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" The Global challenges on the development and the education of mathematics and science "

3rd ICRIEMS

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The Global Challenges on The Development and
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Faculty of Mathematics and Science
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- Mathematics & Mathematics Education
- Physics & Physics Education
- Chemistry & Chemistry Education
- Biology & Biology Education
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Preface

Bless upon God Almighty such that this proceeding on 3rd International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) may be compiled according to the schedule provided by the organizing committee. All of the articles in this proceeding are obtained by selection process by the reviewer team and have already been presented in the Conference on 16 – 17 May 2016 in the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. This proceeding comprises 9 fields, that is mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 3rd ICRIEMS is '*The Global Challenges on The Development and The Education of Mathematics and Science*'. The main articles in this conference are given by six keynote speakers, which are Prof. Allen Price, Ph.D (Emmanuel College Boston USA), Ana R. Otero, Ph.D (Emmanuel College Boston USA), Dr. Michiel Doorman (Utrecht University, Netherlands), Prof. Dr. Marsigit, M.A (Yogyakarta State University), Asst. Prof. Dr. Warakorn Limbut (Prince of Songkla University, Thailand), and Prof. Dr. Rosly Jaafar (Universiti Pendidikan Sutan Idris, Malaysia). Besides the keynote and invited speakers, there are also parallel articles that presented the latest research results in the field of mathematics and sciences, and the education. These parallel session speakers come from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of Mathematics and Sciences and the Education such that they are accessible by many people and useful for the Nation Building.

Yogyakarta, May 2016

The Editor Team

Forewords From The Head Of Committee

Assalamu'alaikum warahmatullahi wabarakatuh

May peace and God's blessings be upon us all

First of all, allow me to thanks to God, Allah SWT, who has been giving us blessing and mercies so we can join this conference. Ladies and Gentlemen, it is my great honor to welcome you to Indonesia, a unique country which has more than 17,000 islands, more than 1,300 ethnic groups, and more than 700 local languages, and I am also very happy to welcome you to Yogyakarta, the city of education, culture, tourism, and a miniature of Indonesia. We wish you be happy and comfortable in attending the conference in this city.

The third International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS 3rd) 2016 is organized by the Faculty of Mathematics and Science, State University of Yogyakarta. In this year, theme of the conference is : The Global Challenges on The Development and The Education of Mathematics and Science. This conference are dedicated to the 52nd anniversary of Yogyakarta State University and to face challenges of Asean Economic Community in 2016.

This conference facilitates academics, researchers and educators to publish and disseminate their research in the fields of pure, application and education of Science and Mathematics. Furthermore, the purposes of the conference are to establish interaction, communication, and cooperation among academics, researchers and educators at an international level.

On behalf of the committee of this conference, I would like to express our highest appreciation and gratitude to the keynote speakers, including:

1. Allen Price, Ph.D. (Associate Professor of Emmanuel College, Boston USA)
2. Ana R. Otero, Ph.D. (Emmanuel College, Boston USA)
3. Dr. L.M. (Michiel) Doorman (Associate Professor of Utrecht University, Netherland)
4. Prof. Dr. Marsigit, MA. (FMIPA, Universitas Negeri Yogyakarta)
5. Asst. Prof. Dr. Warakorn Limbut (Faculty of Science, Prince of Songkla University, Thailand)
6. Prof. Dr. Rosly Jaafar (Faculty of Physics, Universiti Pendidikan Sultan Idris, Malaysia)

Furthermore, we inform you that the papers presented in this conference are about 200 papers from 302 applicants, who come from various countries and various provinces throughout Indonesia. Therefore, I would like to give my appreciation and many thanks to the presenters and participants who have been actively involved in this seminar.

Finally, I would like to thank the committee members who have been working very hard since half a year ago to ensure the success of the conference. However, if you find any shortcomings and inconveniences in this conference, please forgive us. We would very

happy to receive your suggestions for improvement in the next conference. Thank you very much.

Wassalamu'alaikum warohmatullahi wabarakatuh.

Yogyakarta, May 2016

Dr. Warsono, M.Si.

Forewords From The Dean Of Faculty Of Mathematics And Sciences, Yogyakarta State University

Assalamu'alaikum warahmatullahi wabarakatuh. My greetings for all of you. May peace and God's blessings be upon us all.

On behalf of the Organizing Committee, first of all allow me to extend my warmest greeting and welcome to the International Conference on Research, Implementation, and Education of Mathematics and Sciences, the third to be held by the Faculty of Mathematics and Science, State University of Yogyakarta, one of the excellent and qualified education universities in Indonesia. This conference is also celebrate the 52th Anniversary of State University of Yogyakarta.

This conference proudly presents keynote speeches by six excellent academics, these are: Allen Price, Ph.D., Ana R. Otero, Ph.D., Dr. Michiel Doorman, Prof. Dr. Marsigit, MA., Asst. Prof. Dr. Warakorn Limbut, and Prof. Dr. Rosly Jaafar, and around 200 regular speakers.

The advancement of a nation will be achieved if education becomes a priority and firmly supported by the development of technology. Furthermore, the development of technology could be obtained if it is supported by the improvement of basic knowledge such as mathematics, physics, chemistry, and biology. The empowerment of this fundamental knowledge may be achieved by conducting research which is then implemented in developing the technology and the learning process in schools and universities.

This international conference is aimed to gather researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Moreover, through this conference it is expected that we keep updated with new knowledge upon recent innovative issues and findings on the development and the education of mathematics and science, which is in accord with the theme of the conference this year. All material of the conference which are compiled in the abstract book and proceedings can be useful for our reference in the near future.

This conference will be far from success and could not be accomplished without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members who have done an excellent job in organizing this conference. I would also like to thank each of the participants for attending our conference and bringing with you your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept our sincere apologies.

To conclude, let me wish you fruitful discussion and a very pleasant stay in Yogyakarta.

Wa'alaikumsalam warahmatullahi wabarakatuh

Yogyakarta, May 2016
Dean Faculty of Mathematics and Science
Yogyakarta State University

Dr. Hartono, M.Si.

