Science and Mathematics Education Centre

Curriculum Evaluation in Higher Education: A Case Study of a Physics Pre-service Teachers' Curriculum in Indonesia

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This thesis is presented for the Degree of
Doctor of Philosophy
of
Curtin University

January 2013

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

Signature: Maison 10/01/2013

Abstract

Recent government policies about the curriculum and the needs of stakeholders for qualified graduates have provided arguments for physics pre-service teacher education programmes in Indonesia to be evaluated. These arguments have increased due to the rapid changes in local, national, and international dynamics.

The purpose of this research was to evaluate by means of a case study the physics education curriculum for pre-service teachers by examining five levels of curriculum representation (the ideal, the formal/written, the perceived, the operational, and the experiential curriculum) in one Indonesian higher education institution. This case study involved (1) collecting and analysing information from government and institution documents, (2) developing and administrating surveys to assess the pre-service teachers' and graduates' as well as their lecturers' perceptions of the physics education curriculum, (3) observations of teaching and learning in three different subjects, (4) one-on-one interviews with three physics lecturers, and (5) five focus group interviews with the pre-service teachers and graduates.

Within this case study, the research design that was developed to answer the four research questions was a mixed method convergent parallel design for collecting and analysing quantitative and qualitative data. In this design, the researcher implemented the quantitative and qualitative methods during the same timeframe and with equal weight. While the quantitative and qualitative data were collected and analysed separately, the two sets of results were merged using strategies so that those could be interpreted together.

The Indonesian government has provided generic guidelines for the ideal curriculum that is appropriate for physics pre-service teacher programmes as well as other programmes in all higher education institutions throughout Indonesia. In other words, the guidelines are expressed in very general and flexible terminologies. Therefore, by rewording them, every higher education institution can use the guidelines. However, the analyses associated with the formal/written curriculum suggest that the number of subjects and credits in the curriculum should be reduced because the curriculum was overloaded and the syllabi were overcrowded. Focus group interviews showed that several students had difficulties learning physics because some subjects in physics consisted of many theories and complex concepts. Additionally, they would like more physics content that is related to their future work as secondary school physics teachers rather than be required to study difficult physics theories.

The actual process of teaching and learning in three subjects (General Physics I, Mechanics, and Laboratory Management) was observed with the focus on the content, the learning activities and lecturer's role, the teaching resources and facilities, and the assessment. The observations, questionnaire, and interview results indicated that the lecturers provided assistance to students to learn, for example, by providing notes, examples, handouts, and library references. However, not many lecturers demonstrated enough interaction and recognition of their students' level of understanding. The lecturers' approaches to teaching seemed to be content-centred rather than learner-centred. On the other hand, only a few pre-service teachers showed enthusiasm or were engaged in the teaching and learning process. In general, the pre-service teachers had surface approaches to learning physics. Nevertheless, lecturers, pre-service teachers as well as graduates were in agreement with the aims and objectives of the physics education curriculum.

The results of this research make a distinct contribution to improve the curriculum within the field of secondary physics teacher education, which are summarised as basic assertions. In brief, the number of subjects and credits in the curriculum should be reduced; the curriculum should be more related to the pre-service teachers' future jobs and the needs of stakeholders; the lecturers should use the physics methods that address the individuality of the pre-service teachers; and the resources, facilities and number of lecturers should be increased. These assertions have implications for the lecturers or physics teacher educators, curriculum developers, decision makers of higher education institution and future physics pre-service teachers.

ACKNOWLEDGEMENTS

I would like to thank “Allah” for giving me guidance, mercy and strength upon the accomplishment of this thesis. The successful completion of my thesis was also made possible by the contributions, support, and assistance of many people whom I wish to take this opportunity to acknowledge.

Firstly, I would like to express my thanks and gratitude to my supervisor Professor David F. Treagust who encouraged me to continue and stay with my research. He helped me to improve my research writing skills through the invaluable feedback for every single piece that I wrote and submitted to him. He believed that I would succeed.

Secondly, I would like to acknowledge friends, colleagues, pre-service teachers, and graduates at Jambi University Indonesia and also friends at SMEC Curtin University Western Australia, who encouraged, supported, collaborated, or participated in my research and study. Furthermore, I also wish to thank the government of Indonesia for sponsoring my study.

Finally, I wish to express my deep gratitude to all of my family (especially my loving wife) who had made so many sacrifices so that I might realize this dream. Thank you for your patience, support, and understanding.

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INTRODUCTION TO THE THESIS

1.1 Introduction

The purpose of this chapter is to provide an introduction to this thesis which consists of eight sections. Section 1.2 discusses the rationale for the study describing the reason why the study was undertaken to evaluate the physics pre-service teachers' (physics education) curriculum in one higher education institution in Indonesia. Section 1.3 introduces the conceptual framework for curriculum representations which focuses on the *ideal*, *formal/written*, *perceived*, *operational*, and *experiential* curriculum. Section 1.4 presents the general and specific purposes of this research while Section 1.5 delineates the research questions which were established within the framework of each curriculum representation. Section 1.6 communicates and gives supporting evidence for the significance of the study. Section 1.7 presents the research design which was developed to answer the research questions. Finally, Section 1.8 describes an overview of the thesis. A figure is also designed to provide a clearer picture about every chapter.

1.2 Rationale for the Study

The Indonesian Government has changed the policy in terms of the curricula for all levels of educational institutions – primary, secondary, and tertiary schools or higher education institutions. Due to this policy, the curricula must be competency-based and must be developed by each institution (Act of the Republic of Indonesia number 20, year 2003). As with all similar higher education programmes in Indonesia, this policy presents a challenge for curriculum reform of the physics pre-service teachers' programmes in higher education institutions.

Another challenge is the need of stakeholders and learning institutions for qualified higher education graduates. According to the literature (Harris, Driscoll, Lewis, Mathews, Russell, & Cumming, 2009; Harvey, 2000), higher education curricula must meet the needs of diverse stakeholders and respond to dynamic local, national, and international contexts. Hills, Robertson, Walker, Adey, and Nixon (2003) also mention that higher education curricula should be re-orientated toward developing a more appropriate awareness of the world of work for university graduates. Moreover curricula must be flexible and adaptable in order to face rapid change in the future. Therefore, in order to find complete information related to the change of the Indonesian curricula, a baseline evaluation is needed.

This study was conducted in one of the Indonesian higher education institutions located in Jambi. This institution has several study programmes (e.g. physics education for pre-service teachers, chemistry education for pre-service teachers, medical science, agriculture, law, etc.). Like other study programmes in all universities in Indonesia, the physics pre-service teachers' curricula (also referred to as the physics education curricula) can be divided into the core curriculum and the institution curriculum. The core curriculum consists of several subjects that aim to (1) develop the personality of students (for example, *Bahasa Indonesia, English, and National Education*), (2) develop the foundations of students' knowledge and skills (for example, *Fundamentals of physics*, *Mechanics*, *Optics*, *Electricity and Magnetism*, *etc.* in physics pre-service teachers' programmes), (3) develop professionalism (for example, *Educational Profession*, *Teaching and Learning*, *Study of Secondary Curricula*, *etc.* in physics pre-service teachers' programmes), (4) nurture students' attitudes and abilities related to their knowledge and skills (for example, *Micro-Teaching* and *Teaching Practice*), and (5) develop student abilities to live in society (for example, *Basic Humanities* and *Culture*). The institution curriculum on the other hand consists of several subjects involving universal characteristics related to its environment's needs and conditions, for example, *Workshop* and *Computers in Science Education*. In total, the physics pre-service teachers' (physics education) curriculum has 52 subjects (see Chapter 5).

As stated previously, a government policy about the science curriculum is not the only reason to evaluate the curriculum. The needs of stakeholders and the environmental dynamics – whether local, national, or international – are also important factors. Although it is not obligatory for physics pre-service graduates to become secondary physics teachers, their major future job will likely be related to schools or learning institutions. Unlike in previous years, school curricula are competency-based and must be developed in each school by teachers and school committees at every level (Ministry of Education Regulation Numbers 22 and 23 in 2006). So, the development of a curriculum does not depend completely on the government, namely, the Curriculum Centre, anymore. To achieve these outcomes, physics teachers need to enhance their skills and knowledge. Consequently, a challenge for university physics pre-service teachers' programmes is to increase their role to enhance student knowledge, skill, attitudes, and abilities (Harvey, 2000). Ministry of Education Regulation Number 14 in 2005 states that Indonesian teachers should have holistic competencies that include professional, pedagogical, social, and personal competencies. On the other hand, science and technology have developed rapidly. The result is that the physics pre-service teachers' curricula should have a scientific vision to accommodate new knowledge. Clearly, these facts suggest that the current physics pre-service teachers' curriculum should be evaluated.

1.3 Conceptual Framework

A framework for curriculum evaluation was used to guide the study by identifying different representations of the physics education curriculum. This framework, initially developed by Goodlad, Klein, and Tye (1979), has been used and modified over a number of years by several researchers (see, for examples, Goodlad, 1994; Keeves, 1992; Rosier & Keeves, 1991; Treagust, 1987; van den Akker, 1998, 2003). This study used five of six curriculum representations developed by van den Akker (2003): the *ideal* curriculum that is determined by the government, the *formal/written* curriculum that is the intentions as specified in higher education curriculum documents, the *perceived* curriculum as viewed by physics pre-service teachers' educators, the *operational* curriculum or curriculum in action, and the *experiential curriculum* as experienced by physics pre-service teachers and graduates. It is possible that the view which pre-service teachers have of the physics education curriculum may be different from that envisaged by the body that determined what the curriculum should be.

1.4 Purpose of the Study

The general purpose of this research was to evaluate the physics pre-service teachers' curriculum in a higher education institution in Indonesia.

Further, this research had four more specific purposes. The first purpose was to describe and understand the framework of the physics education curriculum in terms of government guidelines and higher education institution's documents. The second purpose was to identify how the physics pre-service teachers' educators perceived the physics education curriculum. The third purpose was to identify and describe the actual process of teaching and learning of the physics education curriculum or the curriculum in action. The final purpose was to analyse how the physics pre-service teachers and graduates perceived their learning experiences.

1.5 Research Questions

The research questions are:

1. What is the framework for the physics education curriculum (the *ideal* and the *formal/written* curriculum)?
2. What are academic teaching staff perceptions of the physics education curriculum (the *perceived* curriculum)?
3. What are the actual process of teaching and learning in terms of the physics education curriculum (the *operational* curriculum)?
4. What are physics pre-service teachers' and graduates' perceptions of the physics education curriculum (the *experiential* curriculum)?

1.6 Significance

The present study is the first to evaluate physics education curriculum associated with the five levels of curriculum representations (the *ideal,* the *formal/written*, the *perceived*, the *operational*, and the *experiential curriculum*) in Indonesia. The significance of this research is that it provides the comprehensive data about physics pre-service teachers' curriculum in Indonesia. In general, these data are expected to be useful for all science pre-service teachers' programmes in higher education institutions throughout Indonesia by setting these data within the context of Jambi University. In particular, the findings of this research provide valuable information for the institution which is currently developing a new physics pre-service teachers' curriculum.

The data gathered in this research may identify some ways in which the physics pre-service teachers' curriculum in Jambi University and other similar institutions in Indonesia could be improved so that the curriculum will meet the needs of stakeholders and relate to government guidelines to produce graduates who have the intended holistic competencies (e.g. professional, pedagogy, social and personal competencies).

It is also expected that the findings of this research will have implications for the science teaching profession and for physics pre-service teachers' programmes world-wide.

1.7 Research Design

The research design that was developed to answer the research questions was a mixed method convergent parallel design (also referred to as the convergent design) for collecting and analysing quantitative and qualitative data (Creswell & Plano Clark, 2011). In this design, the researcher implemented the quantitative and qualitative methods during the same timeframe and with equal weight. The purpose of this design (as mentioned by Morse, 1991) was to obtain different but complementary data on the same topic to best understand the research problem. According to Creswell (2008), quantitative or qualitative research has different characteristics. Gillham (2000) stated that different methods have different, even if overlapping, strength and weaknesses. By using the convergent design, the researcher can bring together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalisation) with those of qualitative methods (small sample, details, in depth) (Patton, 1990, 2002).

1.8 Overview of the Thesis

This thesis comprises nine chapters (see Figure 1.1). Chapter 1 provided a background to the study, including the conceptual framework for curriculum evaluation, as well as the research design for the study. The significance and purpose of the study were discussed and the four research questions also were delineated.

