local Interest Only) (Of Regional Interest) (Of International Interest)	**Excellent**	**Good**	**Moderate**	**Poor**
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EFFECTIVENESS OF THE KKNI-BASED LEARNING ON A GENERAL PHYSICS FOR IMPROVING STUDENT'S LEARNING OUTCOMES

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Abstract. This research aims to analyze effectiveness of the Indonesian National Qualification Framework (KKNI)-based learning on general physics to increase student's Learning Outcomes (LO) according to the KKNI indicators that cover the cognitive what do you mean ?? and psychomotor skills aspects what do you mean ??. This research was conducted using two groups of students that consisted of 29 and 30 people. A pleminary test (pretest) and a posttest were applied to the groups that assumed to have the same level of knowledge. The data were analyzed using the paired t-test, n-gain, and analysis of variance (ANOVA). The results show that the KKNI-based learning applied to the general physics is consistently effective in increasing the student's LOs according to the KKNI indicators. Moreover, examination using the n-gain, it is shown that the increment score between the pretest and the posttest can be categorized as moderate for cognitive aspect and categorized as high for the psychomotor skills.

Key words: KKNI-based learning, general physics, student's learning outcomes, cognitive aspects, psychomotor skill.

Introduction

In this 21st century, accreditate international literature claim?? that one of student achievement is directed to problem solving skill. According to their authors (please list them) student achievement is mainly aimed to accomplish learning and innovation skills in the 21st century. The learning and innovation skills that are required are including problem solving skills, critical, and creative thinking (Griffin & Care, 2015; Partnership for 21st Century Skills, 2009). This is a repetition…please specify what kind of problem posing and solving you are going to adopt….

Furthermore, it is also mentioned in the same paper you can re-cite the author… and now pages that in order to achieve the 21st century skills, a certain qualification requirement is compulsory (Griffin & Care, 2015, pp??). 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 (LO) to given standards (Allais, 2014; James & Dorn, 2015). National qualifications system are related to the national recognition of learning and other mechanisms that links education and training to the labor 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).

Recently, Indonesia established a similar framework which is called Indonesian National Qualification Framework (INQF; In Indonesian it becomes *Kerangka Kualifikasi National Indonesia* (KKNI)). It was issued through the Presidential Decree No. 8 of 2012. The KKNI aims to provide recognition of competence of work in accordance with the structure of employment in various sectors. The KKNI 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 LO conferring to certain level in the KKNI structure.

According to the KKNI, there are nine qualification 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 KKNI structure categorizes undergraduate degree program in the field of education into the sixth level. The LOs of the sixth level are defined as follows: (i) able to apply their expertise and utilize Arts and Sciences (science and technology) in solving problems; (ii) mastering (Jatmiko, Widodo, Martini, & Budiyanto, 2014) theoretical 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.

In line with the KKNI structur, 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 lead to the achievement of LO indicators of the KKNI. 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 lead to achievement of LOs indicators according to the KKNI, including our university, the State University of Surabaya (Universitas Negeri Surabaya/Unesa).

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 (Stasiunaitiene & Teresevieiene, 2006). In general, it showed that the NQF provided significant impact on the improvement of the learning outcomes scores (Chakroun, 2010)

Series of researches related to the KKNI 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 KKNI-based curriculum to enhance professional and pedagogical competence of science education teachers. The work had succesfully published a book entitled of "Book in prototyping KKNI-based science education curriculum 1st Edition" in 2014 (Jatmiko, Widodo, Martini, & Budiyanto, 2014). Subsequently, a limited test (including 15 students) was done for the KKNI-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 KKNI-based Curriculum for the science education curriculum 2nd Edition". The second edition book equipped with learning syntax and examples of the learning tools for the general physics research that based on the KKNI (Jatmiko, Wahono, & Martini, 2015).

In this work, our research aims to analyze effectiveness of the learning process against the student's LOs that have been defined according to the sixth level of the KKNI. However, compared to the previous work, this research involves a greater number of research subjects. Hence, by enhancing the number of research subjects, we expect to acquire a more consistent learning tools.

You might move this part in the end of the next paragraphs

Problem of Research

The problem in this research can be formulated as to how effective the KKNI-based learning on the general physics can improve student's LOs? *A priori* You used within title and previous running text "effective, effectiveness etc. but you should well-define what you mean with term "effective": calculated? Measured? Esteemed?

This section should be reworked

Research Focus

Main focuses of the research include: (i) is there any increment participating? Official subscription? Increment of knowledge? The LO is not clear to me on student's LOs of the general physics before and after given by the KKNI-based learning?, (ii) how much do increases of the student's LOs?, and (iii) is there any consistence increment of the student's LOs between group-1 and group-2?

This section should be reworked

Research Methodology

General Background of Research

The research emphasis on analyzing effectiveness of the KKNI-based learning by analyzing the impact of the KKNI-based learning on general physics to student's LOs in terms of cognitive and psychomotor skills aspects. The normalized gain scores (n-gain) was employed before and after the KKNI-based learning. In this research, effectiveness of the LOs is reffered to the existence of significant what do you mean significant? Statistically? increment scores between the preliminary test (pretest) and the posttest. When it measured by the n-gain, it can be categorized as moderate for both cognitive and psychomotor skills aspects.

Research 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. We called impersonal style only them Group 1 and Group 2. Those groups are consisted of 29 and 30 students, respectively. We assumed that the two groups hold the same cognitive and psychomotor skills in terms of the LOs.

Instrument and Procedures

This research can be classified as a quasi-experimental research. It was performed using the one group pretest and posttest design, i.e., O1 X O2 (Fraenkel & Wallen, 2009). The two groups of the students were offered exactly the same pretest before learning process was provided. The test instrument was consisted of: (i) mastering theoretical concepts, (ii) formulating procedural problem-solving, (iii) formulating non-procedural problem-solving, and (iv) decision making. The theoretical 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) analyzing 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) analyzing the information, and (iv) making a choice (Campbell, Lofstrom, & Brian, 1997).

After finalizing the pretest, learning process of general physics that based on the KKNI 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 work sheets. In the previous work, these learning tools had been evaluated in terms of the content and the construction validities, 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 are 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, Wahono, & Martini, 2015). Finally, after the learning process, the two groups were asked to work with a posttest. It should be reminded that we devised the same instrument for posttest as it was provided at the pretest.

What about measures in a physics laboratory?