PE – 03

Development Of Indonesian Qualification Framework (IQF) Level 6 Of Physics Education

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Abstract - This study aims to develop a draf of spesific descriptor IQF Level 6 of Physics Education at Indonesian College. This study is a research and development (R&D) that consists of three phases that include preliminary study, product design, and development. The first phase is preliminary study that consist of : (1) literature study and (2) field study that include need analysis and problem diagnosis. The second phase is product design of IQF Level 6 of Physics Education. The third phase is development that consist of : (1) creating and arranging a draf of spesific descriptor IQF Level 6 of Physics Education and (2) expert validation by colleges and schools. The results show that spesific descriptors IQF Level 6 of Physics Education based on learning outcomes consist of 45 items that contain competences that must be mastered by graduates from Physics Education S1 in Indonesian College. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply sciences or knowledge, and (4) managerial ability that in line with discipline of physics education.

Keywords *: IQF Level 6 and Physics Education*

I. INTRODUCTION

One of effects that is felt Indonesia today is the challenge of global competition of employees nationally and internationally. Movement of employees from and to Indonesian can not endured by the protective rules or regulations. Ratification has been done Indonesian to various regional and international conventions, obviously that has put Indonesian as a country that is more open and easily entered by many sectors including the employee sectors or human resources in general and not the exception in the educational world.

Further effects of globalization by the presence of employee competitions is the emergence of unemployment that is estimated due to low quality and competence of workers. According to data from the Central Statistics Corporation as of August 2011, the number of registered unemployed in Indonesian has reached 7.7 million people. The number of unemployed were estimated because of competence of graduates toward the quality of learning outcomes from educational institutions, such as universities with the demands of employment qualifications and competence.

As one of the institutions, all at once the answers to the problems of employee quality, the Ministry of National Education through the General Directorate of Higher Education, supported by the idea from the Directorate of the Trainer and Power of Coaching and Transmigration Ministry has resulted a framework called the Indonesian Qualifications Framework or IQF (General Directorate of Higher Education, 2010: 7). IQF positioned as an equalizer competence of learning outcomes acquired through formal, informal, and non formal education. Learning outcomes are obtained through internalization of knowledge, attitudes, skills, competencies, and the accumulation of work experience (General Directorate of Higher Education, 2010, p. 17). Parameters of the learning outcomes should be mastered by every graduate of an educational institution of the curriculum and learning applied. Learning curriculum arranged and applied by study program greatly affects the quality of the learning outcomes of study program.

M. Rosul Asmawi stated that the demands toward the quality of higher education needs to be improved in order to create a quality output and to ready to plunge into the employee market and to meet national standards (Asmawi, 2005, p.71). The results obtained from this study were the strategy of improving quality graduates in college. The another research related to the quality of graduates' competence is the research that has been done by Suparwoto in 2010 on the performance of a science teacher at elementary, junior high, and senior high school after certification which shows that the professionalism of teachers in the many schools are still very varied including physics teacher at school (Suparwoto et al., 2010, p. 93). In addition, evaluation of learning curriculum in many universities ideally

be the first step that was needed to be resolved, but so far that have not found many studies that revealed about learning curriculum in many universities. Furthermore, the Head of Education UNESCO Jakarta Anwar Al Said assessed curriculum in many universities contain plagiarized material and repeat and not relevant to the times and places, especially in Indonesia.

Afzaal Hussain revealed that the core of achievement of curriculum depends on the evaluation process during the development of the curriculum. This is happened because there is no evaluation of the curriculum implemented, then there is no feedback received to revise the curriculum (Afzaal et al., 2011, p. 263). Higher education curriculum development programs should be able to accommodate and serve all the existing value system to achieve the objectives that can be accepted by all parties in accordance with the role and function of each that should really get attention, because the authority and responsibilities of the different do not disrupt efforts to develop curriculum (Trisharsiwi, 2008, p. 380). Furthermore, Moses L. Singgih & Rahmayanti stated that the curriculum of study program is one of the factors that significantly affect the quality of graduate education (Moses L. Singgih & Rahmayanti, 2008, p. 133).

The quality and relevance of education in Indonesia needs to be improved to produce quality graduates. Sumantri said that the policy program to improve the quality and relevance of education includes four aspects are curriculum, staff, facilities and leadership education units (Tritjahjo & Setyorini, 2005, p. 57). Curriculum development should be sustainable and based on the Indonesian Qualifications Framework (IQF), if the curriculum is not suitable with the service users of the college as soon as the contents of the curriculum updated. This is similar to what was said Murray that "Curricullum is, after all, the very substance of the schooling and the raison d'etre for teachers in schools" (Ghufron, 2007, p. 107).

In addition, graduate successes is largely determined by the quality of teachers in the school. Average quality of teacher candidates in Indonseia still low and varied from one another. This is shown by the results of the exam from teacher candidates were done by the Directorate of Educational Personnel prior to the implementation of decentralization of education. The test results showed an average low value on the subjects of skills required to teach. Data center of educational assessment mentioned that the average score obtained by physics teachers is 13,24 from 40 questions that tested (Vincent, 2004, p. 3).

The quality of education in schools today is very varied both in primary education, secondary education, and higher education. This problem has always been associated with a teacher or lecturer as care taker for implementation in education. Act No. 14 of 2005 about Teachers and Lecturers has regulated the qualifications and competences of lecturers and teachers, but has not given a significant impact for improving the quality of education in Indonesia. Therefore, IQF was expected to answer one of these issues. Directur General of Higher Education has formulated a generic descriptor IQF Level 6 for many study programs, including Physics Education Study Program, but have not specific descriptors yet clearly based on the needs of many schools. Development of specific descriptors of IQF Level 6 of Physics Education is the responsibility of all sides, especially the colleges that have S1 Physics Education Study Program. IQF Level 6 of Physics Education is a new policy for the university in Indonesia for determining the minimum standard of competence to achieve the learning outcomes that are determined, so that the expected standard of graduates produced has the same capabilities of a variety of college graduates. Development of specific descriptors IQF Level 6 of Physics Education should involve universities and senior high school in Indonesia.