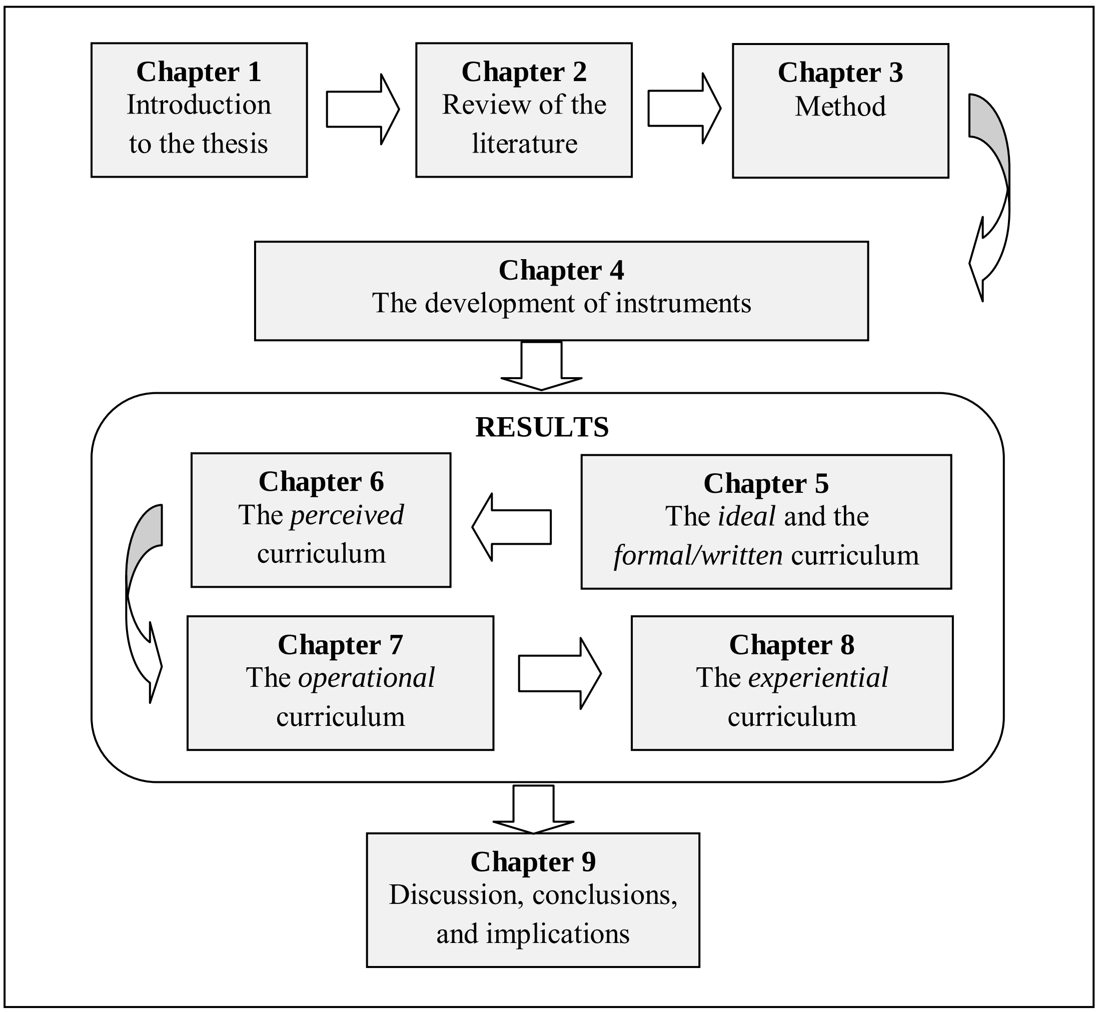

Figure 1.1 Overview of the thesis

Chapter 2 comprehensively reviews the literature on curriculum for secondary physics teacher education in Indonesia. It examines the historical foundations of physics teaching, programmes of physics education, and the changes that have occurred in the programmes that have been offered nationally. In particular, research relating to the physics pre-service teacher curriculum is discussed. Some conceptual frameworks for the investigation of curricular issues are described and the possibilities to develop questionnaires are discussed.

Chapter 3 presents the research methods used in this study. The development of the research strategy, including the theoretical framework, research questions, and research design (in collecting data, analysing data, and interpreting results) is presented in this chapter.

Chapter 4 describes the development of an instrument for assessing pre-service teachers' and graduates' Perceptions of the Physics Education Curriculum (PPEC), including validation of the instrument. This chapter also presents the development of an instrument for assessing lecturers' perceptions of the physics education curriculum (PPEC-survey2).

Chapters 5, 6, 7, and 8 present the main results of these investigations in relation to the conceptual framework of the study. Chapter 5 describes the results relating to the analysis of documents (the *ideal* and the *formal/written* curriculum). Chapters 6 and 8 present the results relating to the perception of lecturers, pre-service teachers and graduates of the physics education curriculum (the *perceived* curriculum and the *experiential* curriculum), whereas Chapter 7 discusses the results relating to the actual process of teaching and learning (the *operational* curriculum).

The final chapter (Chapter 9) summarises the findings by addressing each of the research questions outlined in the first chapter and described in the third chapter. Implications of the research for secondary physics teacher education are presented in term of several assertions. Distinctive contributions, significance, limitations, and recommendations for future research are outlined.

1.9 Summary of the Chapter

This first chapter, which has introduced this study and presented an overview of every chapter, provides a map of the investigation that we will pass through. Chapter 2 provides a literature review associated with the curriculum, develops and presents the theoretical framework for this research.

Chapter 2
REVIEW OF THE LITERATURE

2.1 Introduction

The purpose of this chapter is to review the literature related to the study, provide a description of the current landscape of research not only on differentiating various levels of the curriculum into several aspects related to the school system, society, nation and state, but also on describing several types of curriculum representations. As a means of developing a theoretical framework for this research, several issues associated with the reasons for evaluating the physics education curriculum are introduced. This chapter consists of five sections. Section 2.2 provides a brief historical background of Indonesian pre-service teachers' programme in higher education institutions. Section 2.3 describes the physics pre-service teachers’ study programme and its curriculum. Section 2.4 presents a basic concept of curricula and develops the conceptual framework for curriculum inquiry, and section 2.5 communicates some facts related to the evaluation of physics education curriculum in a higher education institution in Indonesia.

2.2 A Brief Historical Background of Indonesian Pre-service Teachers’ Programmes in Higher Education Institutions

After Indonesia gained independence, the Indonesian government felt the lack of educational human resources at all levels and types of educational institutions. To address this problem the government established various teacher education courses (for example, B-I and B-II to prepare teachers for secondary schools' level) around 1950s, (http://unj.ac.id). Government efforts to improve the quality and quantity of secondary school teachers continued through the establishment the four *Perguruan Tinggi Pendidikan Guru* which is abbreviated as PTPG (College of Teacher Education) based on a regulation of the Ministry of Education and Culture number 382/Kab of 1954. These PTPG were established in four cities – Batusangkar (in Sumatera Island), Menado (in Sulawesi Island), Bandung (in west Java), and Malang (in east Java).

Since 1954 Indonesia had two types of institutions to supply the demand of teachers for secondary schools, i.e. vocational courses (B-I and B-II) and PTPG. These two categories of institutions located in several cities were then integrated into the *Fakultas Keguruan dan Ilmu Pendidikan* (FKIP) (Faculty of Education and Teachers' Training) at a nearby university through several stages (for example: In 1958, PTPG in Bandung was integrated into FKIP Faculty of Padjadjaran University, then in 1961, B-I and B-II courses were integrated into the same faculty).

In 1963, several Institutes of Teacher Education (namely IPG) were also established in several regions to produce secondary school teachers as well. Due to the dualism of teacher education institutions (FKIP and IPG), the management of teachers' education did not work effectively. To eliminate such dualism, on May 1, 1963 it was issued by Presidential Decree Number 1 of 1963, which merged FKIP and IPG became the *Institut Keguruan dan Ilmu Pendidikan* (IKIP) (Institute of Education and Teachers' Training) as the only higher education institution that educated secondary school teachers.

Later, the number of IKIPs increased to ten (for example, IKIP Bandung, IKIP Malang, IKIP Jakarta, IKIP Padang, IKIP Surabaya, etc) as some IKIP were assigned to develop or improve several IKIPs in others provinces (for example IKIP Bandung had a duty to enhance it branches in Banda Aceh, Palembang, Palangkaraya, and Banjarmasin). In accordance with the policy of the Department of Education and Culture, in the early 1970s, several branches were joined to the nearby university (as one of it faculties, namely FKIP) and a few of them were developed further to become an independent IKIP.

At a further development, in years 1999 and 2000, the ten IKIP changed their names and turned into the state universities (for example: IKIP Padang became the *Universitas Negeri Padang* or UNP; IKIP Jakarta became the *Universitas Negeri Jakarta* or UNJ; IKIP Malang became the *Universitas Negeri Malang* or UM; IKIP Manado became the *Universitas Negeri Manado* or UNIMA; IKIP Medan became the *Universitas Negeri Medan* or UNIMED, etc) by keeping their task as an educational institution (Ditnaga, 2008). IKIP Bandung turned into the *Universitas Pendidikan Indonesia* or UPI (Education University of Indonesia). All of these new universities offer not only educational programme (to educate school teachers) but also several other programmes (for example, physics, chemistry, biology, management, accounting, and communication design) as an extension of the mandate of the government.

Now, secondary school teachers in Indonesia can be educated at many higher education institutions or universities, both public and private, in a certain faculty (FKIP) or in many faculties of the 10 universities which originally developed from IKIPs. All of these higher education institutions that have a mission to produce or educate teachers are called *LPTK* or *Lembaga Kependidikan Tenaga Kependidikan* (article 2 of the act number 14 in 2005).

Pre-service teacher study programmes in higher education institutions in Indonesia, as mentioned previously, may be different from pre-service teacher programme in higher education institutions in other countries (Australia or most countries in Europe). In Indonesia, pre-service teacher study programmes have specific curricula which involve both learning materials of particular field of knowledge (for example, physics, chemistry, biology or mathematics) related to each programme and pedagogical knowledge or how to manage, plan, and implement the learning process at secondary schools. Therefore, if high school graduates enrol, for example, in a Biology Education Study Programme then they will have the status of a Biology pre-service teacher from the beginning of their study at the higher education institution or the university.

2.3 Physics Pre-service Teachers' Study Programme and its Curriculum

There are two types of programme studies in Indonesian tertiary schools related to physics, i.e., "*Program Studi Pendidikan Fisika*" and "*Program Studi Fisika*". *Program Studi Pendidikan Fisika* (Physics education study programme or Physics pre-service teachers' study programme) educates or prepares physics teachers for junior and senior high schools (*SMP* and *SMA*). *Program Studi Fisika* (Physics Study Programme or non-educational programme) educates physicists. From the first programme, physics education graduates have the *S.Pd.* (Bachelor of Education) for their degree, and for the second programme physics graduates will obtain the *S.Si.* or Bachelor of Science.

Several universities have study programmes for both physics and physics education (commonly, these universities were IKIPs in the past). Other universities offer only one programme, i.e. physics or physics education (for example, University of Indonesia or *UI* and Bandung Institute of Technology or *ITB* only provide physics, Jambi University only has physics education). Some universities or higher education institutions do not have any programme related to physics.

A survey of several universities in Indonesia shows a tendency for physics programmes (both educational and non-educational) to have the smallest number of lecturers/educators/physicists among science or mathematics programmes. A preliminary research at the largest higher education institution in Jambi province (which has the population of more than three million people with a heterogeneous society, census in 2010) provided data that the Physics pre-service teachers' study programme at this institution only has a total of eleven lecturers, including new lecturers and lecturers who still continuing their studies at other universities in Indonesia or abroad. In comparison, the Chemistry pre-service teachers' study programme at the same institution has more than 30 lecturers.

The Physics pre-service teachers' study programme was first set up at this institution in 1999 as a four-year Bachelor of Education degree to meet the high demand for Physics teachers in secondary schools for various places in the province. Before 1999, physics teachers in many schools were brought in from other provinces or islands (mainly from Java, West Sumatera, and North Sumatera). Some schools did not have physics teachers, therefore, it was understandable that many teachers taught physics even though their backgrounds were not related to physics.

From 1999 to 2007, the programme used a curriculum referred to as the Consortium of Basic Science. In 2002, there was a small revision to the curriculum related to the number and distribution of subjects for each semester. The last revision of the curriculum in 2007 incorporated government policies to reform the national curricula at all levels of education. However, the last revision is still similar to the first revision which focused only on the change of a few subjects (the name or the load), regrouping and redistribution of subjects per-semester. According to some lecturers who were the curriculum developers or revisers, no quality evaluation was done before the revision. Consequently, the Physics pre-service teachers' curriculum still needs to be evaluated and revised. The views of these curriculum developers seemed to be match several other researchers, for examples, Harris, Driscoll, Lewis, Mathews, Russell, and Cumming (2009), and Harvey (2000) who stated that higher education curricula must meet the needs of diverse stakeholders and respond to dynamic local, national, and international context.

In Indonesia, the higher education curricula need to be reformed due to recent government policies providing more opportunities for all universities to develop their curriculum based on the Minister of National Education (MoNE) Resolution Numbers 232/U/2000 and 045/U/2002. Another important factor is the need of stakeholders and learning societies for qualified higher education graduates. Hills, Robertson, Walker, Adey, and Nixon (2003) mention that higher education curricula should be re-orientated toward developing a more appropriate awareness of the world of work in their graduates. Moreover, curricula must be flexible and adaptable in order to face rapid change in the future. Thus, in order to discover complete information related to the change of the Indonesian curricula, a baseline evaluation is needed.