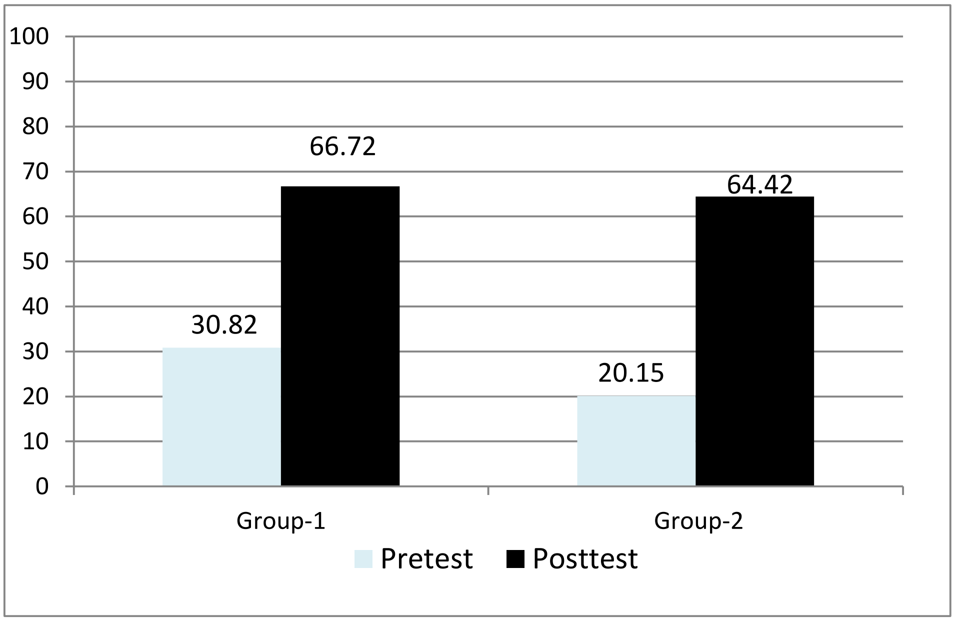
Data Analysis

In order to analyze the impacts of the KKNI-based learning against the student's LOs, the scores of the pretest and post-test that had been collected were analyzed using the paired t-test or non-parametric analysis of Wilcoxon test. The selection of the testing methods depended on the fulfillment of the normality assumption for both pretest and posttest 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 impact of the KKNI-based learning against the student's LOs (Hake, 1998). The analysis was performed using the IBM SPSS Statistics 19 software.

Furthermore, to analyze the consistency of the impact of the KKNI-based learning against the student's LOs, we employed the analysis of variance (ANOVA) for both groups, i.e. the group-1 and group-2, in terms of the cognitive and the psychomotor skills. The testing method depended on the fulfillment of the normality and equality of the two variances assumption for both group-1 and group-2 averages of the n-gain.

Research Results

The pretest and the posttest mean scores of the two groups are presented in Figure 1. The grey bar representing the pretest and the black bar signifying the posttest. The overall examination for the two groups in terms of cognitive and psychomotor skills aspects are shown in Figure 1 dan Figure 2, respectively, while the detail is shown in Table 1.



The terms pre-test and post-test are wrongly written

Figure 1: The mean scores of the students pretest and posttest in terms of cognitive aspects what do you mean ?? for both the group-1 and the group-2.

Figure one is to bulky…make it more compact

Table 1. The mean scores of the pretest, posttest, and the n-gain of the student's LOs in terms of cognitive aspects what do you mean ?? for the group-1 and the group-2.

` **Namb**	**Student's LOs of the KKNI indicators in terms of cognitive aspect**	**Group-1**			**Group-2**		
		Pretest	Posttest	n-gain	Pretest	Posttest	n-gain
1.	Mastering theoretical Consepts	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

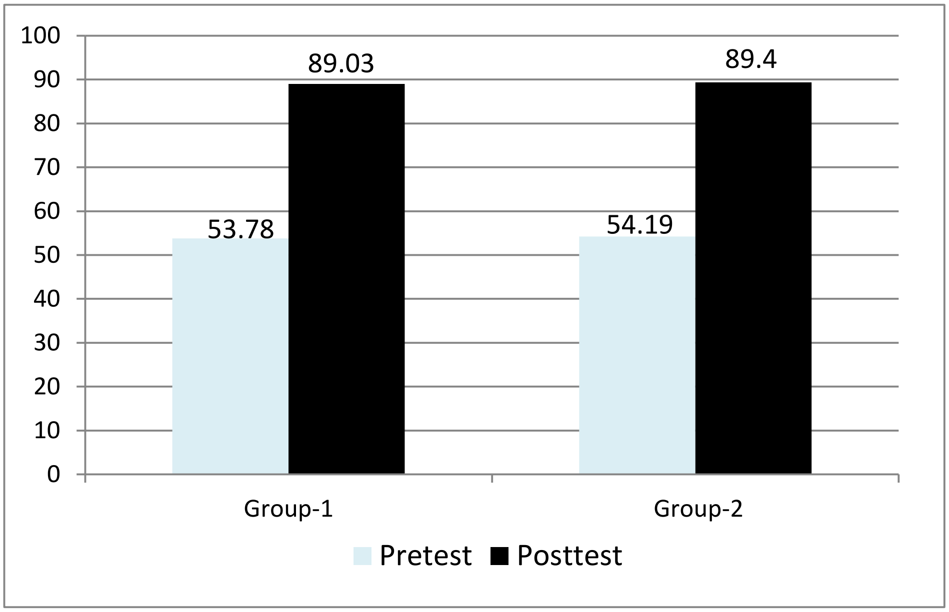


Figure 2. The mean scores of the students pretest and the posttest in terms of psychomotor aspects what do you mean ?? for both the group-1 and the group-2.

Figure 2 is to bulky…make it more compact

Mean scores of the n-gain for the student's LOs for both the cognitive and psychomotor skills aspects what do you mean ?? for the group-1 and the group-2 are shown in Figure 3.