Based on the above description can be known that problems of the quality of employee, quality of physics teacher, the quality of education in schools, and there is not the specific descriptors IQF Level 6 of Physics Education. Thus need is to research and development of specific descriptors IQF Level 6 of Physics Education as one of the efforts is to improve the quality of education in Indonesia.

II. THEORETICAL BASIS

A. Physics and Physics Education

1. Physics

Physics is part of science so that studying physics is the same as studying science. Science as a basic foundation of human activities can be viewed from three different viewpoints. The third viewpoint includes : (1) science as a way of thinking; (2) science as a way of investigating; (3) science as a body of knowledge that was resulted by inquiry which consists of facts, concepts, principles, laws, theories, and models (Collette & Chiappetta, 1994, p. 30).

Another opinion about the definition of science expressed by Carin and Sund are stated as follows.

> ".... Science is human activity that has evolved as an intelectual tool to facilitate describing and Ordering the environment. Once one accepts the idea that science does not exist in any of the realm but the mind, it ceases to be a "thing," an entity with is own existence. Though scientific truth or fact is ideally objective, it is subject to human perception and iogic .... As a method, are

> relatively stable and science is Universally applied, while as a body of knowledge, it is constantly changing "(Carin and Sund, 1980 , p. 2).

Thus, it can be stated that the theory of physics always have empirical truth. The conclusion that can be understood from some opinions, physics by collecting data on observations and experiments to study natural phenomena uses scientific attitude or process and the scientific method.

2. Physics Education

Physics education is an interdisciplinary knowledge from science of physics with science of education. Physics education contained in the classification field in science of physics as physics teaching. Physics education can also be included in the classification field of science of education. Physics education is essentially an application of education theory in the context of physics education for instruction. Physics education as a science, as well as other sciences, has the object or subject of study (ontological aspect), a way of obtaining (epistemological aspect), and usefulness (axiological aspect). Physics education have study materials as following (Sukarjo, 2010, p. 9) :

a. Curriculum, which includes theory of physics curriculum development, physics curriculum organization, physics curriculum content, and models of physics curriculum development.
b. Learners and learning actions, which include the theory of the characteristics of learners, the types and how to learn physics, physics learning process hierarchy, and the conditions of learning physics.
c. Educators and teaching actions, which include theory of physics educator characteristics, characteristics of act educate or teach physics, models educate or teach physics, methods or techniques to educate or teach physics, and classroom management system.
d. Environment of Education, which includes theory of physics education regulation, planning and management of physics education, guidance and counseling or career guidance, and the means or media physics education.
e. Assessment, which includes theory of models of assessment of learning physics, techniques of physics assessment, and instruments of assessment physics.

An expert in physics education should be experts in physics and have a depth knowledge for five disciplines at the top, although one of them is usually dominant.

B. Indonesian Qualifications Framework

Sandra Bohlinger stated that this qualification framework is an engine of innovation as the following statement.

> "Countries that introduce a qualifications framework are thereby seeking to make-Reviews their national educational systems more transparent, more innovative and more competitive. Also They aim to improve the match between the educational system and the labor market. Thus Spake, qualifications frameworks are seen as engines of innovation: the point of introducing them is to promote a number of fundamental, long-term reforms "(Bohlinger, 2008, p. 1).

In addition, the Ministry of Higher Education of Srilanka defined that qualification framework is a new framework that aims to improve the quality of higher education and training through recognition and accreditation of qualifications offered by different institutions (Wijeyaratne, 2012, p.1).

European Qualification Framework (EQF) for life long education consists of 8 levels which is defined by a set of descriptors indicating the learning outcomes assessed based on three criteria : knowledge, skills, and competence (Ligija Kaminskienė, 2011, p. 5). The framework has also become a factor in developing Indonesian Qualification Framework (IQF). In the context of EQF, knowledge is described as theoretical and or factual. Skill is described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving the manual dexterity and the use of methods, materials, tools and instruments). Competence is described in terms of responsibility and autonomy. National qualification framework is to facilitate migration (international) for students to continue their studies or move into the labor market (Higher Education Comprises HBO, 2008, p. 3).

Indonesian Qualification Framework (IQF) has been loaded in Presidential Regulation No. 8 of 2012 which states that Indonesian Qualification Framework is a hierarchy framework of the competence and qualifications that can reconcile, equalize, and integrate among the fields of education, job training, and work experience, in order to give recognition of job competence, according to the structure of employment in various sectors (Presidential Regulation No. 8 of 2012). Arranging of IQF has a legal basis that came within in Government Regulation No. 31 of 2006 about the National Vocational Training System, Government Regulation No. 23 of 2004 about the National Professional Certification, and Law No. 30 about Labour. (General Directorate of Higher Education, 2010, p. 7).

IQF has been made based on the needs and specific objectives, which is typical for Indonesia to harmonize education and training system with a career system in the field of work (General Directorate of Higher Education, 2010, p. 16). IQF has also been designed to fit and equal with the developed system of other countries. General qualification framework is composed tiered from lowest to highest based on the ability to work, mastery of the knowledge achieved through education or skill acquired through training.

European Qualifications Framework (EQF) is one of the qualification framework referred to developt Indonesian Qualification Framework (IQF), divide level qualification framework in eight levels from the first level until the highest level eight (Cedefop, 2010, p. 17). EQF has equalized level qualification in education or training. The concept of life long education seems strong for underlying development of EQF. The development of IQF also refers to and considers the qualification systems of other countries such as Europe, Australia, England, Scotland, Hong Kong, and New Zealand (General Directorate of Higher Education, 2010, p. 16). It makes qualification included in IQF which can easily be compared and accepted by other countries so that the exchange of students and labor between countries can be done properly.

IQF provides nine levels of qualification, starting from the qualification level 1 as the lowest qualification and qualification level 9 as the highest qualification (Presidential Regulation No. 8 of 2012). Every level of qualification descriptors is also appropriated by considering the condition of the country as a whole, including the development of science, technology and art, supporting the development of sectors of the economy and welfare of the people, and aspects of the builders of national identity that is reflected in Bhinneka Tunggal Ika or Unity, which is a commitment to recognize the diversity of religion, ethnicity, culture, language and art as the characteristic of the Indonesian.