As mentioned previously, a government policy about the science curriculum is not the only reason to evaluate the curriculum. The needs of stakeholders and the environmental dynamics whether – local, national, or international – are also important factors. Although it is not obligatory for physics pre-service graduates to become secondary physics teachers, their major future job will likely be related to schools or learning institutions. Unlike the previous years, school curricula are competency-based and must be developed in each school by teachers and school committees at every level (Ministry of Education Regulation Numbers 22 and 23 in 2006). In this era of SBC (school based curriculum, KTSP), the Indonesian teacher's role is very crucial. They now have more duty and authority because the development of a curriculum does not depend completely on the government, namely, the Curriculum Centre, anymore. To achieve these outcomes, physics teachers need to enhance their skills and knowledge.

Furthermore, for the implementation of Article 28 paragraph (5) Government regulation number 19 of 2005 on National Education Standards, the MoNE sets rules on standards of academic and competence of teachers (MoNE Regulation number 16 year 2007). In the competence area, Indonesian teachers should demonstrate the four categories of competencies, namely pedagogical, personal, social, and professional competences. Pedagogical competence refers to gaining a deeper insight of general pedagogical knowledge, for example, how students learn, how schools work, and how teaching and learning processes should be well planned, implemented, and evaluated. Personal competence refers to the integrity and personality and how the teacher should behave. Social competence refers to the teacher's ability to develop social relationships with students and other members of the school communities, as well as with educational stakeholders outside the school. Professional competence indicates a deeper and broader understanding of subject matter in the field in which they work.

In 2012, the competence pre-test (in Bahasa Indonesia, *Uji Kompetensi Awal or UKA*) for Indonesian teachers at all levels of education (from pre-school teachers to high school teachers) (http://www.kemdiknas.go.id), showed that the average score is 42.25 nationally. This result is unsatisfactory, even though the mechanism for the future test needs to be improved, as the maximum score that the teachers could reach is 100.

Consequently, the previous facts are the challenges for university physics pre-service teachers' programmes to increase their role to enhance student knowledge, skill, attitudes, and abilities. On the other hand, science and technology have developed rapidly. The result is that the physics pre-service teachers' curricula should have a scientific vision to accommodate new knowledge as well. Clearly, these facts suggest that the current physics pre-service teachers' curriculum should be evaluated.

There is much less agreement about how to evaluate the curriculum of science pre-service teachers' programme (Levine, 2002; Madaus & Kellaghan, 1992). However, it is reasonable that researchers must understand the basic concept of curricula in order to gain valuable data and interpret them accurately.

2.4 Basic Concept of Curricula

2.4.1 Images of Curriculum

Reading and reviewing many curriculum books would be likely to disclose many different images or characterisations of curriculum. Many curriculum authors use their own preferred definitions of curriculum – each highlighting other meanings or connotations. Due to numerous curriculum books, it would be a massive work to analyse and discuss all of the images, however, Schubert (1986) tried to categorise major conceptions of curriculum, explicitly: (1) curriculum as content or subject matter, (2) curriculum as a programme of planned activities, (3) curriculum as intended learning outcomes, (4) curriculum as cultural reproduction, (5) curriculum as experience, (6) curriculum as discrete tasks and concepts, (7) curriculum as an agenda for social reconstruction, and (8) curriculum as "currere", including with examples, intents, and criticism of each. According to Schubert (1986), the images of the curriculum and its conceptualisation should be continued. Due to the difficulty in imaging and using the term curriculum properly, a more clear representation is needed, especially when one wants to investigate curricula with limited time, facilities, and resources.

2.4.2 A Conceptual Framework for Curriculum Inquiry

Tyler (1949), one of the earliest researchers in investigating curricular issues, identified four major elements of curriculum design associated with the four questions:

(1) What educational purposes should the school seek to attain?
(2) What educational experiences can be provided?
(3) How can these educational experiences be effectively organised?
(4) How to determine whether these purposes are attained?

At that time, interest in designing curriculum was the focus on what *should* be in a curriculum, rather than what was happening in reality, what the problems might be, and were there any socio-political issues involved in curriculum planning. Schwab (1969) criticised curriculum experts for an over-dependence on theory and proposed, with the intention of a more practical approach, what might be needed to understand the processes of curriculum development and its products.

Like Schwab, Goodlad (1979) accepted as true that it was essential to focus on the practical (what *is* done) rather than the theoretical (what *should be* done). However, he proposed that curriculum inquiry should include not only the *substantive* domain which included Tyler's four elements but also the *political-social* domain (referring to curriculum decision-making processes) and the *technical-professional* domain (referring to the practical implementation processes).

To develop these ideas further, Goodlad, Klein, and Tye (1979) distinguish five domains in curricula which are dependent on whose view is accepted. Several curricula are determined by a government and these could be described as the *ideal* or the ideological curriculum. Schools or other institutions need to interpret this ideological curriculum, and formalize into written documents which require approval. Goodlad called this curriculum the *formal* curriculum which must be interpreted and implemented by teachers or educators. Obviously, teachers' perceptions of the curriculum may reflect a different view of the curriculum that could be described as the *perceived* curriculum. The actual process in the individual classroom from time-to-time could be described as the *operational* curriculum. Finally, and most essentially, there are the experiences of the students which could be described as the *experiential* curriculum.

The previous framework has been used and modified over a number of years by several researchers (see, for examples, Goodlad, 1994; Keeves, 1992; Rosier & Keeves, 1991; Treagust, 1987; van den Akker, 1998, 2003). The International Association for the Evaluation of Educational Achievement (IEA) for its studies of mathematics and science (Keeves, 1972; Rosier & Keeves, 1991) investigated the *intended* curriculum (the curriculum established at the level of the educational system); the *implemented* curriculum, (the content of the curriculum translated into reality at the level of school or classroom); and the *achieved* curriculum (the knowledge and attitudes acquired by the students). Treagust (1987) used similar term to the IEA studies, but he included the *perceived* curriculum which is the curriculum as perceived or experienced by students.

Van den Akker (1998) added one further view – the *attained* curriculum – to the list of Goodlad framework, related to the students' learning outcomes. In 2003, van den Akker change the term "*attained*" to "*learned*" as the resulting learning outcomes of learners. In very clear words, van den Akker (2003) differentiated various levels of the curriculum into several distinctions, explicitly: system, society, nation and state (or *'macro'* level) (for example, national syllabi or core objectives); school and institution (or *'meso'* level) (for example, school-specific curriculum); classroom (or *'micro'* level) (for example, textbooks and instructional materials); and individual and personal (or *'nano'* level).

Furthermore, van den Akker represented curricula into various forms: the *Ideal* curriculum (vision or rationale underlying a curriculum); the *formal/written* curriculum (intentions as specified in curriculum documents and/or materials); the *perceived* curriculum (curriculum as interpreted by its users, especially teachers); the *operational* curriculum (actual process of teaching and learning); the *experiential* curriculum (learning experiences as perceived by learners); and the *learned* curriculum (resulting learning outcomes of learners). The typology of curriculum representations has been grouped into three levels – the *intended*, the *implemented*, and the *attained* curriculum (Figure 2.1). For the purposes of this study, the researcher used the refined typology described by van den Akker in 2003. However, one representation (the *learned* curriculum) needs to be omitted to fit the aim and research questions of this study.

<table>
<tr><th rowspan="2">Level</th><th rowspan="2">(Goodlad, Klein, & Tye,1979)</th><th rowspan="2">(Keeves, 1972; Rosier & Keeves, 1991)</th><th rowspan="2">(Treagust, 1987)</th><th colspan="2">van den Akker</th></tr>
<tr><th>(1998)</th><th>(2003)</th></tr>
<tr><td rowspan="2">INTENDED</td><td>Ideal</td><td rowspan="2">Intended</td><td rowspan="3">Intended</td><td>Ideal</td><td>Ideal</td></tr>
<tr><td>Formal</td><td>Formal</td><td>Formal/ Written</td></tr>
<tr><td rowspan="2">IMPLEMENTED</td><td>Perceived</td><td rowspan="2">Implemented</td><td>Perceived</td><td>Perceived</td></tr>
<tr><td>Operational</td><td>Implemented</td><td>Operational</td><td>Operational</td></tr>
<tr><td rowspan="2">ATTAINED</td><td>Experiential</td><td rowspan="2">Achieved</td><td>Perceived</td><td>Experiential</td><td>Experiential</td></tr>
<tr><td></td><td>Achieved</td><td>Attained</td><td>Learned</td></tr>
</table>

Figure 2.1 Typology of curriculum representations

Table 2.1

Curriculum components

Rationale or vision	Why are they learning?
Aims and objectives	Towards which goals are they learning?
Content	What are they learning?
Learning activities	How are they learning?
Teacher role	How is the teacher facilitating learning?
Materials and resources	With what are they learning?
Grouping	With whom are they learning?
Location	Where are they learning?
Time	When are they learning?
Assessment	How to measure how far learning has progressed?

(adopted from van den Akker, 2003)

Improved curriculum reform is strongly associated with data from researchers of all levels and representations of curriculum. Furthermore, one of the major challenges for curriculum improvement is creating a balance and consistency between various components of a curriculum (*'plan for learning'*). In keeping with the relatively simple curriculum definition by Walker (1990) consisting of three major panning elements – content, purpose and organisation of learning, van den Akker (2003) provided another framework (see Table 2.1) of ten components that address ten specific questions about the planning of student learning.

The 'rationale' works as a main orientation point, and the nine other components are ideally connected to the rationale, and preferably also are consistent with one another. According to van den Akker, many subquestions are possible for each of the components, not only on the substantive issues, but, for example, also on *'organisational'* aspects. The following questions prove an illustration related to these aspects. How are students allocated to various learning trajectories? Are students learning individually, in small groups, or in whole classes? (sub-questions related to grouping); Are students learning in class, in the library, at home, or elsewhere? What are the social and physical characteristics of the learning environment? (sub-questions concerning location); How much time is available for various subject matter domains? How much time can be spent on specific learning tasks? (sub-questions associated with the time). To illustrate many inter-connections, van den Akker visualised the ten components as a spider's web.

2.4.3 The Use of this Framework in Previous Studies

Goodlad's framework for curriculum inquiry which suggests several different views of any curriculum, depending on whose perspective is examined, has been used by researchers in their studies. Rosier and Keeves (1991) in the IEA study of science world-wide used the framework of the intended, implemented, and achieved curriculum. Friedel and Treagust (2005) investigated the perceptions of nursing students and nurse educators in relation to bioscience in nursing curriculum. The results of their study suggest that there is a difference between the intended and prescribed curriculum and the perceptions of nurse educators and nursing students – the *perceived* and the *experiential* curriculum. Hartley, Treagust, and Ogunniyi (2008) utilised the framework to describe how the computer-assisted lessons (CAL) in computer centres were actually implemented and what learners' perceptions of their CAL classes.

Ideally, the realisation of the curriculum has a strong relation to the intention as well as to the vision or rationale underlying a curriculum. However, several other researchers also find the lack of coherencies among curriculum representation; for example, Bekalo and Welford (2000) revealed that the link between policy and practice in secondary science in terms of practical work was weak. In addition, their study also had shown no internal coherencies between curriculum objectives as well as teaching and learning activities and the stated policies. Another study described the lack of connections within or across the different phases of learning as well as teaching (Feiman-Nemser, 2001). However, some efforts have been made to establish relationships, for example, Harris et al. (2009) discussed the potential of evaluation to establish responsive communication between students, teaching staff and programme administrators to ensure a match between the intended, implemented and attained curriculum.

2.5 The Evaluation of Physics Education Curriculum

The most basic form of evaluation is simply to measure what is happening (Anderson, 1998). Furthermore, Patton (1998) stated that trying to figure out what's really going on is, of course, a core function of evaluation. An evaluation process in educational areas may provide valuable data which can be used by related educational organisations, for example higher education institutions, to improve or to reform education. However, curriculum evaluation in higher education is rarely done in a systematic manner; more often the emphasis is placed on a particular aspect which is only a little help in terms of modifying education (Spiel, Schober, & Reimann, 2006).

Evaluations and studies in teacher education or in other areas of higher education are needed to examine some problems. Feimen-Nemser (2001) claims that teacher educators typically overload student teachers with too much information that they might need in the future. In their report Hobson et al. (2006) stated that teacher candidates often become confused about what information is important. Trigwell, Prosser, and Waterhouse (1999) discovered the relationship between teachers' approaches to teaching and students' approaches to learning in higher education. Teachers who adopted more of an information transmission/teacher-focused approach to teaching had students who themselves adopted a more surface approach to learning rather than a deep approach.

There are several approaches in evaluation, for example, experimental approaches, quasi-experimental approaches, value added evaluation, evaluation according to standards, and fourth generation approaches (Anderson, 1998). Unlike other approaches, fourth generation approaches are not intended to highlight comparisons but have as their main concern an emphasis on gaining an in-depth understanding of the programme and all its effects, both planned and unplanned. According to Anderson (1998), such evaluation approaches bring together the strength of quantitative and qualitative methods and have much in common with case study methodology.

There are many sources of data which can be involved in the process of the evaluation. Government reports, institution documents, and lecturers' teaching portfolios are some of the important sources of data used in evaluation of higher education institutions.

Many educational reforms are based on the views of people working in upper levels of the education system (Levin, 2000). However, Levin stated that education reform cannot succeed and should not proceed without direct involvement of students in all aspects. It is understandable because by talking with and listening to students, we can learn more about how classroom and school processes can be made more powerful, and how improvement can be fostered.