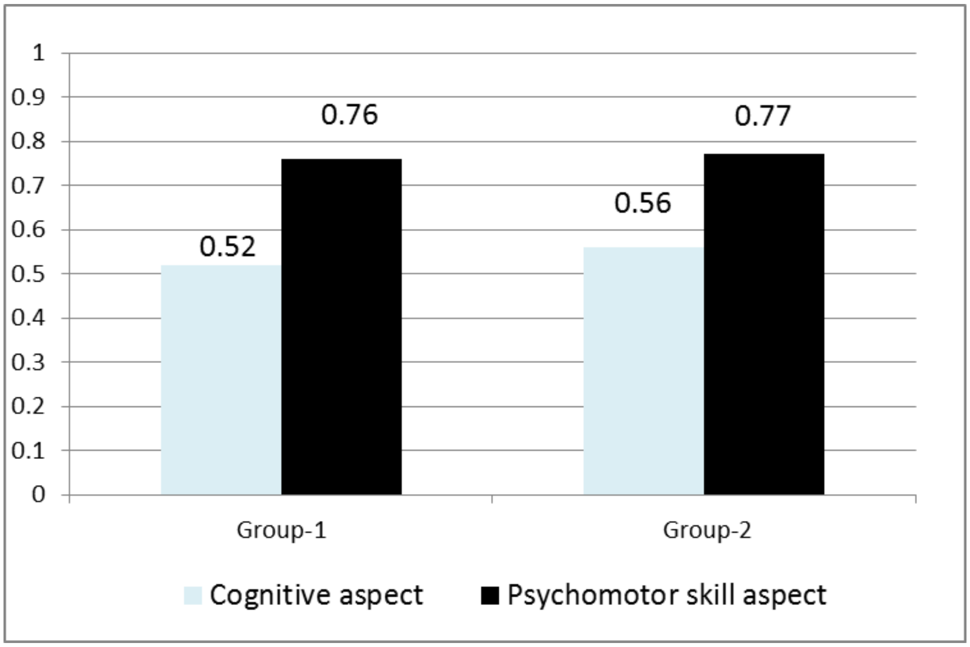


Figure 3. The mean scores of the n-gain for the student's LOs for both the cognitive and the psychomotor skill aspects for the group-1 and the group-2.

Figure 3 is to bulky…make it more compact

It is evident ?? in Figure 1 that the mean score between the pretest and the posttest in terms of the cognitive aspects for both group-1 and group-2 is increasing. The pretest and posttest scores for the group-1 are 30.82 and 66.72, respectively; while the pretest and the posttest score for the group-2 are 20.15 and 64.42, respectively. Similar conclusion can be seen in Figure 2 for the case of psychomotor skills. Average of the n-gain in terms of cognitive aspects for both the group-1 and the group-2 are depicted in Figure 1 and detailed in Table 1. Figure 1 and Table 1 demonstrate both of the groups can be categorized as moderate (Hake, 1999). Conversely, average of the n-gain in terms of the psychomotor skills depicted in Figure 3 and it can be categorized as high for both of the groups.

It clearly seen in Figure 2 that the pretest and posttest mean scores for the group-1 of the psychomotor skills achieves 53.78 and 89.03, respectively. For the group-2, the mean scores are 54.19 and 89.40. Figure 3 depicts the mean score of the n-gain for both the group-1 and the group-2 in terms of cognitive resulting 0.52 and 0.56, respectively. On the other hand, the mean score of the n-gain in terms of the psychomotor skills shows 0.76 and 0.77 for the group-1 and the group-2, respectively. The mean scores of both groups in terms of psychomotor skills can be categorized as high (Hake, 1999).

For analyzing the impact of the student's LOs in the KKNI-based learning in terms of cognitive aspects, we used a paired t-test statistical measurement. The summary of the paired t-test after the fulfillment of the normality assumptions for both pretest and posttest is shown in Table 1 and Table 2.

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

Table 2. The results of cognitive paired t-test in group-1

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pretest-Posttest	29	-1.438	-0.313	28	-24.716	0.000

*P < .05 (2-tailed)

Table 3. The results of cognitive paired t-test in group-2

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pretest-Posttest	30	-1.770	-0.360	29	-26.963	0.000

*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=0.00 < 0.05. Therefore, it can be concluded there is a significant impact of the KKNI-based learning for the group-1 in the cognitive aspects 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=0.00 < 0.05. Hence, there is a significance impact of the KKNI-based learning in the cognitive aspects at significance level of 5% level for the group-2. The significance is only statistically but it is not clear the related magnitude or variable whom you refers.

In order to analyze the improvement of the student's LOs for the group-1 in terms of psychomotor skills aspects, 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 pretest and posttest in terms of the psychomotor skills aspects for both group-1 and group-2 are shown in Table 4 and Table 5.

Table 4. Wilcoxon test for psychomotor skills aspects in group-1

Paired Samples Test

	N	Z	p
Pretest-Posttest	29	-4.714	0.000

*P <0.05 (2-tailed)

Table 5. The results of paired t-test psychomotor skills on aspects in group-2

Paired Samples Test

		N	Mean	S	df	t	p
Pair 1	Pretest-Posttest	30	-1.409	-0.196	29	-39.276	0.000

*P <0.05 (2-tailed)

Significance level cannot be referred to as 0.000, but always "1" needs to be involved (e.g., p < 0.0001).

Table 4 shows the Wilcoxon test for psychomotor skills aspects. Examination of on the third column reveals that the Z test gives value of -4.714 with significance level p=0.00 <0.05. It clearly indicates that there is impact on the KKNI-based learning to the student's LOs for the psychomotor skills for the group-1. Similarly, Table 5 shows that the t test gives value of -39.276 with significance level p=0.00 <0.05. Based on the table, it can be admitted that there is significant impact of the KKNI-based learning to the student's LOs for the psychomotor skills aspect on the group-2.

Furthermore, consistency of the impact KKNI-based learning to the student's LOs for both cognitive and psychomotor skills aspects is analyzed using the independent t-test to the group-1 and group-2. The results after the fulfillment 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 independent t-test on knowledge 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 result of independent t-test results for psychomotor skills aspects 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 clear 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 KKNI-based learning to the student's LO on KKNI indicators for the cognitive aspect is consistent with 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 consistency in terms of psychomotor skills aspects at the 5 % significance level.

The whole section should be reworked

Discussion

1. Student's LOs improvement in term cognitive aspects

Based on the Figure 1 and Table 1, it can be observed that before the learning process was done, sure? What do you mean? the students showed to have low competence. ?? The mean scores of the student's competence 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 achievement 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 student's competence for each KKNI indicators were below the standard score 40. This might be because the students were not familiar with the thinking activities that are designed by the KKNI sixth level of qualification.