Achieving each level or increasing to a higher level in IQF can schematically be done through four pathways or combination of the four pathways. These pathways are illustrated in Figure 1 which consists of pathways through formal education, professional development, career advancement in the industry, the field of work, or through the accumulation of individual experience (General Directorate of Higher Education, 2010, p. 17).

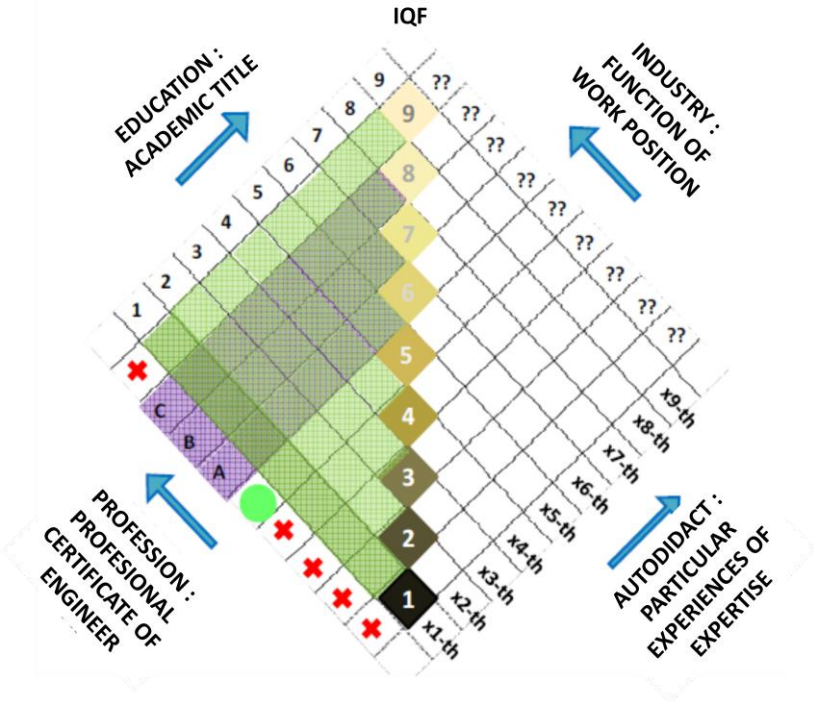

Figure 1. The Level of IQF

Each level of qualification in IQF conceptually composed by four main parameters : (a) job skill, (b) the scope of science or knowledge, (c) the method and level of knowledge or ability in applying the knowledge, and (d) the ability of managerial (General Directorate of Higher Education, 2010, p. 18). These four parameters contained in each level are arranged in the form of descriptors of IQF. Internalization and accumulation of four parameters are achieved through a structured educational process or through work experience called learning outcomes.

Each descriptor of IQF for the same level of qualification can contain or consist of a composition of elements of science, knowledge, expertise (know-how), and skills that vary from one another. Each learning outcomes from an educational can have content more prominent of the skill than science, but given the recognition of hierarchy for equivalent qualification. Figure 2 illustrates that for higher level qualification, the descriptor of IQF will be science, while the lower level qualification will be more emphasise on the mastery of skill (General Directorate of Higher Education, 2010, p. 19).

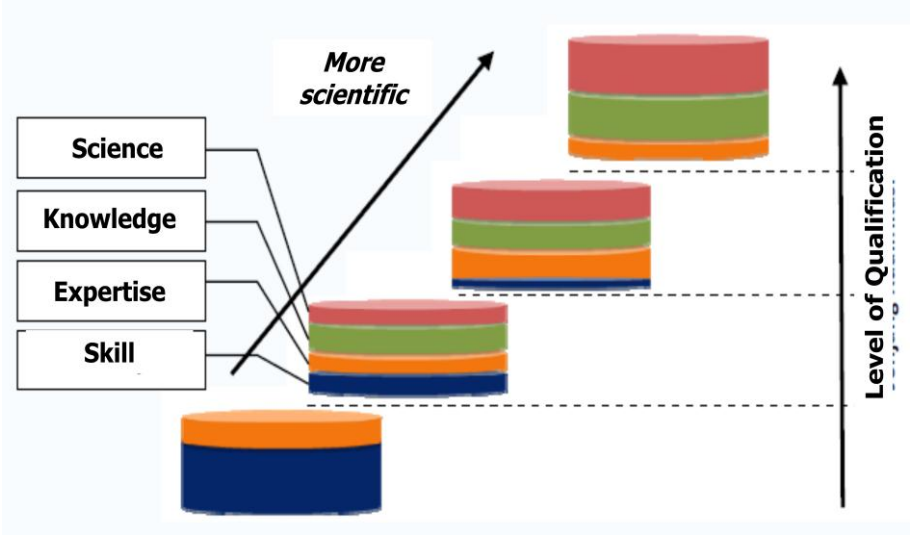

Figure 2. Content of IQF

Explanation.

1. Science is described as a system based on a scientific methodology to build a knowledge through the results from research in the body of knowledge. Ongoing researchs used to build a science should be supported by the data records, observation, and analysis of measured, and aims to increase human understanding of the phenomena of nature and social.
2. Knowledge is described as a mastery of theory and skill by someone in a particular field of expertise or understanding of the facts and information obtained by a person through experience or education for a particular purpose.
3. Expertise (know-how) is described as a mastery of theory and skills by someone in a particular field of expertise or understanding about the methodology and technical skill obtained a person through experience or education for a particular purpose.
4. Skill is described as psychomotor abilities (including manual dexterity and the use of methods, materials, tools, and instruments) achieved through measurable training based on the knowledge or understanding (know-how) that someone is able to produce a product or performance which can be assessed both qualitatively and quantitatively.
5. Affection is described as an attitude of a sensitive person toward aspects around her or his life grown by the instruction and the environment of family or society largely.
6. Competence is the accumulation of a person's ability to implement a job description measurely through a structured assessment, aspects of self-reliance and individual responsibility in the field of work.
7. Learning outcomes are an internasilisasi and accumulation of science, knowledge, skill, affection, and competence achieved through a structured educational process and including a field of science, specific expertise, or through work experience (Higher Education, 2010, p. 20).