The involvement of graduates in the evaluation is also important. Nuroso, Khoiri, Saptaningrum, and Siswanto (2008) who focused on graduates of a physics teacher education institution in Indonesia in their study about curriculum suggested that the physics education curriculum must be improved by increasing the practical work activities and subjects of expertise.

Further literature associated with the evaluation of physics pre-service teacher or physics education curriculum in Indonesia are needed; unfortunately, even though the legal framework for curriculum reform in Indonesia has been established (see Chapter 5) and evaluation usually relates to practice (Anderson, 1998; Grinnell & Unrau, 2011), it is difficult to find any other literature. Perhaps, the lack of the literature is caused by two major factors, i.e., there were few researchers in physics education curriculum and the researchers did not publish their findings. One important question comes into view; if there is insufficient research, then how is it possible to improve physics education curriculum in higher education institution? Interview results with some lecturers answered this question. The development or improvement of the curriculum was mostly done through meetings among the lecturers, the head of the programme, and sometimes with the curriculum experts in a specific workshop. The discussion would include the needs of the environment, the weakness of the previous curriculum, and new government policies.

Curriculum can be renewed through the previous 'meeting' process, but, that way is not a high quality method because the data are not complete. For example, the views of the pre-service teachers or graduates who had learning experiences were not included. Also it is possible that their perceptions would be different from the perceptions of other lecturers.

Curriculum evaluation also should include classroom observations made in the physics education programme. Due to the lecturers' authorities, compared to primary and secondary school teachers, it is not usual for lecturers to be observed by, for example, the head of the study programme or other people to evaluate their teaching and learning process. Therefore, the evaluation of the physics education curriculum associated with each representation which has been discussed previously may provide very important data. Subsections 2.5.1 and 2.5.2 have the purposes to describe the theoretical background related to student perceptions and classroom observations.

2.5.1 Perceptions of the Physics Education Curriculum

The word 'perceptions' is a very general term that refers to the process of attaining awareness or understanding of the environment. Perception is a process which involves the recognition and interpretation of stimuli which register on our sense (Rookes & Willson, 2000). Perception is not just the passive receipt of the sensory information (for example, vision and hearing) but can be shaped by learning, memory, and expectation. Goldstein (2002) stated that perceptions both create an experience of the environment and enable people to act within it. Lecturers', pre-service teachers', and graduates' perceptions of the physics education curriculum should prove picture of how they perceive or experience this curriculum. Also these perceptions may affect the way they respond to their learning experiences, and the way they apply it to their practice.

Lecturers' perceptions of the physics education curriculum might be different from pre-service teachers or graduates perceptions. Lecturers' perceptions of the curriculum not only rely on several factors (for example, their *interest in physics*, their *approaches to teaching*, and the *aims and objectives* of physics education curriculum) but also involve their students' *approaches to learning* physics. Conversely, pre-service teachers' and graduates' perceptions of the physics education curriculum include their lecturers' approaches to teaching as well.

Furthermore, the perception of lecturers, pre-service teachers, and graduates will be associated with the ten curriculum components which has mentioned previously. For example, the perceptions about lecturers' approaches to teaching will be connected with the lecturers' instruction, the content of subject matter, lecturers' assessment methods, resources, etc. The perceptions about pre-service teachers' and graduates' approaches to learning will be related to their learning activities, grouping, time, location, resource, etc.

2.5.2 The Use of Classroom Observations in Evaluation

Observation is the process of gathering open-ended, firsthand information by focussing on people and places at a research site (Creswell, 2008). There are a number of classroom observation methods, from on-site observations to remote video observations. Pickering and Walsh (2011) used videoconferencing technology to enhance their classroom observation methodology for the instruction of pre-service early childhood professionals. Xie and Cao (2010) included on-site observations and comparisons with video in their study on teacher-student interaction behaviours in the classroom.

According to Creswell (2008), observers might consider one of three popular roles for on-site observations, i.e., the role of participant observer, the role of non-participant observer, and the changing observational role. A participant observer is an observational role adopted by researchers when they take part in activities in the setting they observe; a non-participant observer is an observer who visits a site and records notes without becoming involved in the activities of the participants. In some observational situations, it is also advantageous to shift or change the role.

Regardless of the method and the role of the observers, classroom observation is used to provide a detailed picture of the operational curriculum and classroom environment. The observations present valuable data associated with many curriculum components, such as aims and objectives, content, learning activities, teachers' role, materials and resources, etc. Lecturers, curriculum developers, or evaluators can use these appropriate data, for example, in their activities related to the evaluation of the physics education curriculum.

2.6 Summary of the Chapter

Within this chapter, it has been argued that there are concerns about the physics pre-service teacher programme in higher education institutions in Indonesia. These concerns are about the importance of the evaluation of the physics education curricula. Therefore, the theoretical framework for this research has been developed and presented. That framework incorporated an approach to the evaluation of the curriculum where five representations are considered important: the *ideal* curriculum, the *written* curriculum, the *perceived* curriculum, the *operational* curriculum, and the *experiential* curriculum.

Chapter 3
METHODS

3.1 Introduction

The literature discussed in Chapter 2 has identified that there has been little research relating to the physics education curriculum in Indonesia. Furthermore, it is clear from the discussion and analysis about curriculum inquiry that there is not just one view of curriculum. The physics education curriculum may be seen very differently by the people who develop it, by the people who use it, and by the people who are affected by it. For example, the lecturer's views of the aims and objectives of teaching physics may be different from the views of pre-service teacher who learns it.

Chapter 3 explains the methods used in this study. Section 3.2 consisting of several sub-sections showing the development of the research strategy and design. In this section, the theoretical framework for the research is discussed and incorporated into several research questions. The selection and development of the data collection – methods and strategies – and data analysis are elaborated. The selection of the subjects to be involved in the research is portrayed, and the procedures to be followed in the research are described.

In the next chapter (Chapter 4), the development of instruments to answer the research questions is discussed.

3.2 Developing a Research Strategy and Design

3.2.1 Theoretical Framework

Curriculum evaluation is not simple (Levine, 2002). There is no shared model or format to evaluate higher education curricula because of the diverse size, scope, and variation of curricula in each college or university (Chen, Hsu, & Wu, 2009). However, it is helpful to consider a typology of different curricular representations especially when one is trying to understand what should be evaluated. As mentioned previously in Chapter 2, these curricular representations can be broadly grouped into three levels – the *intended*, the *implemented*, and the *attained* curricula (Figure 2.1). van den Akker (2003) developed a more refined typology of curriculum representations consisting of the following:

- the *ideal* curriculum: the original vision underlying a curriculum (government/education board);
- the *formal/written* curriculum: the intentions as specified in curriculum documents and/or materials;
- the *perceived* curriculum: the curriculum as interpreted by its users (especially teachers);
- the *operational* curriculum: the actual process of teaching and learning (also: curriculum-in-action)
- the *experiential* curriculum: the learning experiences as perceived by learners
- the *learned* curriculum: the resulting learning outcomes of learners

Conducting curriculum evaluation related to the all six stages above will produce the most complete and valuable information. However, due to the limitation of time, the researcher carried out five of the six aspects of curricula - the *ideal*, the *formal/written*, the *perceived*, the *operational*, and the *experiential* curriculum of the physics pre-service teachers' programme study in higher education institutions in Indonesia, especially in Jambi associated with the change of government policy. This evaluation not only can identify the weaknesses and the strengths of the implemented curriculum but also can yield data to determine the feasibility of new curriculum in order that it does not deviate from government guidelines, the needs of stakeholders, and also responds to recent societal dynamics. These aspects of the curriculum were highlighted using a case study.

3.2.2 Research Questions

Research Question 1

What is the framework for the physics education curriculum (the *ideal* and the *formal/written* curriculum)?

This question discussed the rationale and the intentions as specified in curriculum documents at the system and the institution levels.

Research Question 2

What are academic teaching staff perceptions of the physics education curriculum (the *perceived* curriculum)?

This question directly addresses pre-service teachers educators' perceptions of the physics education curriculum from directed and slightly personal perspectives based on the information from questionnaires and one-on-one interviews.

Research Question 3

What are the actual process of teaching and learning in terms of the physics education curriculum (the *operational* curriculum)?

This question is answered by observing the process of teaching and learning in the classroom.

Research Question 4

What are physics pre-service teachers' and graduates' perceptions of the physics education curriculum (the *experiential* curriculum)?

This question directly addresses the pre-service teachers' and graduates' perceptions of the physics education curriculum from directed and somewhat personal perspectives through information from questionnaire and focus groups' interviews.

3.2.3 Research Design

This study used a mixed method convergent parallel design for collecting and analysing both quantitative and qualitative data (Figure 3.2). The mixed method convergent parallel design (also referred to as the convergent design) is a one-phase design in which researchers implement the quantitative and qualitative methods during the same timeframe and with equal weight (Creswell & Plano Clark, 2011). In this design, quantitative and qualitative results were merged during the overall interpretation.

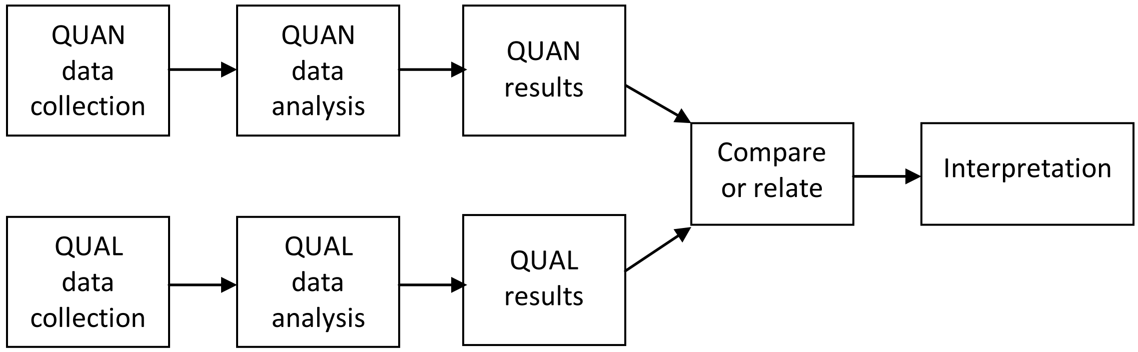

Figure 3.2 The mixed method: Convergent parallel design

Since the 1980s, this design has had many names, for examples simultaneous triangulation (Morse, 1991), parallel study (Tashakkori & Teddlie, 1998), convergence model (Creswell, 1999), and concurrent triangulation (Creswell, Plano Clark, Gutmann, & Hanson 2003).

A flowchart of procedures in implementing the convergent design which were divided in four steps is displayed in Figure 3.3. Step 1 involved the design of quantitative and qualitative strands and the procedures for collecting both quantitative and qualitative data. Step 2 analysed the quantitative and qualitative data separately. Step 3 used strategies to merge the two sets of results, and step 4 interpreted the merged results.

3.2.3.1 Data Sources and Data Collection Methods

The main data sources were documents, educators, pre-service teachers and graduates of one higher education institution or university in Jambi Province in 2010. This institution was the only one institution in the province which prepared physics teachers for secondary schools. The number and the variation of data collection methods depended on the research questions and the model of curriculum representations (Figure 3.4) that the researcher used.