Lacks of competence without physical measure conceptualization??

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 cognitive and psychomotor skills aspects (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 school 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 empirical data (Jatmiko & Martini, 2014).

In contrast, after the learning process of General Physics that based on KKNI was done, the result shows that the undergraduate students are able to obtain 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 KKNI competency scores on these two groups is significant and consistent 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 existence of significant impact of learning process that based on the KKNI. The degree of impact, represented by the mean scores of the n-gain, for the learning process for both groups are consistently significant at significance level of 5%, even though they are slightly different. Both of the n-gain can be categorized as moderate.

Increasing competence according to the indicators of the KKNI is probably because the students in this research were trained and directed to achieve LO 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 has been constructed based on the KKNI 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 has been formulated in Jatmiko (Jatmiko, Wahono & Martini, 2015) is 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).

This section should be reworked

2. Student's LOs improvement in term psychomotor skill aspect

According to Figure 2, 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 score are almost at the C grade ($55 \leq E < 60$) from range values E (the lowest) to A (the highest). This student's LOs in terms of psychomotor skills aspects show less moderate skills in order to use or operate the measuring tools, 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. Finally you cite the measure!! But your define them at beginning…. But I do not understand why to be able to do a measure in physics should be related to psychomotor skill aspect…. 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 got the knowledge and skills" (McLeod, Barr, & Welch, 2015). After the learning process of the KKNI-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 ($85 \leq A \leq 100$). 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 KKNI competency scores for these two groups are significant and consistent 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 KKNI-based learning to the LO indicators significantly, the degree of the impact in n-gain are not significantly different (consistent) at the 5% significance level. Both are in the same category: at high category.

An increase in the psychomotor skills might be because the students have been trained and directed to achieve competence on psychomotor skills, i.e., familiarity to use or operate the measuring tools, including: length, time, mass, temperature, and ticker timer. The indicators of the psychomotor skills that have 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 LOs in terms of the cognitive and psychomotor skills aspects in this research is consistent with results in the previous work, which involve fewer number of research subjects (15 students) (Jatmiko, Widodo, Martini, & Budiyanto, 2015), as well as consistent with studies as follows: (1) improvement of the LO in terms of the cognitive and the psychomotor skills aspects is guaranteed when learning process utilizes the national qualifications framework concept (Krstovic & Cepic, 2010); (2) improvement of the LO can create significant contribution to transparency and international recognition of qualifications, especially through the strengthening of the concept and practice (Keevy, 2013).

This section should be reworked

What about to build (educationally) the capacity of abstraction in physics and its mathematical description…. (What do you call cognitive aspects) and modelling after measure… (what you call psychomotor…). I mean teachers should build this educational aspects of learning-teaching process… non evaluate them a priori…?

Conclusions

Based on the research results and discussion above, the KKNI-based learning on the general physics can be considered effective to increase student's LOs according to the KKNI indicators in terms the cognitive and psychomotor skills. The effectiveness of improving student's LOs are based on as follows: (i) there is increment on the student's LOs for both the cognitive and the psychomotor skill aspects, (ii) the increase student's n-gain scores can be categorized as moderate for the cognitive aspect and can be categorized as high for the psychomotor skills aspect and (iii) the increment of student's LOs for both group-1 and group-2 are consistent (no different).

This section should be reworked

Effectiveness is the level of results from the actions

Effectiveness is about doing the right task, completing activities and achieving goals….

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It is not clear the relation learning-teaching and the role played by effective term

Accept without revision	
Accept with minor revisions	
Accept: with moderate revisions	
Accept: major revisions and re-evaluation	X
Reject: Rework and re-submit	
Reject: do NOT re-submit	

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

Revised_2check

Abstract. This research aims to analyze 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 equipments. 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 analyzed 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 equipments.

Key words: INQF-based learning, General Physics, student's learning outcomes.

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 continously for both the prosedural and non-procedural problem solving. Moreover, problem solving in General Physics requires skills of using the physics laboratory equipments.

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).

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 certain level in the INQF structure.

According to the INQF, there are nine qualification 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 lead 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 lead 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 (Stasiunaitiene & Teresevieiene, 2006). In general, it showed that the NQF provided significant impact on the improvement of the learning outcomes 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 concepts 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) analyzing 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) analyzing the information, and (iv) making a choice (Campbell, Lofstrom, & Brian, 1997).

Problem of Research

The problem in this research can be formulated as to how effective the INQF-based learning on the General Physics can improve student's LOs according to the sixth level of INQF indicators? It can not be in a question format The INQF-based learning is said to be effective when the learning proccess 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 equipments 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 criterias: (1) if n-gain ≥ 0.7 (high), (2) if $0.3 <$ n-gain < 0.7 (moderate), dan (3) if n-gain ≤ 0.3 (low).

In this work??, our research impersonal style should be used aims to analyze 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 equipments. Compared to the previous work (Jatmiko, Widodo, Martini, & Budiyanto, 2015), this research involves a greater number of research subjects.?? What is it?

Research Focus

The main focuses of the research including: unclear (i) is there any significant increment (statistically) of the sixth level student's LOs and student's skills in using the physics laboratory equipments before and after employing the INQF-based learning?, (ii) how much do the increases of the sixth level student's LOs and the student's skills in using the physics laboratory equipments? and (iii) is there any increment difference of the sixth level student's LOs and the skills in using the physics laboratory equipments between group-1 and group-2?

Methodology of Research

General Background of Research

The research emphasis on analyzing effectiveness of the INQF-based learning by analyzing 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 equipments with n-gain was employed before and after the INQF-based learning. In this research, effectiveness of the sixth level student's LOs and the student's skills in using the physics laboratory equipments is referred to the existence of significant (statistically) increment scores between the preliminary test (pre-test) and the post-test. When it 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 equipments.

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, called them group-1 and group-2. Those groups are consisted of 29 and 30 students, respectively. We assumed that the two groups hold the same the sixth level of student's LOs and student's skills in using the physics laboratory equipments.

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 was consisted of sixth level INQF indicators and the student's skills in using the physics laboratory equipments. 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 work sheets. In the previous work, these learning tools had been evaluated in terms of the content and the construction validities, 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 are 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 equipments was determined by performance test in terms of skills in measuring length, time, mass, temperature and ticker timer.

Data Analysis

In order to analyze 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 analyzed 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 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 analyze 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 equipments, 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 variances assumption for both group-1 and group-2 averages 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 black 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 equipments is shown in Figure 1.