IQF is a realization of the quality and identity of Indonesia in the national education system, the national vocational training system and the system of recognition of national competence, it is intended as a guide as follows.

1. Establishing qualification of learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;
2. Establishing recognized scheme of qualification of learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;
3. Balancing qualification between learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;

4. Developing a method and system of recognition of qualifications of human resources from other countries who will be working in Indonesia (Higher Education, 2010, p. 9).

C. Descriptors of IQF Level 6

Descriptors of IQF are divided into two parts : a general description which describes the character, personality, attitude to work, ethics, morals of every human Indonesia at every level; and specific descriptions which describe the skills, practical knowledge, science, knowledge that is mastered by a person depends on the education level (Higher Education, 2010, p. 21). General descriptions of IQF Level 6 indicate suitability with the ideology of state and the culture of Indonesia. Curriculum and learning process that are applied in the study program should be able to develop the following affections.

1. Obeying to God Almighty.
2. Having the moral, ethics, and good personality in finishing the task.
3. Serving as a citizen who is proud and love of the homeland and support world peace.
4. Having ability to work together and having a social sensitivity and high attention for the society and the environment.
5. Respecting for diversity of cultures, views, beliefs, religious, and opinions or original finding from other people.
6. Upholding the rule of law and having the spirit to give priority to importance of the nation and the wide community.

Generic descriptions of IQF Level 6 consist of four paragraphs. The first paragraph is able to utilize science and technology in the field of expertise and able to adapt to situations encountered in solving the problem. The second paragraph is mastering theoretical concepts in the field of indepth knowledge of specific areas, and able to formulate procedural problem solving. The third paragraph is able to take a strategic decision based on the analysis of information and data, and able to provide guidance in selecting various alternative solutions. The fourth paragraph is responsible for his own work and can be given responsibility for the achievement of the organization's work. These generic descriptors become a base in the development of specific descriptors of each study program for developing curriculum in Indonesia.

III. STUDY METHODS

A. Type of Study

This study is included research and development which follow development steps of model of Borg and Gall (1983: 772) modified according to needs of study.

B. Time and Place of Study

This study was done in Physics Education Study Program S1: Yogyakarta State University (UNY), Indonesian Education University (UPI), Sriwijaya University (UNSRI), Lambung Mangkurat University (UNLAM), Pattimura University (UNPATTI), and Nusa Cendana University (UNDANA), as well as and several senior high schools in Yogyakarta, Bandung, Palembang, Banjarmasin, Ambon, and Kupang on October 2012 until February 2013.

C. Subjects of Study

Subjects of this study consist of the colleges and the schools which become expert validation in the development of specific descriptors IQF Level 6 of Physical Education. The universities consist of 54 lecturers and 180 students of Physical Education Program S1 of Yogyakarta State University (UNY), Indonesian Education University (UPI), Sriwijaya University (UNSRI), Lambung Mangkurat University (UNLAM), Pattimura University (UNPATTI), and Nusa Cendana University (UNDANA). The schools consist of 108 physics teachers and 36 headmasters of senior high school in the Yogyakarta, Bandung, Palembang, Banjarmasin, Ambon, and Kupang. Determination of the number of subjects in this study uses nonprobability sampling technique, namely sampling technique that does not give equal opportunity for each element or member of the population to be selected into the sample.

D. Procedures of Study

The procedures of this study follow model of Borg & Gall modified according to needs of study which includes three steps : preliminary studies, product design, and development. The first step is preliminary study consisting of: (1) the study of literature and (2) a field study that includes a needs analysis and diagnosis of the problem. The second step is product design of IQF Level 6 of Physics Education. The third step is development which consists of: (1) creating and arranging a draft of specific

descriptor IQF Level 6 of Physics Education and (2) validation of experts by the colleges and schools. The study steps is as figure 3.

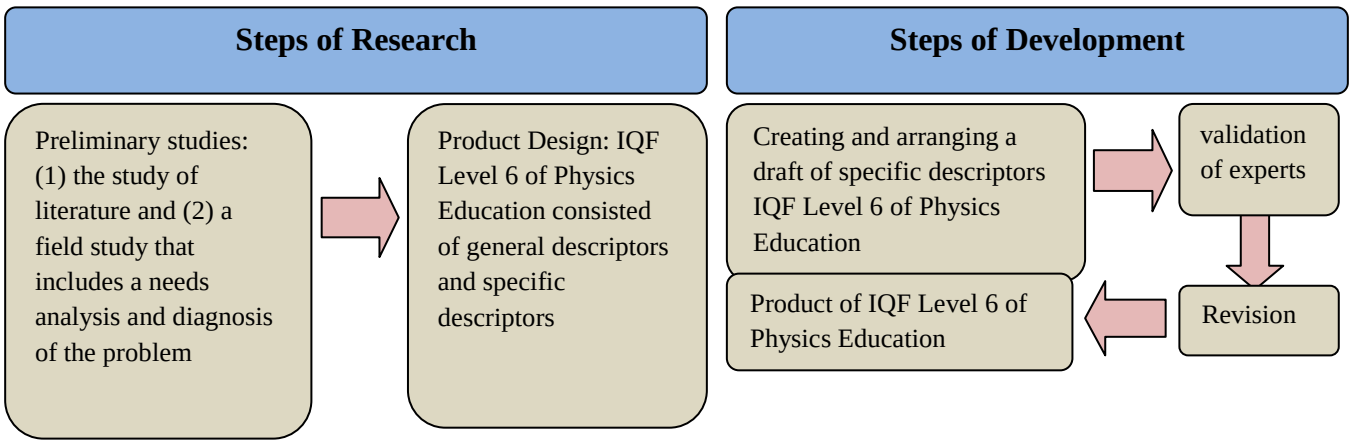

Figure 3. Steps of Study

E. Data Analysis Techniques

Data collected from the validation of experts is analyzed by using quantitative description, and validity of the data was done by using triangulation of data sources from the colleges and the schools. Quantitative descriptive technique is used to determine the level of trend in the variable. Therefore, it is necessary to determine the mean ideal (MI), the standard deviation of ideal (Sdi), and the highest score and lowest score of ideal each sub-variables as criteria. Calculation of the mean ideal (MI) and the standard deviation of the ideal (Sdi) refers to Glas and Hopkins (Glas and Hopkins, 1984, p. 81). The steps of the analysis are as following.