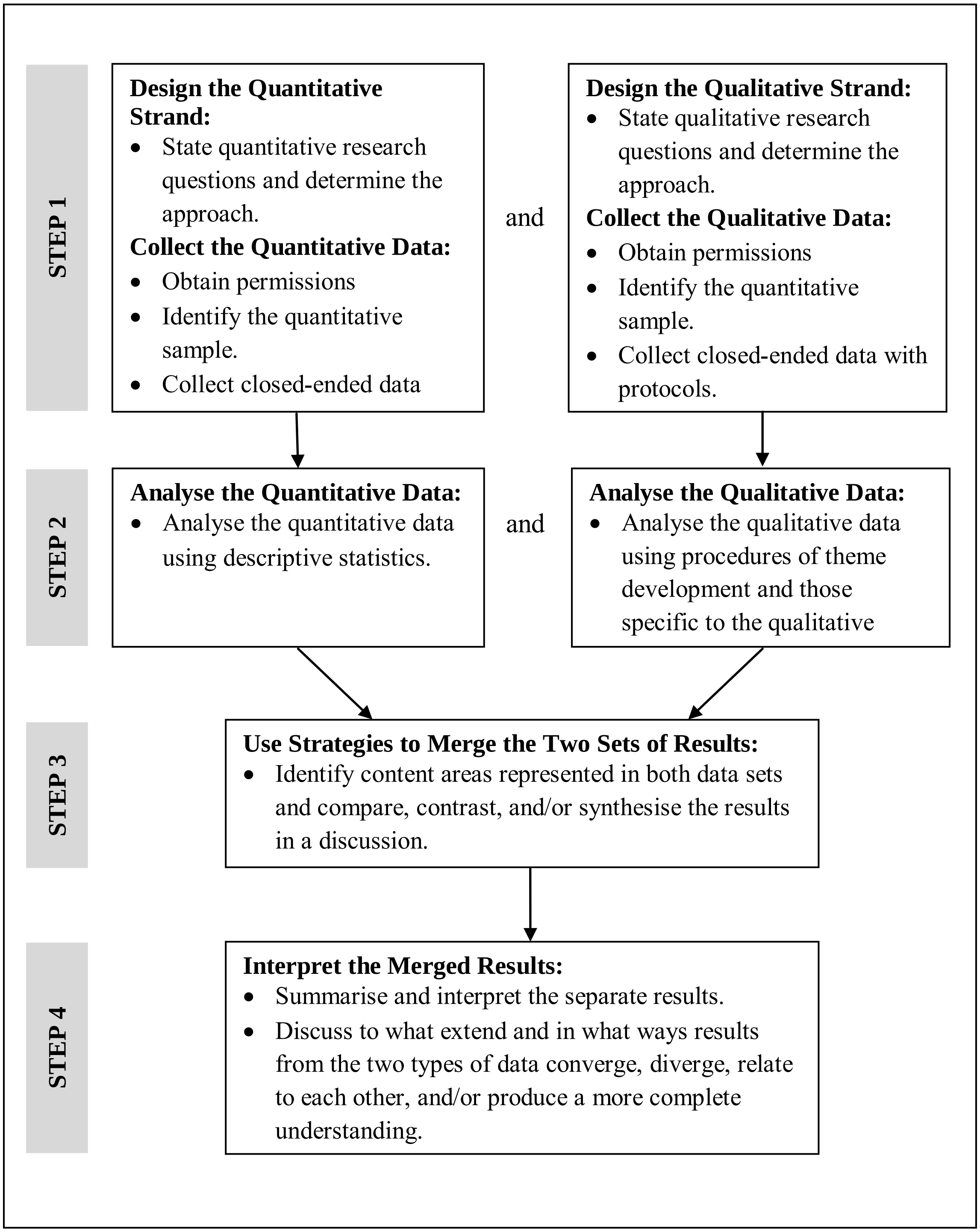

Figure 3.3 Flowchart of the procedures in implementing a convergent design (adopted only the corresponding procedures from Creswell & Plano Clark, 2011)

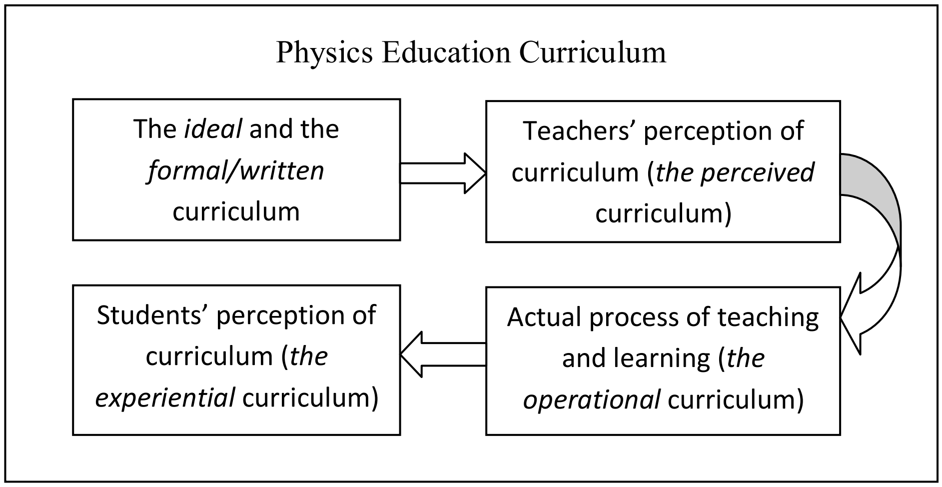

Figure 3.4 Model of curriculum representations

Based on the above model, several data sources and data collection methods are associated with each representation. This study collected information from documents, questionnaires (for pre-service teachers and graduates and for educators), interviews (one-on-one interviews with the educators and focus group interviews with the pre-service teachers and graduates), and also classroom observations. The types of data which included in this study were both quantitative and qualitative data.

Documents

A valuable source of information in qualitative research can be documents (Creswell, 2008). The documents can be in either written, electronic, visual, or audio-visual forms. In this study, the data were collected from government and institution documents related to the *ideal* and the *formal/written* curriculum.

Questionnaires

A questionnaire is a method of collecting data from participants, which is useful when the information required is straightforward, and there is a need for standardised data from identical questions (Denscombe, 2010). Information about the thoughts, feelings, attitudes, beliefs, values, perceptions, personality, and behavioural intentions of research participants can be obtained using questionnaires. In other words, questionnaires can be developed and used to measure many different kinds of characteristics (Johnson &

Christensen, 2012). However, questionnaires often limit the answers that can be provided and sometimes create misunderstanding. A carefully written pilot study of the questionnaires may reduce and identify any potential problems (Denscombe, 2010).

In this study, two separate questionnaires associated with the Perceptions of the Physics Education Curriculum (PPEC) were developed, i.e. students' and graduates' questionnaire and teachers' questionnaire (see Chapter 4). Both questionnaires were developed by modifying and adopting the questionnaires that have been used in previous research (see Chapter 4).

The first questionnaire (PPEC-survey1) consisting of 38 items were administered to 201 pre-service teachers and graduates. The second questionnaire (PPEC-survey2) comprised 42 items and was administered to seven teaching staff of the Physics Education Programme in the higher education institution in Jambi.

Interviews

Interviews are useful for providing detailed information because they can provide an in-depth insight into a topic. This study conducted one-on-one interviews with three lecturers and focus group interviews with five groups of pre-service teachers and graduates. A one-on-one interview is a type of data collection process in which the researcher asks questions and records answers from only one participant in the study at a time (Creswell, 2008). It involves personal interaction between an interviewer and an interviewee; this is a dynamic process and responses can be recorded by mechanical or electronic means (Anderson, 1998). A focus group interview is the process of collecting data through interviews with a group of people typically four to six (Creswell, 2008). Morgan (1998) and (Finch & Lewis, 2003) stated that focus group interviews are a way of listening to people and learning from them. In this study, there was a clear list of issues to be discussed and there was a scope for more open-ended answers or more elaboration of answers. Appendix 1 provides an interview protocol which contains questions for physics pre-service teachers, graduates, and lecturers. These questions were constructed based on Research Question 4 and Research Question 2 which addressed the *experiential* and the *perceived* curriculum. Some questions were adopted from van den Akker (2003) to address some curriculum components (see Table 2.1). All questions were put in the right order to make the interview process easier; for example the first question serves the purpose of an icebreaker, to relax the participants and motivate them to talk.

Classroom observations

Observations by the researcher is a very direct way of collecting data because it offers evidence of what actually happens (Denscombe, 2010) and observing teachers in action is the primary way of assessing teaching (Zepeda, 2009). This research involved 12 observations of teaching and learning in three different classes to gather data about how the teachers implement the curriculum and the actual process of teaching and learning (the *operational* curriculum or curriculum-in-action).

Table 3.1

Research participants

Status	Total Number	Participant		
		Type of participation	Name/Initial	Number
Pre-service teacher or graduate	201	Questionnaire	–	201
		Interview:		
		Focus Group 1	AWDS, DMSR, LP, DY, and SB	5
		Focus Group 2	DS, F, EN, S, and EG	5
		Focus Group 3	R, MF, GDS, WAP, and M	5
		Focus Group 4	RFD, UW, JN, and TLI	4
		Focus Group 5	EFH, AM, IRA, and N	4
Lecturer	7	Questionnaire	–	7
		Observation	LA, LB, and LC	3
		Interview	LA, LB, and LC	3

Participants

This research involved a total of 208 participants from physics pre-service teachers, graduates, and lecturers (Table 3.1). The characteristics of these participants are presented in Table 6.2 and Table 8.1. Each participant completed a consent form (Appendix 2) before participating in the study. Focus group participants were selected by using maximal variation sampling strategy, in which diverse individuals were chosen who were expected to hold different perspectives (Creswell & Plano Clark, 2007). The researcher used some criteria, for example, gender, year level, participant status (student or graduate), and achievement or GPA for maximising the differences. Therefore, the focus groups included participants from difference genders, year levels, status, as well as GPA so that their views provided a complex picture of the phenomenon.

3.2.3.2 Data Analysis Procedures

After collecting both quantitative and qualitative data concurrently, the researcher went through a similar series of steps: preparing the data for analysis, exploring the data, analysing the data, and representing the data analysis.

Preparing the Data for Analysis

In quantitative research, the raw data were converted into a form useful for data analysis, which means scoring the data by conveying numeric values to each response, cleaning data entry from errors, and creating variables and the numbers associated with the response options that might be needed. Recoding and computing were completed with Statistical Programme for the Social Sciences (SPSS).

For qualitative data analysis, preparing the data means arranging the documents and audio data for review or transcribing text from interviews and observations into word processing files for analysis. The researcher checked the transcription for accuracy during the transcription process and then entered it into NVivo programme.

Exploring the Data

Exploring the data means investigating or examining the data with an eye to developing broad trends and the structure of the distribution or reading through the data, making memos, and developing a preliminary understanding of the database (Creswell & Plano Clark, 2011).

In quantitative data analysis, this procedure included inspecting the data visually and conducting a descriptive analysis (the mean, standard deviation, and variance of responses to each item on the instrument) to determine the general trends in the data. The data were explored to see the distribution of the data in order to choose the proper statistic for analysis. The quality of the scores from the data instrument was also examined to assess their validity and reliability. Furthermore, the descriptive statistics were generated for several scales in the study.

For qualitative data analysis, the exploring involved the reading through the data to develop a general understanding of the database. All forms of data were reviewed, such as observational field notes and transcripts of interviews. Making these memos becomes an important initial step to form the broader categories of information, for example codes or themes. The process of generating codes assisted in the organisation of the data and facilitated agreement on the contents of the transcripts since some new codes were added and other codes removed during the coding process.

Analysing the Data

Analysing the data had been done to examine the database to address the research questions. In quantitative data analysis, the researcher analysed the data based on the type of questions and used the appropriate statistical test (e.g., a description of trends and the type of scales) to address the questions. Additionally, the researcher also used a non-parametric statistic which had the purpose to measure the differences between two independent groups on a continuous measure.

In qualitative data analysis, the analysis involved coding the data, dividing the text into small components (phrases, sentences, or paragraphs), assigning a label to each component, and then grouping the codes into themes. Throughout the process of qualitative data collection and analysis, the researcher needed to make sure that the findings and interpretations were accurate. Some criteria of trustworthiness (Lincoln & Guba, 1985) were used to deal with this issue such as triangulation of data and member checks.

The relationship between research questions, data sources, data collection method, type of data, reliability/validity measurement, and analysis of data displayed on Table 3.2.

Table 3.2

Relationship between research questions, data sources, data collection method, type of data, reliability/validity measurement, and analysis of data

Research questions	Data sources	Data collection methods	Type of data	Quality standards	Analysis of Data
Research Question 1 What is the framework for the physics education curriculum?	Government and higher education institution	Documents analysis	Qualitative	Trustworthiness (credibility by cross-checking of data)	Transcribes documents and field notes, Obtains a general sense of material, Codes for description
Research Question 2 What are academic teaching staff perceptions of the physics education curriculum?	Physics educators (lecturers)	Structured questionnaire	Quantitative	Validity & reliability	Descriptive statistics, factor analysis (construct validity), and Cronbach alpha (reliability) by using SPSS version 17.0
		One-on-one semi-structured interviews	Qualitative	Trustworthiness	Transcribes field notes, Checks with the member (internal validity), Obtains a general sense of material, Codes the data, Codes the text for theme (NVivo 9 programme).
					Quantitative and qualitative data are merged using Mixed Methods design.
Research Question 3 What are the actual process of teaching and learning in terms of the physics education curriculum?	Physics educators and students (pre-service teachers)	Classroom observations	Qualitative	Trustworthiness	Transcribes field notes, Checks with the member (internal validity), Obtains a general sense of material, Codes the data, Codes the text for theme (Hand analysis)
Research Question 4 What are pre-service teachers' and graduates' perceptions of the physics education curriculum?	Pre-service teachers and graduates	Structured questionnaire (PPEC-survey1)	Quantitative	Validity & reliability	Descriptive statistics, factor analysis (construct validity), and Cronbach alpha (reliability) by using SPSS version 17.0
		Pre-service teachers' and graduates' focus group interviews	Qualitative	Trustworthiness	Transcribes field notes, Obtains a general sense of material, Codes the data, Codes the text for theme (NVivo 9 programme)
					Quantitative and qualitative data are merged using Mixed Methods design.

Representing the Data Analysis

This process was to represent the results of the analysis in summary form in statements, tables, and figures. For the quantitative process, this involved representing the findings in statements summarising the statistical results. Tables reported results related to the descriptive questions and organised with clear titles and with labels on the rows and columns. Figures were used to present quantitative results in a visual form.

For the qualitative process, the researcher presented the results in a way that involved a discussion of the evidence for the themes or categories to convince the reader that the themes, or categories, emerged from the data.

3.2.3.3 Strategies to Merge the Two Set of Results

There were three popular options for strategies to merge from the analysis of the data in the concurrent approach: side-by-side comparisons in a discussion or summary table, joint display comparisons in the results or interpretation, or data transformation in the results (Creswell & Plano Clark, 2011).