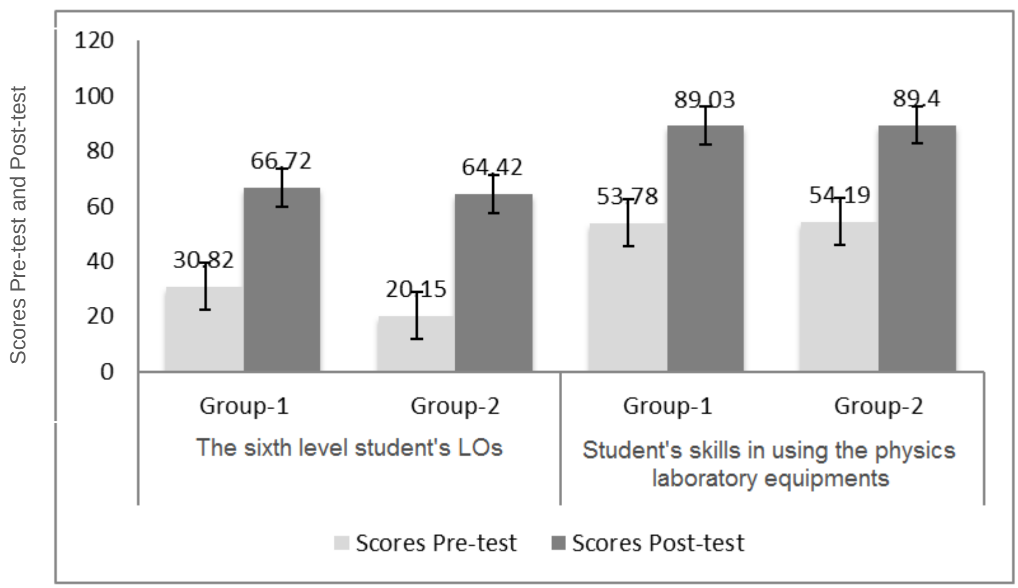

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Figure 1: The mean scores of the students pre-test and post-test in terms of the sixth level student's LOs and the studengt's skills in using the physics laboratory equipments for both the group-1 and the group-2.

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 consepts	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 equipments for the group-1 and the group-2 are shown in Figure 2.

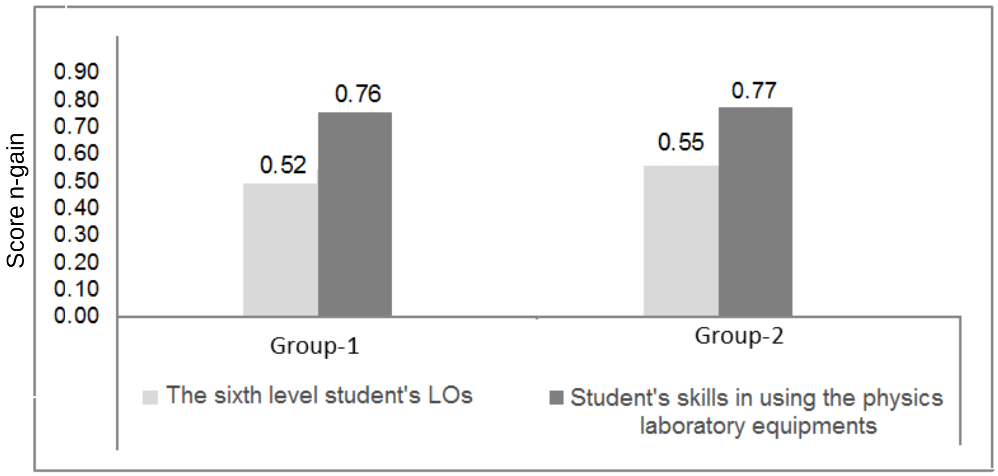

Figure 2. The mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipments for the group-1 and the group-2.
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Figure 1 shows that the mean score between the pre-test and the post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipments for both group-1 and group-2 is increasing. Average of the pre-test and the post-test scores for the group-1 are 30.82 and 66.72, respectively; while average of the pre-test and the post-test scores for the group-2 are 20.15 and 64.42, respectively. 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 the group-1 and the group-2 are depicted in Figure 1 and detailed in Table 1. Figure 2 depicts the mean score of the n-gain for both the group-1 and the 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 (Hake, 1999). No any mix

It 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 equipments 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 demonstrate the mean score of the n-gain in terms of the student's skills in using the physics laboratory equipments 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 equipments can be categorized as high (Hake, 1999).

For analyzing 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 used terms of inquiring and discussion not defined before. Thus the result of this section is confused almost not clear.

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	0.42E-13

*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	0.13E-15

*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=0.42E-13 < 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=0.13E-15 < 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 analyze the improvement of the sixth level student's LOs for the group-1 in terms of student's skills in using the physics laboratory equipments, 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 equipments 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 equipments in group-1

Paired Samples Test

	N	Z	p
Pre-test - Post-test	29	-4.714	0.24E-5

*p <0.05 (2-tailed)

Table 5. The results of paired t-test the skills in using the physics laboratory equipments on 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	0.14E-14

*p <0.05 (2-tailed)

Table 4 shows the Wilcoxon test for the student's skills in using the physics laboratory equipments. Examination of on the third column reveals that the Z test gives value of -4.714 with significance level p=0.24E-5<0.05. It clearly indicates that there is impact on the INQF-based learning to the student's skills in using the physics laboratory equipments 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 significant impact of the INQF-based learning to the student's skills in using the physics laboratory equipments 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 equipments is analyzed 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 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 result of ANOVA results for the skills in using the physics laboratory equipments 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 clear 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 are 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 different in terms of the student's skills in using the physics laboratory equipments at the 5% significance level.

Discussion

1. 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 achievement fell on the grade E ($0 \leq E < 40$). 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 indicators 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.

Results of the research were supported by low scores 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 school 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 empirical 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 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- ($65 \leq E < 70$). 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 different 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 existence of significant impact of 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 are 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 has 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 has been formulated in Jatmiko (Jatmiko, Widodo, & Martini, 2015) is 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).