1. Calculating total score of each sample on each variable.
2. Calculating total score of ideal on each variable.
3. Calculating mean ideal (Mi), namely Mi = 1/2 (highest ideal score + lowest ideal score).
4. Calculating standard deviation of ideal (Sdi), namely = 1/6 (highest ideal score - lowest ideal score).

Trend level is divided into four categories as shown in Table 1.

Table 1. Category of Variable Assessment

No	Score range	Category
1.	$X \geq Mi + 1{,}8\ Sdi$	SA
2.	$Mi \leq X < Mi + 1{,}8\ Sdi$	A
3.	$Mi - 1{,}8\ Sdi \leq X < Mi$	DA
4.	$X < Mi - 1{,}8\ Sdi$	SDA

If Mi = 112,5 and Sbi = 22,5, the trend level in table 1 as shown in Table 2.

Table 2. Category of Variable Assessment

No	Score range	Category
1.	$X \geq 153{,}0$	SA
2.	$112{,}5 \leq X < 153{,}0$	A
3.	$72 \leq X < 112{,}5$	DA
4.	$X < 72$	SDA

Description of category :
SA = Strongly Agree
A = Agree
DA = Disagree
SDA = Strongly Disagree

IV. RESULTS AND DISCUSSION

A. Description of Study Data

Specific descriptors IQF Level 6 of Physics Education is developed from generic descriptors IQF Level 6. Specific descriptors developed have 45 points, all of which is a explanation from four paragraphs of generic descriptors IQF Level 6. Total score of assessment from the universities is as Table 3.

Table 3. Assessment from Higher Education

No	Colleges	Lecturers			Students		
		Total Score	(%)	Category	Total Score	(%)	Category
1	UNY	169,7	94,3	SA	164,2	91,2	SA
2	UPI	166,7	92,6	SA	163,5	90,8	SA
3	UNDANA	174,3	96,9	SA	172,2	95,7	SA
4	UNSRI	179,0	99,4	SA	168,7	93,7	SA
5	UNPATTI	167,0	92,8	SA	168,2	93,4	SA
6	UNLAM	170.3	94.6	SA	168.7	93.7	SA

Assessment from the school is done by involving headmasters and physics teachers in six cities around the universities. The total score of assessment from the schools is as Table 4.

Table 4. Assessment from Senior High School

No	Senior High Schools	Physics Teachers			Headmasters		
		Total Score	(%)	Category	Total Score	(%)	Category
1	Yogyakarta	167,3	93,4	SA	165,0	91,7	SA
2	Bandung	161,2	89,5	SA	156,0	86,7	SA
3	Kupang	164,2	91,2	SA	156,0	86,7	SA
4	Palembang	167,3	93,0	SA	171,0	95,0	SA
5	Ambon	165,8	92,1	SA	152,0	84,4	A
6	Banjarmasin	167,2	92,9	SA	162,0	90,0	SA

B. Discussion

Specific descriptors IQF Level 6 of Physics Education is developed from generic descriptors IQF Level 6. This specific descriptors is developed from four generic descriptors IQF Level 6 that became 45 grains of competence that must be possessed by graduates of Physics Education Program S1 or physics teacher. Assessment and validation of experts is done by universities namely lecturers and students of Physics Education S1, and schools that contained of headmasters and physics teachers. The procedures of this study follow model of Borg & Gall modified according to the needs of study which includes three steps : preliminary study, product design, and development. The first step is preliminary study consisting of a literature study and field study which includes a needs analysis and diagnosis of problem. Preliminary study has shown that IQF Level 6 of Physics Education be the first step in improving quality of graduates from Physics Education Program Study S1 in the College of Indonesia. Furthermore, all of the curriculum and the learning process in higher education should lead to achievement of learning outcomes which has been determined.

The second step is the product design of IQF Level 6 of Physics Education. Product design of IQF Level 6 of Physics Education consists of general descriptions, generic descriptors, and specific descriptors. General and generic descriptors from General Directorate of Higher Education have been become a reference in the development of each study program including Physics Education Study Program S1. The third step is the study of development consisting of creating and arranging draft of specific descriptors IQF Level 6 of Physics Education and validation of expert by universities and schools. Creating and arranging this draft of specific descriptors IQF Level 6 are based on learning outcomes to be achieved. Learning outcomes for Physics Education Study Program S1 include physics teacher, physics education research, and education managers. Competence of the learning outcomes refers to four competencies which consist of professional competence, pedagogical competence, social competence, and personal competence. Draft of IQF Level 6 of Physics Education which has been arranged further assessed and validated by the universities namely students and lecturers Physical Education S1 from several universities in Indonesia, and senior high schools namely physics teachers and headmasters of several senior high schools in Indonesia. Result of validation and revision shows the final

draft IQF Level 6 of Physics Education that can be used as a reference in developing of curriculum for Physics Education S1 in Indonesian Higher Education and as a reflection of competencies that must be owned by a physics teacher.

The results of the assessment from universities are as in Table 3. The total score of assessment from lecturers of Physical Education S1 toward specific descriptors IQF Level 6 of Physics Education, namely: a) UNY 169,7 or 94,3% by category SA (Strongly Agree), b) UPI 166,7 or 92.6% by category SA (Strongly Agree), c) UNDANA 174,3 or 96,9% by category SA (Strongly Agree), d) UNSRI 179,0 or 99,4% by category SS (Strongly Agree), e) Unpatti 167,0 or 92,8% by category SA (Strongly Agree), and f) UNLAM 170,3 or 94,6% by category SA (Strongly Agree). These assessment results show that the lecturers of Physical Education S1 from several universities in Indonesia strongly agreed with the specific descriptors which have been made.