The researcher used the first option – side-by-side comparison – for merged data analysis. The procedure involved presenting the quantitative results and the qualitative finding together in a discussion so that they can easily be compared. The presentation then becomes the means for conveying the merged results. The quantitative results might be presented first in a results or discussion section followed by the qualitative results in the form of quotes (or vice versa). A few comments then followed stating how the qualitative quotes either confirmed or disconfirmed the quantitative results.

3.2.3.4 Interpretation of the Merged Results

The final step in the analysis process was to make an interpretation of the meaning of the results which usually came through a discussion section of report. It involved stepping back from the results and advancing the larger meaning considering the research problems, research questions, the literature and possibly personal experiences.

3.3 Summary of the Chapter

This chapter has presented a detailed itinerary of the study that lies ahead, through a description of methods of the research. The mixed method convergent parallel design, with a one phase or concurrent strategy for collecting data and a side-by-side comparison of discussion for merged data analysis, were used. The next chapter (Chapter 4) describes the development of instruments for assessing pre-service teachers' and graduates' as well as lecturers' perceptions of the physics education curriculum. The findings of the research are presented in four chapters. Chapter 5 presents the results of documents analysis of the ideal and the formal/written curriculum. Chapter 6 presents the results of lecturers' perceptions of the physics education curriculum (the *perceived* curriculum). Chapter 7 presents the results of the actual process of teaching and learning (the *operational* curriculum). Chapter 8 presents the results of pre-service teachers' and graduates' perceptions of the physics education curriculum (the *experiential* curriculum).

Chapter 4

THE DEVELOPMENT OF THE INSTRUMENTS USED IN THE STUDY

4.1 Introduction

This chapter presents the development of the instruments that were used to answer the second and fourth research questions presented in Chapter 6 and Chapter 8. The first instrument is a questionnaire for assessing pre-service teachers' and graduates' perceptions of the physics education curriculum. This instrument was pilot-tested with a total of 287 physics pre-service teachers and graduates from two higher education institutions. The statistical analysis involved descriptive statistics (as a preliminary analysis to describe the characteristics of sample and to check variables), factor analysis (to refine and reduce items to form a smaller number of coherent scales), and reliabilities (to check the reliability of each scale) (see section 4.2). The second instrument is a questionnaire for assessing lecturers' perceptions of the physics education curriculum. Due to the limited number of physics lecturers, this questionnaire was not validated in a pilot test process. However, this questionnaire was carefully developed by transforming or rewording validated items of PPEC (the first instrument). The researcher made an attempt to not change many words or items within the questionnaire (see section 4.3).

4.2 The Development of an Instrument for Assessing Pre-Service Teachers' and Graduates' Perceptions of the Physics Education Curriculum (PPEC)

4.2.1 Physics Education Curriculum

In Indonesia, the physics education curricula are designed and used for the pre-service education of secondary school physics teachers. Like other study programmes in all universities in Indonesia, the education curricula can be divided into the core curriculum and the institution curriculum. The core curriculum consists of several subjects that aim to (1) develop the personality of students (for example, *Bahasa Indonesia, English, and nationality education*), (2) develop the foundations of students' knowledge and skills (for example, *fundamental of physics*, *mechanics*, *optics*, *electricity and magnetism*, *etc.* in physics pre-service teachers' programmes),

(3) develop professionalism (for example, the *education profession*, *teaching and learning*, *study of secondary curricula*, *etc.* in physics pre-service teachers' programmes), (4) nurture students' attitudes and abilities related to their knowledge and skills (for example, *micro-teaching* and *teaching practice*), and (5) develop student abilities to live in society (for example, *basic humanities* and *culture*). The institution curriculum on the other hand consists of several subjects involving universal characteristics related to its environment's needs and conditions, for example, *workshop* and *computers in science education*.

Subsequently, each higher education institution has different physics education curricula because of the diverse size, scope, and variation of the institutions. Some institutions focus on broader and deeper theories while others offer more practical work because they have better laboratory facilities. Some institutions provide more opportunities for their students to practice teaching in micro-teaching programmes as well.

4.2.2 Theoretical Background

Several differences are evident in the components of each curriculum. According to van den Akker (2003) there are ten curriculum components, i.e. (1) rationale, (2) aims & objectives, (3) content, (4) learning activities, (5) teacher role, (6) materials & resources, (7) grouping, (8) location, (9) time, and (10) assessment. All components are connected with each other and can be represented completely by six types of curriculum representations, i.e. the *ideal*, the *formal/written*, the *perceived*, the *operational*, the *experiential*, and the *learned* curriculum. The PPEC questionnaire focused only on the experiential curriculum that is, the learning experiences as perceived by learners.

As mentioned previously, learners' perceptions can be shaped by learning, memory, and expectation (see Chapter 2). Therefore, pre-service teachers', and graduates' perceptions of the physics education curriculum should prove picture of how they perceive or experience this curriculum. Their perceptions are related to several factors, namely (1) *lecturers' approaches to teaching*; (2) the *aims and objectives*; (3) *interest in physics*; and (4) *students' approaches to learning*. There have been several studies related to these issues (see for example, Hidi, Renninger, & Krapp, 2004; Kember & Kwan, 2000; Schiefele, 2009; Trigwell et al., 1999).

Lecturers' approaches to teaching vary between two broad approaches – content-centred and learning-centred – and are characterised by a motivational component and a strategy component (Kember & Kwan, 2000). On the other hand, students' approaches to learning are related to students' ways of experiencing and handling learning situations (Entwistle, McCune, & Walker, 2001). Any learning approach includes not only process but also intention. Students who are consistently relying on a surface approach, prefer and appraise lecturers who provide pre-digested information ready for 'learning', whereas students with a deep learning approach prefer lecturers who challenge and stimulate (Entwistle & Tait, 1990). Understanding the lecturers' approaches to teaching and students' approaches to learning provide valuable information related to the curriculum.

One important question when people learn relates to the goals of their learning. In the educational institution one may ask "What is the aim and objective of the curriculum?" In general, the teacher education curriculum has several aims and objectives, namely, to support students to be professional teachers, to provide knowledge and skills necessary for their future careers, and to support students to be skilled teacher researchers. How the pre-service teachers and graduates perceive these aims and objectives is also extremely precious.

Furthermore, the concept of interest is also very important because it can be used to predict students' school subject preferences and choices (Elsworth, Harvey-Beavis, Ainley, & Fabris, 1999), their expected success in higher education, and their career satisfaction (Silvia, 2006). It is appropriate therefore that studies on attitudes towards science and technology include the concept of interest in science (e.g., Cheung, 2009; Fraser, 1978; P. L. Gardner, 1975). Empirical studies in the field of physics education have examined the relation between students' learning or individual experiences and specific interest (Fischer & Horstendahl, 1997; von Aufschnaiter, Schoster, & von Aufschnaiter, 1999).

4.2.3 Purpose of the Research

The purpose of the study was to develop an instrument (the PPEC) that could be used to identify and evaluate students' and graduates' perceptions of their physics education curriculum. Students and graduates are in a good position to form accurate impressions about their physics education curricula because they have encountered various learning environments during their higher education studies. The development of an instrument for assessing pre-service teachers' and graduates' perceptions of the physics education curriculum would be very useful for higher education institutions that are responsible for the supply of physics teachers.

4.2.4 Methodology

After the conceptual framework for the instrument was established, several issues were carefully considered: (1) as no existing suitable instrument was available to evaluate the physics education curriculum in Indonesia, the researcher needed to write individual items within the scales (Maison & Treagust, 2012). However, items from previously validated questionnaires were examined and, if appropriate, adopted or modified; (2) the items should be easy to understand and not be ambiguous; (3) each item should be meaningful from the students' and graduates' perspectives.

Eleven to 14 items of the PPEC questionnaire were developed in each of the four scales/categories. Several items were developed by modifying and adopting items from questionnaires that have been used in various studies (see Table 4.1 and details in Appendix 3). Each of the items required respondents to make a selection on a 5-point Likert-type scale ranging from 1 for strongly disagree, 2 for disagree, 3 for not sure, 4 for agree, and 5 for strongly agree (Appendix 4).

Once the items for each scale had been modified or written, to establish face validity, two experienced physics lecturers were asked to assess the comprehensibility, clarity, and accuracy of items for each scale (see Figure 4.1 for the complete procedures). The lecturers evaluated each items and made suggestions whether the items were representative of the corresponding scale. Additionally, lecturers were asked to give comments on whether they felt that the items were suitable or not and, if appropriate, to propose or recommend additional items. The items of each scale were revised based on these reviews.

It was necessary to translate the questionnaire into Indonesian because it would be administered to Indonesian participants. As mentioned by Chang, Chau, and Holroyd (1999), the translation of a previously developed instrument may often be the choice when addressing the research questions to groups of participants whose language is not English. From a review of the literature (Bracken & Barona, 1991; Brislin, 1970; Chang et al., 1999; Temple, 1997) adequate translation procedures are (1) translation of source language to target language, (2) blind back-translation, and (3) ensuring the equivalence of a translated version.

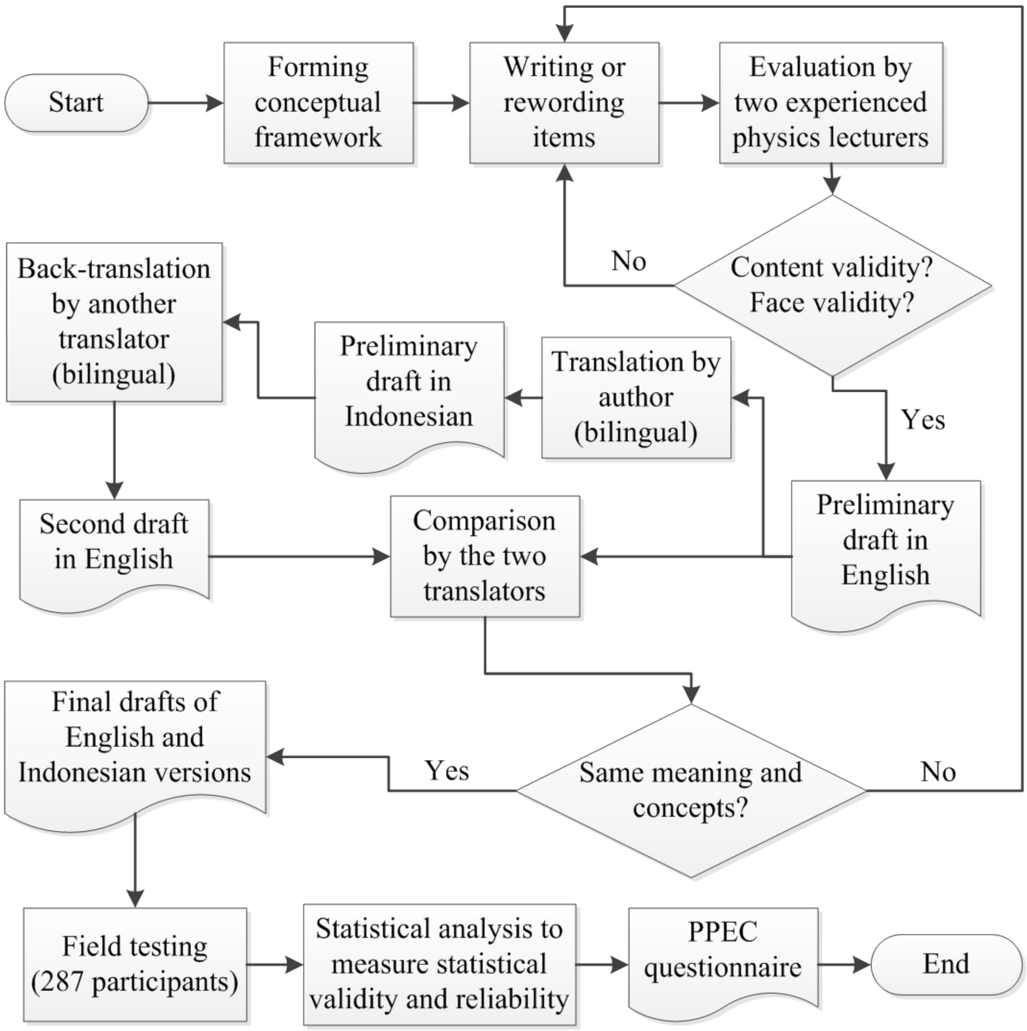

Figure 4.1 Flowchart of questionnaire development

Translation and back translation were used to develop an Indonesian version of the PPEC questionnaire. The first stage involved translating the English instrument into Indonesian by the author (translator 1) who is bilingual. The translation should have the same meaning and concept with the original version. Therefore, in the next stage, this instrument was back-translated into English by an Indonesian science lecturer (translator 2) who is also bilingual without reference to the original items. The two translators then compared and checked the meaning and concept of the back-translation and the original instrument in order to decide whether or not any items needed to be revised.

Several items were modified in order to make them more meaningful. For example, the item ‘I prefer to do physics experiments more than any other experiments’, was deleted because students in physics education programmes only conducted physics experiments during their studies. The item ‘I understand that my major future job will likely be related to schools’ was changed to ‘I understand that my major future job will likely be related to schools and learning societies’. Finally, 47 items were established in the PPEC questionnaire in four scales – Approaches to teaching physics (AT), Aims & objectives of physics education curriculum (AO), Interest in physics (IP), and Approaches to learning physics (AL).