2. Student’s skills in using the physics laboratory equipments 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 score are almost at the C grade ($55 \leq E < 60$) from range values E (the lowest) to A (the highest). This 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 got 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 ($85 \leq A \leq 100$). 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 equipments scores for these two groups are significant and there is no different 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 equipments significantly (statistically), the degree of the impact in n-gain there is no different 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 equipments might be because the students have been trained and directed to achieve on the skills in using the physics laboratory equipments 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 use the physics laboratory equipment that have 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 equipments in this research is not different with results in the previous work, which involve fewer number of research subjects (15 students) (Jatmiko, Widodo, Martini, & Budiyanto, 2015), as well as there is no different with studies as follows: (1) improvement of the sixth level student's LOs and the student's skills in using the physics laboratory equipments is guaranteed when learning process utilizes the national qualifications 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 equipments. The effectiveness of improving the sixth level student's LOs and the student's skills in using the physics laboratory equipments 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 equipments 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 equipments, and (iii) the increment of the sixth level student's LOs and the student's skills in using the physics laboratory equipments for both group-1 and group-2 are not different.

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Some corrections are needed

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*.

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).

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 (Stasiunaitiene & Teresevicienе, 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, 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.

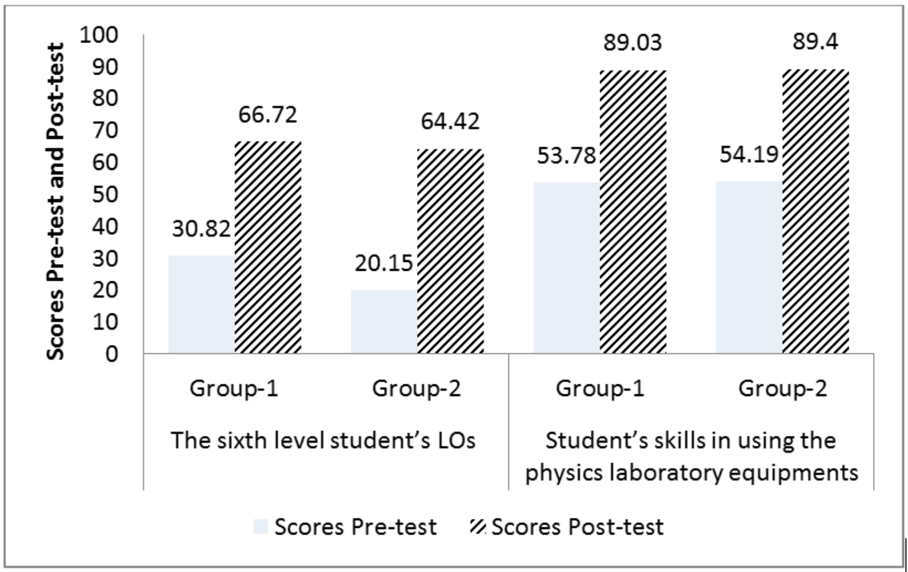

Figure 1: The mean scores of the student's pre-test and post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both the group-1 and the group-2.

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.

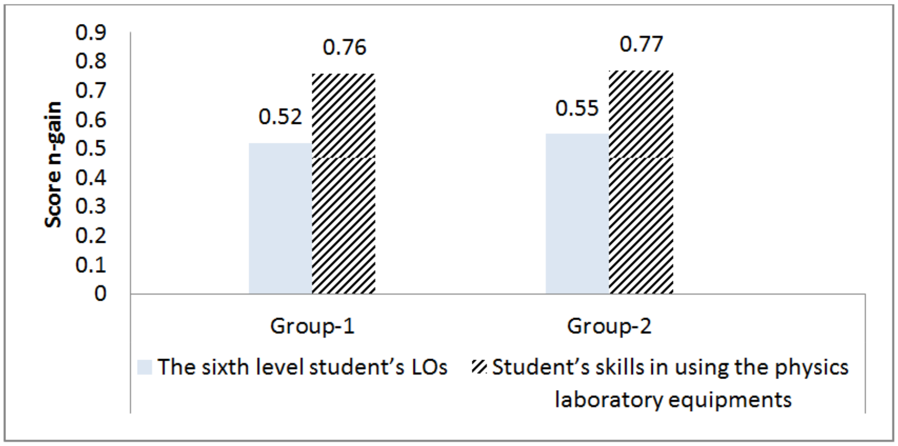

Figure 2. The mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment for the group-1 and the group-2.

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.

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 ($0 \leq E < 40$). 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 empirical 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- ($65 \leq E < 70$). 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 ($55 \leq E < 60$) 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 ($85 \leq A \leq 100$). 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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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*.

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).

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 (Stasiûnaitienë & Teresevièienë, 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, 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.

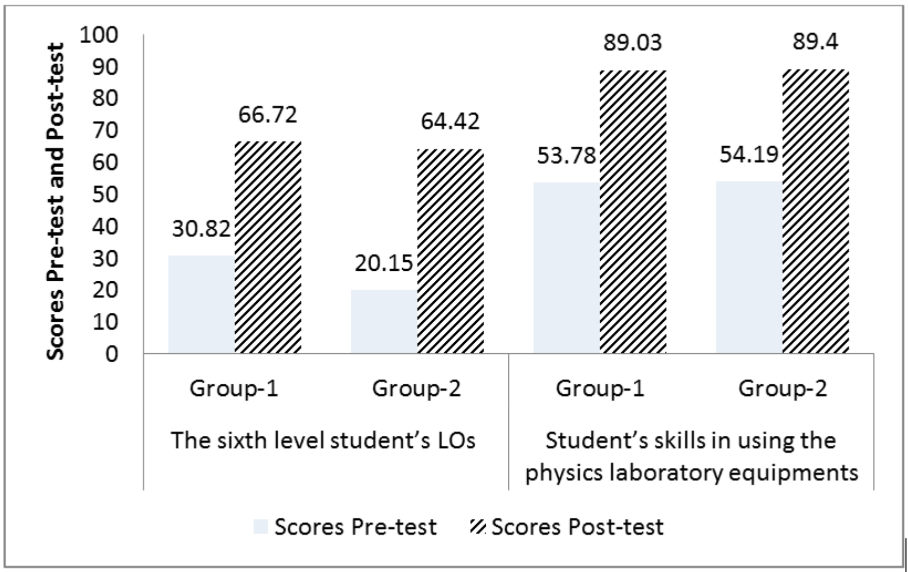

Figure 1: The mean scores of the student's pre-test and post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both the group-1 and the group-2.

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.