The total score of assessment from students of Physical Education S1 toward specific descriptors IQF Level 6 of Physics Education, namely: a) UNY 164,2 or 91,2% by category SA (Strongly Agree), b) UPI 163,5 or 90,8% by category SA (Strongly Agree), c) UNDANA 172,2 or 95,7% by category SA (Strongly Agree), d) UNSRI 168,7 or 93,7% by category SA (Strongly Agree), e) UNPATTI 168,2 or 93,4% by category SA (Strongly Agree), and f) UNLAM 168,7 or 93,7% by category SA (Strongly Agree). These assessment results show that the students of Physical Education S1 from several universities in Indonesia strongly agreed with the specific descriptors which have been made.

The results of the assessment from schools are as in Table 4. The total score of assessment from school of physics teachers from several regions of Indonesia toward specific descriptors IQF Level 6 of Physics Education, namely: a) Yogyakarta 167,3 or 93,4% by category SA (Strongly Agree), b) Bandung 161,2 or 89,5% by category SA (Strongly Agree), c) Kupang 164,2 or 91,2% by category SA (Strongly Agree), d) Palembang 167,3 or 93,0% by category SA (Strongly Agree), e) Ambon 165,8 or 92,1% by category SA (Strongly Agree), and f) Banjarmasin 167,2 or 92,9% by category SA (Strongly Agree). The assessment results show that physics teachers from several big cities in Indonesia strongly agreed with the specific descriptors which have been made.

The total score of assessment of headmasters from several regions in Indonesia toward specific descriptors IQF Level 6 of Physics Education, namely: a) Yogyakarta 165,0 or 91.7% by category SA (Strongly Agree), b) Bandung 156,0 or 86,7% by category SA (Strongly Agree), c) Kupang 156,0 or 86,7% by category SA (Strongly Agree), d) Palembang 171,0 or 95,0% by category SA (Strongly Agree), e) Ambon 152,0 or 84,4% by category S (Agree), and f) Banjarmasin 162,0 or 90,0% by category SA (Strongly Agree). The assessment results show that headmasters from several big cities in Indonesia strongly agreed with the specific descriptors which have been made.

The first paragraph of generic descriptors IQF Level 6 explains that S1 graduates should be able to use science and technology in the field of expertise and able to adapt toward situations encountered in problem solving. These generic descriptors are described or explained into three specific descriptors. The second paragraph of generic descriptors IQF Level 6 explains that S1 graduates must master the theoretical concepts in the field of indepth knowledge of specific areas, and able to formulate procedural problem solving. These generic descriptors are described or explained into two specific descriptors.

The third paragraph of generic descriptors IQF Level 6 explains that S1 graduates should be able to take strategic decisions based on analysis of information and data, and give guidance in selecting various alternative solutions. These generic descriptors are described or explained into two specific descriptors. The fourth paragraph of generic descriptors IQF Level 6 explains that S1 graduates must be responsible for their own work and able to be given responsibility for the achievement of the organization's work. These generic descriptors are described or explained into three specific descriptors.

The specific descriptors of the first paragraph of generic descriptors, namely: a) having capability for using ICT in physics instruction, b) having capability for using laboratory equipment in physics instruction, and c) having capability for using creating a simple laboratory equipment to support physics instruction. The criticisms or suggestions for specific descriptors "having capability for using ICT in Physics instruction" are namely: 1) the concept of ICT is directed to on-learning or on Campus and to development of competence, professional, and pedagogical physics teacher, 2) there is not only able to use, but also able to create and perform a hyperlink in a power point, 3) it needs to be reviewed by the facilities and infrastructure related to the Internet, 4) assessment is done manually to avoid when there are trouble about ICT, 5) learning process can be interesting and simple. The criticisms or suggestions for the first specific descriptors of the first generic descriptors indicate that the various sides strongly agree and demand that graduates of Physics Education S1 or a physics teacher must mastery of ICT for instruction.

Thus the first specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Having a mastery of basic concepts about ICT.
2. Having ability to design physics instruction based on ICT.
3. Having ability to apply physics instruction based on media of audio, visual or audio-visual.
4. Having ability to apply physics instruction based on multimedia for presentation.
5. Having ability to implement physics instruction based on website (e-learning).
6. Having ability to use ICT as a medium of communication for teacher and student.
7. Having ability to use ICT for assessment of physics instruction.

The criticisms or suggestions for the second specific descriptors of the first paragraph of generic descriptors "having ability to use laboratory equipment in physics instruction" are namely : a) graduates need to be furnished with maintenance capabilities for the damaged laboratory equipment and b) laboratory instruction is easier to be remembered than the theoretical. The criticisms or suggestions on the second specific descriptors of the first paragraph of generic descriptors indicate that the various sides strongly agree and demand that graduates Physics Education S1 or physics teachers should be able to use laboratory equipment in physics instruction. Thus the second specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Knowing the various laboratory equipment to be used in physics instruction.
2. Mastering the steps to use various laboratory equipment of physics and having the ability maintenances or repairs.
3. Mastering the concept shown quantitatively by various laboratory equipment.
4. Having the ability to organize or string up various laboratory equipment in various physics experiment.

The criticisms or suggestions for the third specific descriptors " having capability for using creating a simple laboratory equipment to support physics instruction" are namely 1) a laboratory equipment made must meet the rules of observable, measurable, and reasonable, 2) it can make the students to be active, and 3), it is better to use a real equipment. The criticisms or suggestions for the third specific descriptors of the first paragraph of generic descriptors show that the various sides strongly agree and demand that graduates Physical Education S1 or physics teacher should be able to create a simple laboratory equipment to support physics instruction. Thus the third specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to use the local potential or used items in environment to be used as laboratory equipment to support physics instruction.
2. Having ability to create a simple laboratory equipment to support physics instruction.