Table 4.1

Development of items in the PPEC questionnaire

Item numbers	Sources
AL6, IP7	Approaches to studying (Leathwood & Phillips, 2000)
IP2, IP3, IP4, IP5, IP8, IP9, IP10, IP11, AO1	Attitudes toward Chemistry Lesson Scale (ATCLS) (Cheung, 2009)
AO3, AO6, AO10, AL1, AL2, AL3, AL5, AL8	Science Motivation Questionnaire (Glynn, Taasoobshirazi, & Brickman, 2009)
AT1, AT3, AT5, AT7, AT8, AT9, AT10	Student Perceptions of Teachers’ Knowledge (SPOTK) (Tuan, Chang, Wang, & Treagust (2000).
IP1, IP6, AO2, AO4, AO5, AO7, AO8, AO9, AO11, AO12, AO13, AO14, AL4, AL7, AL9, AL10, AL11, AT2, AT4, AT6, AT11	Developed by the author

A summary of the sources of the 47 items in the PPEC is provided in Table 4.1. The 47-item PPEC questionnaire was pilot-tested by administering to 117 pre-service teachers and graduates from Bengkulu University and 170 pre-service teachers and graduates from Jambi University in 2010, who varied in years of study, sex, and achievement level.

All items were subjected to item-scale correlation and principal components analysis (PCA) using SPSS Version 17. Prior to performing PCA, the appropriateness of data for factor analysis was assessed. Inspection of the correlation matrix had shown the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Olkin (KMO) value was 0.842, exceeding the recommended value of 0.6 (Kaiser, 1974) and Bartlett's Test of Sphericity value ($p = 0.000$) reached statistical significance, supporting the factorability of the correlation matrix.

Principal component analysis revealed the presence of 14 components with eigenvalues exceeding 1, explaining: 19%, 6.49%, 5.24%, and 4.20% of the variance respectively for components number 1 towards 4; around 3% of the variance for each of components number 5 towards 10; and around 2% of variance for each of the last components. An inspection of the screeplot (Appendix 5) revealed a break after the fourth component. Using Catell's (1966) scree test, it was decided to retain all of the four components (scales) for further investigation.

The four-scale solution explained a total of 34.93% of the variance. Scale AT contributing 19%, scale AO contributing 6.49%, scale IP contributing 5.24%, and scale AL contributing 4.20%. To aid the interpretation of these four scales, varimax rotation was performed. It maximises the variance of factors across the variables, which produces a simpler solution.

Based on data analysis involving item-scale correlation and factor analysis, nine items were removed. In this study, all items which had item-scale correlation values higher than 0.4 and factor loadings (correlation coefficients) 0.4 or above were retained. The items 'I like to do better than the other students on the physics test', 'I believe that physics knowledge in a physics pre-service teachers' programme forms the basis for teaching practice', 'I think the content of education curriculum can support me to be a critical thinker', and 'I am confident that I have enough competencies to be a physics teacher' had item scale correlations of 0.47, 0.42, 0.43, and 0.46 respectively, but their factor loadings were less than 0.4, so these items were dropped from the final version of the PPEC-questionnaire.

The final version of the PPEC questionnaire consisted of 38 items (Maison & Treagust, 2012). Examples of items from the final version are provided in Table 4.2 and the complete questionnaire is shown in Appendix 3 and Appendix 4.

Table 4.2

Structure of the final version of the PPEC questionnaire

Scale name	No. of items	Examples of items
Approaches to teaching physics (AT)	11	My teacher's teaching methods keep me interested in physics (AT1). My teacher's assessments encourage me to be a self-regulated learner (AT11).
Aims and objectives of physics education curriculum (AO)	13	I think the physics education curriculum can support me to be a professional teacher (AO4). I think learning physics can help me to be a good physics teacher (AO12).
Interest in physics (IP)	6	I really enjoy learning physics (IP6). Physics subjects are interesting (IP2).
Approaches to learning physics (AL)	8	I put enough effort into learning the physics (AL1). I prepare well for the physics test and labs (AL2).

4.2.5 Results and Discussion

Students' and graduates' responses to the 38 items of the instrument to evaluate their perceptions of the physics education curriculum were analysed using SPSS (Version 17). The descriptive statistics (Table 4.3), factor analysis (Table 4.4), and reliabilities (Table 4.5) are provided in the following sections.

4.2.5.1 Descriptive statistics

In Table 4.3, the mean response for the AT scale (Approaches to teaching physics) was 3.52, indicating that respondents' perceptions of the approaches to physics teaching that their lecturers used ranged between 'not sure' and 'agree'. For the AO scale (Aims & objectives of physics education curriculum), the mean response was 4.12, indicating that in general the respondents were in agreement with the aims and objectives of the physics education curriculum. For the IP scale (Interest in physics), the mean response was 3.77, indicating that respondents in general had an interest in physics. For the AL scale (Approaches to learning physics), the mean response was 3.90, indicating that the respondents on the average agreed with the approaches to learning physics portrayed by the items.

Among the above four scales about the physics education curriculum, students' and graduates' mean scores from highest to lowest were: Aims & objectives of physics education curriculum (AO), Approaches to learning physics (AL), Interest in physics (IP), and Approaches to teaching physics (AT).

Table 4.3

Descriptive statistics for the four scales of the PPEC questionnaire to measure students' and graduates' perceptions of the physics education curriculum

Scale	No of items	Average item mean	Average item standard deviation
AT	11	3.52	0.49
AO	13	4.12	0.39
IP	6	3.77	0.49
AL	8	3.90	0.42

4.2.5.2 Validity of the instrument

The validity of a scale in an instrument refers to the degree to which it measures what it is supposed to measure. According to Trochim and Donnelly (2008) a construct of new instrument must fulfil both translation and criterion-related validity requirements. Translation validity involves content validity (which focuses on whether the construct is theoretically sound and covers all representations of the construct) and face validity (which underlines the need for a clear interpretation of the item, especially by participants). The process of developing the instrument in this study was carefully done to fulfil the content and face validity.

Criterion-related validity involves a relational approach as it confirms whether the construct presents the conclusions that are expected based on theoretical grounds. Therefore, the items of a particular construct or scale should be highly correlated to each other (convergent validity), whereas items from different construct should not be highly correlated to each other (discriminant validity). Statistical analysis was conducted using SPSS statistical package. Inspections of correlation values between items on the component correlation matrix showed that the construct of items met the requirement for convergent and discriminant validity.

Table 4.4

Factor Analysis of Items in Final Version of the PPEC-survey

		Factor			
Item Number		*Approaches to Teaching*	*Aim & Objectives*	*Interest in Physics*	*Approaches to Learning*
1	(AT1)	0.67			
2	(AT2)	0.68			
3	(AT3)	0.43			
4	(AT4)	0.60			
5	(AT5)	0.69			
6	(AT6)	0.63			
7	(AT7)	0.50			
8	(AT8)	0.59			
9	(AT9)	0.41			
10	(AT10)	0.54			
11	(AT11)	0.45			
12	(AO1)		0.47		
13	(AO2)		0.44		
14	(AO3)		0.56		
15	(AO4)		0.49		
16	(AO5)		0.53		
17	(AO6)		0.42		
18	(AO7)		0.60		
19	(AO8)		0.45		
20	(AO10)		0.55		
21	(AO11)		0.56		
22	(AO12)		0.57		
23	(AO13)		0.54		
24	(AO14)		0.62		
25	(IP2)			0.66	
26	(IP3)			0.49	
27	(IP5)			0.66	
28	(IP6)			0.72	
29	(IP8)			0.49	
30	(IP9)			0.52	
31	(AL1)				0.47
32	(AL2)				0.54
33	(AL3)				0.57
34	(AL5)				0.58
35	(AL6)				0.51
36	(AL8)				0.47
37	(AL9)				0.50
38	(AL11)				0.58
	Eigenvalue	8.30	3.05	2.46	1.98
	% Variance	19.00	6.49	5.24	4.20
	Cumulative % variance	19.00	25.49	30.73	34.93

Note. Loading less than 0.4 removed; eigen > 1.632 (based on scree plot); n = 287;
Extraction method: Principal components analysis;
Rotation methods: Varimax with Kaiser Normalization (KMO: 0.842)

The rotated factor matrix, using varimax rotation, shown in Table 4.4 supports the four-scale structure of the PPEC questionnaire based on the scree plot as recommended by Catell (1966) and described by Preacher and MacCallum (2003). Each factor contains high positive loadings on all 11, 13, six, and eight items, respectively, for the AT, AO, IP, and AL scales. These results suggest that the questionnaire has statistical validity.

4.2.5.3 Reliabilities

The reliability refers to the degree to which the items that form the scale 'hang together'. Are they all assessing the same underlying construct? One of the most commonly used indicators is Cronbach's alpha coefficient (Pallant, 2007). In this study, the scales for each category had high Cronbach's alpha values ranging from 0.75 (IP) to 0.84 (AT) (see Table 4.5), indicating that the scales were a reliable measure of the physics education curriculum being investigated. DeVellis (2003) states that the Cronbach's alpha coefficient should ideally be above 0.7.

Table 4.5

Reliability of the PPEC-survey

Scale	*No. of Items*	*Cronbach's alpha Reliability*
AT	11	0.84
AO	13	0.82
IP	6	0.75
AL	8	0.77

4.2.6 Conclusions

The data analysis indicated that the instrument on pre-service teachers' and graduates' perceptions of the physics education curriculum in relation to their lecturers' approaches to teaching physics, aims & objectives, their interest in physics, and their approaches to learning physics have satisfactory validity and reliability measures. The uniqueness of the PPEC questionnaire is that it is specifically related to the experiential curriculum. This is important because the instrument has the potential to assist lecturers to identify pre-service teachers' and graduates' perceptions on their own physics teaching as well as their students' views about the curriculum. By examining the results from the administration of the instrument, researchers and lecturers can recognise those aspects of the physics education curriculum that need to be improved in order to match pre-service physics teachers' and graduates' needs and expectations.

To establish the instrument's usefulness, future research is required to provide in-depth information concerning pre-service teachers' and graduates' perceptions of the physics education curriculum by conducting interviews. Also, further research needs to be conducted with a larger number of institutions with varying standards of physics education programmes in order to ascertain the reliability of the PPEC questionnaire for use in other Indonesian universities.

4.3 Instrument for Assessing Lecturers' Perceptions of the Physics Education Curriculum (PPEC-survey2)

This instrument was developed by transforming or rewording validated items of the PPEC questionnaire to examine lecturers' interest in physics (IP), aims and objectives of physics education curriculum (AO), students' approaches to learning (AL), and lecturers' approaches to teaching (AT). In order to make them meaningful, some words in some items were changed to appropriate words. For examples, the item "I think the physics education curriculum can support me to be a professional teacher" changed to "I think the physics education curriculum can support my students to be professional teachers", the item" I put enough effort into learning the physics" changed to "I think my students put enough effort into learning the physics", and the item "My lecturer's teaching methods keep me interested in physics" changed to "My teaching methods keep my students interested in physics".

Furthermore, three items were deleted, i.e. AO6, AO10, and AL5, because these items were more appropriate to the students than the lecturers. Finally, four items have been added to the survey, i.e. I prepare well for the teaching of physics (AT); I use strategies that ensure I teach my students well (AT); I prepare well for assessing students' achievement and progress (AT); and I think the physics education curriculum can support my students to be creative thinkers (AO). The final version of the PPEC questionnaire for the lecturers or PPEC-survey2 consists of 39 items. Examples of items in each scale are presented in Table 4.6; the complete instrument is provided in Appendix 3 and Appendix 4.

Table 4.6

Structure of the PPEC questionnaire for the lecturers

Scale name	No. of items	Examples of items
Approaches to teaching physics (AT)	14	My teaching methods keep my students interested in physics (AT1). My assessments encourage my students to be self-regulated learners (AT11).
Aims and objectives of physics education curriculum (AO)	12	I think the physics education curriculum can support my students to be professional teachers (AO4). I think learning physics can help my students to be good physics teachers (AO12).
Interest in physics (IP)	6	I really enjoy learning physics (IP6). Physics subjects are interesting (IP2).
Approaches to learning physics (AL)	7	I think my students put enough effort into learning the physics (AL1). I think my students prepare well for the physics test and labs (AL2).

4.4 Summary of the Chapter

The validation process in developing the PPEC questionnaire consisted of calculating both internal consistency reliability (as measured by Cronbach's alpha coefficient) and construct validity (as measured by rotated components). The PPEC was found to have high reliability, and satisfactory validity.

As the second instrument was developed from the first instrument and only had minor modifications made to the scales, such high reliabilities would be expected, however, due to the limited participants, the pilot test like that was done for the first questionnaire could not be conducted.

Chapter 5

THE IDEAL AND THE FORMAL/WRITTEN CURRICULUM

5.1 Introduction

In Chapter 3, the conceptual framework and research strategy were developed and the methods were described to enable the collection and analysis of data from a variety of sources that relate to the physics education curriculum. Chapter 4 portrayed the development process of the instruments. In this chapter and the next three chapters, the data collected are presented, grouped, and analysed to answer the related research questions. This chapter describes data relating to the first research question.