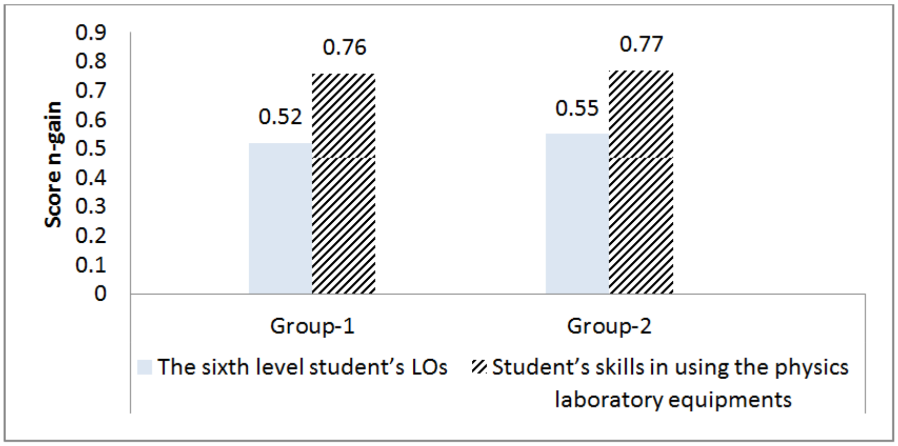

Figure 2. The mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment for the group-1 and the group-2.

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.

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 ($0 \leq E < 40$). 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 empirical 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- ($65 \leq E < 70$). 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 ($55 \leq E < 60$) 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 ($85 \leq A \leq 100$). 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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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.

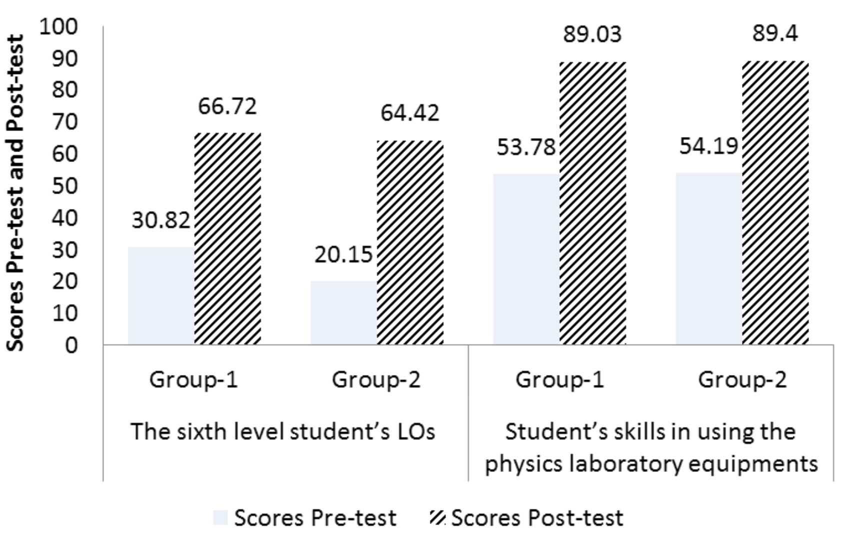

Figure 1: The mean scores of the student's pre-test and post-test in terms of the sixth level student's LOs and the student's skills in using the physics laboratory equipment for both the group-1 and the group-2.

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.

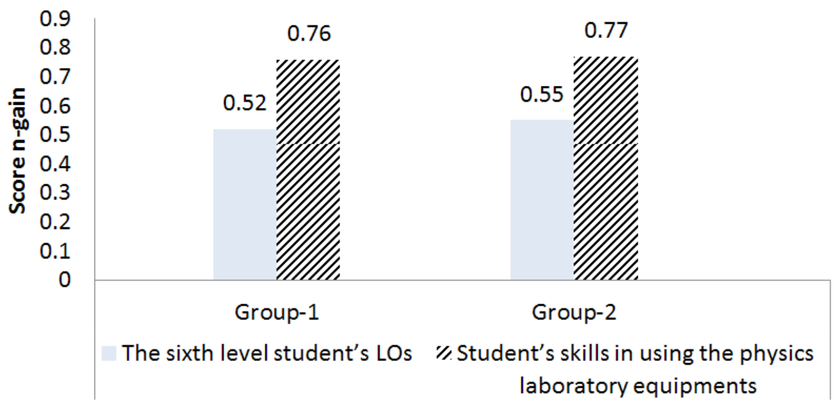

Figure 2. The mean scores of the n-gain for both the sixth level student's LOs and the student's skills in using the physics laboratory equipment for the group-1 and the group-2.

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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Dear Editor,

Thank you, yes I agree with your correction, we hereby send the final manuscript we already fix in accordance with your advice.

I hope this manuscript in accordance with the policy JBSE.

Sincerely,

Author (Budi Jatmiko)

Area lampiran

23 Jul 2016 01.23

Journal of Baltic Science Education <mail.jbse@gmail.com>

ke saya

Dear author,

Thanks for the info. Your payment is received. You will be informed accordingly.

Sincerely,

Editor

2016-07-22 16:04 GMT+03:00 Budi Jatmiko <bjbjatmiko2@gmail.com>:

Dear Editor JBSE

I am the author of a manuscript entitled "EFFECTIVENESS OF THE INQF-BASED LEARNING ON A GENERAL PHYSICS FOR IMPROVING STUDENT'S LEARNING OUTCOMES", our manuscript will be published in JBSE vol 15, 2016. On July 19, 2016. To fulfill the requirements JBSE, I have been sent money to "Vincentas Lamanauskas" via Western

Union amounted to 435 UER or IRD 6,957,992 with details as follows: 390 UER for the cost of publication and 45 UER for an additional 3 exp journal vol 15, 2016 (including postage for 3 exp). Does the money has been received?

Sincerely yours,

Author - Budi Jatmiko

2016-07-19 15:31 GMT+07:00 Budi Jatmiko <bjbjatmiko2@gmail.com>:

Dear Editor JBSE

Policies JBSE for the author of the article that will be published in the journal JBSE, have been fulfilled and the form the declaration has been completed and signed, along with proof of payment for 435 UER or IRD 6,957,992 with details as follows: 390 UER for the cost of publication and 45 UER for an additional 3 exp journal vol 15, 2016.