The specific descriptors of the second paragraph of generic descriptors are namely : a) having professional competence for physics instruction and b) having pedagogical competence for physics instruction. The criticisms or suggestions for specific descriptor "having professional competence for physics instruction " are namely: 1) in order to instruction can become effective and the route of instruction is clear, 2) physics teachers must master the concepts of physics, 3) the competence must be taught and developed in lecture process. The criticisms or suggestions for the first specific descriptor of the second paragraph of generic descriptors indicates that various sides strongly agree and demand that graduates Physical Education S1 or physics teacher must have professional competence for physics instruction. Thus the first specific descriptors of the second paragraph of generic descriptors that have been approved by various sides are as following.

1. Mastering the material, structure, concept, and the mindset of science that supports subject of physics.
2. Mastering the competency standard or basic competency for subject of physics.
3. Having ability to develop matter of physics creatively.
4. Having ability to develop professionalism continually with commit a reflective action.

The criticisms or suggestions for specific descriptors " having pedagogical competence for physics instruction " are namely : 1) it needs strongly supported by development of curriculum, 2) it is one of main competencies that must be had by teachers, 3) it is very important for a teacher for developing curriculum as well as instruments that can support. The criticisms or suggestions for the second specific descriptors of the second paragraph generic descriptors indicate that various sides strongly agree and demand that graduates Physical Education S1 or physics teachers must have pedagogical competence for physics instruction. Thus the second specific descriptors of the second paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to recognize characteristics of students either physical, moral, social, cultural, emotional aspects and intellectual aspects.
2. Mastering instruction theories and principles of educational instruction.

3. Having ability to develop a physics curriculum as well as instruments that can support.
4. Having ability to organize educational physics instruction.
5. Having ability to facilitate development of potential students to actualize their potential (talent development).
6. Having ability to communicate effectively, empathetic, and polite with students.
7. Having ability to conduct assessment, evaluation of processes, and results of physics learning.
8. Having ability to use results of assessment and evaluation for importance of physics instruction.
9. Having ability to do reflective action for improving quality physics instruction.

The specific descriptors of the third paragraph of generic descriptors are namely: a) mastering educational research methods in physics instruction and b) mastering knowledge of guidance and counseling in physics instruction. The criticisms or suggestions for specific descriptors " mastering educational research methods in physics instruction " are namely : a) in order to increase professionalism and quality of the teacher or educator, b) making actively publication of research results in seminars or journal, and c) it needs to focus in particular research methods. The criticisms or suggestions for these specific descriptors of the first three paragraphs of generic descriptors indicate that various sides strongly agree and demand that graduates of Physical Education S1 or physics teachers must master research methods of education in physics instruction. Thus the first specific descriptors of the third paragraph of generic descriptors that have been approved by various sides are as following.

1. Mastering and applying various methods of educational research (such as class action research, experimental research, evaluation research, and research development).
2. Having ability to use results of research for repairing physics instruction.
3. Having ability to give scientific assistance to colleagues when it is needed.

The criticisms or suggestions for specific descriptors " mastering knowledge of guidance and counseling in physics instruction " are namely 1) because not all learners are able to reveal difficulties in the classroom, so there should be a special guidance from teachers, and 2) not only remedial programs but also enrichment. The criticisms or suggestions for the second specific descriptors of the third paragraph of generic descriptors indicate that various sides strongly agree and demand that graduates of Physical Education S1 or physics teachers must master knowledge of guidance and counseling in physics instruction. Thus the second specific descriptors of the third paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to give guidance for students who have difficulty in physics instruction.
2. Having ability to give right solution for students who have difficulties or problems in physics instruction.
3. Having ability to use findings of guidance and counseling from instruction for remedial and enrichment programs.

The specific descriptors of the fourth paragraph of generic descriptors are namely: a) having ability as a physics teacher, especially in planning, implementation, and assessment of physics instruction as well as be able to develop themselves, b) having a personal competence, and c) having a social competence. The results of study show that there are not criticisms or suggestions for these three specific descriptors. Assessment results show that every point in category SA (Strongly Agree). Thus the first specific descriptors of the fourth paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to make a planning of physics instruction (such as syllabi, lesson plans, worksheets, teaching materials, and evaluation instruments).
2. Having ability to perform physics instruction according to planning of physics instruction appropriate steps correctly.
3. Having ability to always endeavor for improving professionalism through self-learning, such as take training, courses, workshops, and seminars.
4. Having ability to give suggestion or innovative ideas to build a school.

The second specific descriptors of the fourth paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to act according to religious norm, law norm, and social norms, as well as national culture norm of Indonesia.
2. Having ability to present personality who is honest, noble, and model for students and community.
3. Having ability to present personality who is steady, stable, mature, wise, and authoritative.

4. Having ability to demonstrate work ethic, high responsibility, sense of pride to be a teacher and a sense of confident.
5. Upholding ethical code of teaching profession.

The third specific descriptors of the fourth paragraph of generic descriptors that have been approved are by various sides are as following.

1. Having ability to inclusive attitude, objective and non-discriminatory act for consideration gender, religion, race, physical condition, family background and socioeconomic status.
2. Having ability to communicate effective, empathetic, and polite with fellow educators, staff, parents, and community.
3. Having ability to adapt in task place in entire region of Indonesia which has a social and cultural diversity.
4. Having ability to communicate with the community's own profession and other professions by oral language, written language, or other form.

Based on above description shows that side of universities namely lecturers and students of Physical Education Program S1 from several universities and side of schools, namely headmasters and physics teachers from several cities in Indonesia have validated content by form of responses in category SA (strongly agree) toward specific descriptors IQF Level 6 of Physics Education. The specific descriptors outline and explain generic descriptor IQF Level 6, which can be used to ensure and improve quality and competence for graduates of Physical Education Program S1 through application curriculum based on IQF Level 6 of Physics Education in university. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply the sciences or knowledge,and (4) managerial ability that in line with discipline of physics education.

V. CONCLUSION

Stakeholders in education include college and school have approved and validated product of development IQF Level 6 of Physical Education to assure and improve quality for graduates of Physical Education Program S1 at universities in Indonesia. These specific descriptors IQF Level 6 of Physics Education which have been developed from generic descriptor IQF Level 6 have 45 items that contain competencies required by graduates of Physical Education Program S1 in Indonesian universities. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply the sciences or knowledge,and (4) managerial ability that in line with discipline of physics education.

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