Thank you for your attention.

sincerely yours,

Budi Jatmiko (author)

2016-07-18 21:16 GMT+07:00 Journal of Baltic Science Education <mail.jbse@gmail.com>:

Dear author,

1. We want to inform you that your paper is preliminary accepted for publication in JBSE (Vol. 15, 2016).

2. According to JBSE requirements:

The author (authors) should confirm in writing (file in PDF or JPG format including author`s signature), that the manuscript has not been published in another journal or handed over (transferred) to another journal for publication.

A template is attached. Please fill in, sign it and scan in PDF or JPG format and return back.

3. According to JBSE policy authors:

are required to pay the partial paper processing charges of **390** EUR in order to publish a paper in the journal (**excluding bank taxes/charges; it is a responsibility of payer. These charges are different from country to country and from bank to bank. Please ask at the bank how much the charge amount is in your case BEFORE to do the transfer**).

The corresponding author will receive one hard copy of the journal via post.
P.S. If you want to get extra copy (-ies), please add **10** EUR for each copy to the indicated sum above + 5 EUR shipping expenses for each additional copy.

Options for Payment:

1 option – via bank transfer:

Payee (or beneficiary): Scientia Socialis, UAB
Identification number: **302614473**,
VAT: LT100006097614
Institution address: Donelaicio Street 29, Siauliai, Lithuania
Beneficiary Bank name: „SWEDBANK" AB
Beneficiary Bank address: Konstitucijos Street 20A, Vilnius, Lithuania.
SWIFT/BIC: HABALT22;
IBAN: **LT077300010126557188**

Correspondent bank (in some cases if needed):
DEUTSCHE BANK AG, Frankfurt
SWIFT: DEUTDEFF
BLZ 500 700 10

2 option – via PayPal system.

To: scientia@scientiasocialis.lt

https://www.paypal.com/lt/

5 EUR should be added to the total amount as a transfer fee (it is valid only in the case of PayPal).

3 option – via Western Union system.

To Vincentas Lamanauskas, Siauliai, Lithuania

*****

We kindly ask you to make a transfer not later than **28 July** 2016.

Sincerely yours,

Editorial Board

2016-07-18 16:11 GMT+03:00 Budi Jatmiko <bjbjatmiko2@gmail.com>:
Dear editor,

We send to you our manuscript third revision, hopefully this paper can read soon.

sincerely yours

Budi Jatmiko
Author

2016-07-18 1:54 GMT+07:00 Journal of Baltic Science Education <mail.jbse@gmail.com>:
Dear author (s),

We send to you your manuscript with some remarks after the second review process. Please make all corrections asap, but not later than **27 July 2016**. If you want to reject this paper please inform us asap. Your explanation / rebuttal letter should be added (Each comment from the referee, the author (s) should explicitly state whether they made a requested change or, if not, they must explain their reasons in detail).
Sincerely yours

Editor of JBSE

2016-07-17 13:08 GMT+03:00 Journal of Baltic Science Education <mail.jbse@gmail.com>:
Dear author (s),

Your paper is received. Thank you very much that you are interested in publishing of your paper in the JBSE Journal. You will be informed accordingly.

Sincerely yours,

Editor

2016-07-15 12:01 GMT+03:00 Budi Jatmiko <bjbjatmiko2@gmail.com>:
Dear Editor,

We send our manuscript (second review) after we make corrections, hopefully the manuscript can be revised soon.

Sincerely yours
Budi Jatmiko (Author)

2016-07-05 20:17 GMT+07:00 Journal of Baltic Science Education <mail.jbse@gmail.com>:
Dear author (s),

We send to you your manuscript with some remarks after the review process. Please make all corrections asap, but not later than **18 July 2016**. If you want to reject this paper please inform us asap. Your explanation / rebuttal letter should be added (Each comment from the referee, the author (s) should explicitly state whether they made a requested change or, if not, they must explain their reasons in detail).
Sincerely yours

Editor of JBSE

2016-07-03 11:06 GMT+03:00 bjbjatmiko2 <bjbjatmiko2@gmail.com>:
Thank you for your attention.

Dikirim dari Ponsel Huawei saya

Journal of Baltic Science Education <mail.jbse@gmail.com> menulis:

Dear author (s),

Your paper is received. You will be informed accordingly.

Sincerely yours,

Editor

2016-06-28 11:19 GMT+03:00 Budi Jatmiko <bjbjatmiko2@gmail.com>:
I have improved the article according to reviewer's suggestion. I hope the article can be published right away.
Thank you for your kindness.

sincerely yours

budi jatmiko

2016-05-11 19:58 GMT+07:00 Journal of Baltic Science Education <mail.jbse@gmail.com>:
Dear author (s),

We want to inform you that after a review process, your paper was rejected at this stage due to serious shortcomings. However, there is a possibility to rework and resubmit it. The author (-s) is-are friendly advised.

Editor of JBSE

2016-04-06 3:31 GMT+03:00 bjbjatmiko2 <bjbjatmiko2@gmail.com>:
Dear Editor
Thank you for your email, hopefully our article can be evaluated soon.

Sicerely yours

Budi jatmiko

Dikirim dari Ponsel Huawei saya

Journal of Baltic Science Education <mail.jbse@gmail.com> menulis:

Dear author (s),

Your paper is received. Thank you very much that you are interested in publishing of your paper in the JBSE Journal. You will be informed accordingly.

Sincerely yours,

Editor

2016-04-04 14:45 GMT+03:00 V. Lamanauskas <v.lamanauskas@ef.su.lt>:

-------- Persiųstas laiškas --------
Tema: Submission
Data: Tue, 29 Mar 2016 10:41:39 +0700
Kas: Budi Jatmiko <bjbjatmiko2@gmail.com>
Kam: v.lamanauskas@ef.su.lt, snaglis@ktl.mii.lt, janis.gedrovics@apollo.lv, toots@tdl.ee, aarne.toldsepp@mail.ee

Dear Chief in editor and co-editors of JBSE,

I attached our article file that tittle"Impact of the KKNI-Based Learning on General Physics Study for Improving Student's Learning Outcomes" to submit on JBSE. Hopefully the article can be evaluated for publishing on JBSE. Thank a lot for your attention.

Besh wishes,

Prof. Dr. Budi Jatmiko, M.Pd.

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Scientific Methodical Center "Scientia Educologica", the Associated Member of Lithuanian Scientific Society, European Society for the History of Science (ESHS) and ICASE
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