Research Question 1

What is the framework for the physics education curriculum (the *ideal* and the *formal/written* curriculum)?

Addressing this research question will not explain what is the best physics education curriculum for higher education students in Indonesia. However, this intended domain will be a reference for the implementation of education for physics pre-service teachers in higher education. Therefore, the aim of the first research question is to discuss the rationale or the underlying principle and the intentions as specified in the curriculum document at the system and the institution levels.

Data are presented relating to the laws, government regulations, the Ministry of National Education resolutions, and the director general of higher education resolutions (the *ideal* curriculum) as well as the intentions or purposes as identified in curriculum documents and/or materials (the *formal/written* curriculum) offered by the higher education institution in Indonesia that is participating in this study.

5.2 The Ideal Curriculum for Higher Education Institutions in Indonesia

The Act of the Republic of Indonesia number 20 in 2003 provides the legal framework for the National Education System. Article 38, section 3 states that the curriculum of higher education shall be developed by each higher education institution concerned, taking into consideration national standards of education for each programme of study.

There are eight categories of national standards of education (Government Regulation number 19 of 2005 on national education standards); four of them are associated with the curriculum, i.e. content standard, process standard, graduate competence standard, and assessment standard.

Article 5 in this regulation stated that the content standard includes the scope of materials and level of competence required to achieve graduate status. The content standard also involves the basic framework and structure of the curriculum, learning packages, and academic calendar. Furthermore, Article 9 explained that: (1) The basic framework and structure of higher education curriculum shall be developed by the higher education institution for each programme of study; (2) The curriculum must include courses for religious education, citizenship education, Bahasa Indonesia, and English. In addition, the Bachelor degree programme must include courses that contain information about personality, culture, statistics and/or mathematics; and (3) the depth of the curriculum is governed by the respective institutions.

Based on the Minister of National Education (MoNE) Resolution Number 232/U/2000, one of the aims in the implementation of academic education in higher education institutions is to enable the learner to be a member of societies who has the academic ability to apply, to develop, and/or to enrich knowledge, technology, and/or art, and also to distribute them in order to increase Indonesia's standard of life and culture. Figure 5.1 presents several legal frameworks for higher education curriculum reform in Indonesia. In this organisation, MoNE Resolution No. 232 Year 2000 and 045 Year 2002 are older than the Act No 20 Year 2003, Government Regulation No. 19 Year 2005, and Government Regulation No. 17 Year 2010 but all higher education institutions still use these guidelines because the content of these resolutions are not contrary to the act and recent government regulations.

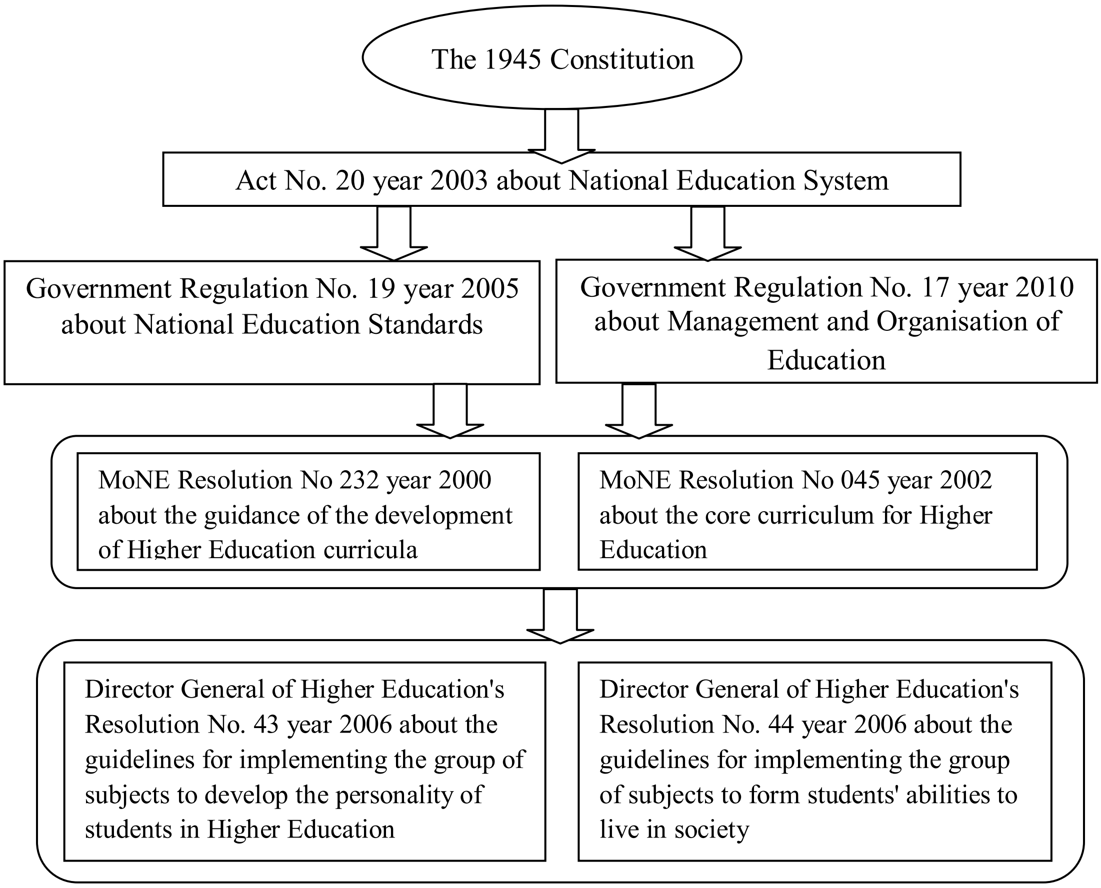

Figure 5.1 The hierarchy of the legal framework for higher education curriculum development in the Indonesian education system.

Furthermore, MoNE Resolution No. 232 of 2000 stated that the Bachelor programme is directed to produce graduates who (a) have qualifications in the nature of knowledge and skills, (b) are able to apply their knowledge and skills, (c) have good attitudes and behaviours, and (d) are able to keep on track with the development of knowledge, technology, or art. The minimum number of credits for one who takes the Bachelor programme is 144, the maximum number of credits is 160, and all credits are scheduled to be completed in eight semesters (see section 5.3.2 for definition of credit). One who enrols in university can finish in less than eight semesters if he or she is able to take subjects outside the normal schedule (there are some decisive factors and procedures about this depending on each institutions). The maximum time for completing the Bachelor programme is 14 semesters or seven years.

All legal regulations previously discussed also become the main considerations for the development of higher education curricula which consist of core curriculum and institution curriculum. The core curriculum comprises subjects that must be included in a study programme and used nationally. MoNE Resolution Number 232 in 2000 states that the core curriculum must contain several groups of subjects (1) to develop the personality of students (for example, *religious education, Bahasa Indonesia, and citizenship education* as mentioned in the regulations), (2) to construct student knowledge and skill foundation, (3) to produce professionals, (4) to form student attitudes and abilities related to their knowledge and skills, and (5) to form student abilities to live in society. Because the government policies do not specifically mention all sample of subjects related to these points, one can see it in the written curriculum of each study programmes in every higher education institution.

The previous five points indicate five competencies that the higher education institutions should refer to in developing their curriculum. Later (in 2002), the MoNE through Resolution No. 045 stated that the five elements of competencies, involve the basis of personality, the mastery of knowledge and skills, the ability to work, the attitudes and behaviours in working associated with knowledge and skills, and the understanding of society in accordance with the choice of expertise in working. In order to get the same perception in developing the personality of students and student ability to live in society, the Director of Higher Education provides the guidelines through resolutions No. 43 and 44 Year 2006 (see Figure 5.1).

The new Government Regulation (No. 17 of 2010 in Article 97) also states that the higher education curriculum to be developed and implemented is competency-based. The competency elements consist of:

(a) The basis of personality;
(b) The mastery of science, technology, art, and/or sport;
(c) The ability and skills to work;
(d) The attitudes and behaviours in working associated with the knowledge and skills mastered;
(e) The ability to live in society in accordance with the choice of expertise in the work.

The percentages of the core curriculum vary between 40% and 80% of total credits for the Bachelor programme (MoNE Resolution No. 232 of 2000). The core curriculum of a study programme should be: (a) the basis to achieve the graduate's competence; (b) the minimum quality standard of the operational study programme; (c) applicable nationally or internationally; (d) flexible and accommodating to the rapid changes in the future; (e) in agreement with universities, professional societies, and stakeholders. The institution curriculum is a small number of subjects that are part of the curriculum of higher education. These are in addition to the core curriculum which shows the strength typical of the higher education institution.

Furthermore, with regard to the standards process, described in Article 19 (government regulation number 19 of 2005), (1) the learning process in educational units should be interactive, inspiring, exciting, and challenging. The learning process should also motivate the learners to actively participate in learning and provide enough space for innovation, creativity, and independence according to their talents, interest, and development; and (2) each unit of education must plan the learning process, implement the learning process, and carry out assessments and supervision to attain the learning process effectively and efficiently.

The content of the first assertion in the standard process which was described previously is related to the principles of good teaching. A good teacher is able to motivate students to achieve their high expectations. The motivation comes through for example, encouraging students, providing interesting and enjoyable classes, preparing relevant material, and a variety of active learning approaches. Good teaching also challenges students' beliefs in establishing appropriate ways of learning and beliefs about knowledge, and deals with misconceptions of fundamental concepts (Kember & McNaught, 2007).

According to Kember and McNaught (2007), teaching and curriculum design need to be consistent with and able to meet students' future needs. This indicates the development of a range of generic capabilities, for example, self-managed learning ability, critical thinking, analytical skills, and communication skills.

5.3 The Formal/Written Curriculum for Physics Pre-service Teachers

5.3.1 The Framework of Curriculum Structure for Physics Pre-service Teachers

All legal products or regulations that have been discussed become the main considerations for the development of the physics education curriculum. In

Indonesia, the physics education curricula in higher education institutions are designed to educate candidates for physics teaching in junior and senior high schools (SMP and SMA). The curricula consist of the core curriculum and the institution curriculum.

Considering the government policies about higher education curricula, the physics pre-service teachers' programme has developed the core and the institutional curriculum. Unfortunately, the higher education's written documents do not mention about the labels of the core or institution curriculum on every subject. However, it can be identified based on the syllabi of every subject and the definition of the core or institution curriculum that is in the MoNE resolution Number 232 Year 2000. The core curriculum contains several groups of subjects to develop the personality of students (see the previous section), to construct student knowledge and skill foundation (in physics pre-service teachers' programme, for example, *general physics*, *mechanics*, *waves and optics*, *electricity and magnetism*, *etc.*), to produce professional understanding (in physics pre-service teachers' programme, for example, *teaching practice*, *teaching and learning*, *review of secondary school curricula and materials*, *etc*), to form student attitudes and abilities related to their knowledge and skills (in physics pre-service teachers' programme, for example, *educational profession*), and to form student abilities to live in society (for example, *social work, social science* and *culture*).

Table 5.1

A distribution and percentage of the core and institution curriculum

Curricula	Semesters	Credits as % of Total Credits
Core curriculum	1-8	80
Institution curriculum	5-7	20

The percentage of the core curriculum was around 80% which is the maximum range of the government recommendation and the percentage of the institution curriculum was around 20% (see Table 5.1). The institution curriculum supported the core curriculum with several subjects related to the condition of the institution and the need of the stakeholders. Environmental Physics, an example of a subject in the institution curriculum, relates to the needs of society in understanding and taking more care of the environment. Another example, General Seismology, was offered to provide pre-service teachers with additional understanding related to seismic activities (for example, earthquakes) that take place in Indonesia as part of natural events.

The core and the institution curriculum are distributed into several subjects or courses which are made compulsory by the university, the faculty, the study programme, and into several subjects by options or choices. All subjects are spread over eight semesters. Semester 7 and 8 (it can be also said the odd and even semester in year 4) had less credits than the others, because the students have teaching practice and write a thesis in these semesters. A summary of the curriculum structure for physics pre-service teacher is provided in Table 5.2. Details or the complete curriculum structure is shown in Appendix 6.

Table 5.2

A summary of the curriculum structure

No	Subjects	Semester and Number of Credits							
		1	2	3	4	5	6	7	8
1	Compulsory by University	6	6	3					4
2	Compulsory by Faculty	3	3	3	4			6	
3	Compulsory by Study Programme	10	10	16	19	24	20	3	
4	Subjects of Choice						2	2	6
	Total (150 credits)	19	19	22	23	24	22	11	10

Table 5.3

Total subjects and percentage of credits

Subject Code	No. of Subjects	No. of Credits	Credits as % of Total Credits
UNJ	6	19	12.7
KIP	5	19	12.7
FIS	41	112	74.7
Total	52	150	

The total number of subjects that must be taken by the students is 52 (see table 5.3) consisting of 50 compulsory subjects and two subjects of choice. Subjects that have the codes UNJ are made compulsory by the university and the coded KIP are made compulsory by the faculty. The FIS codes are only mandatory for the Physics Study Programme. All of these subjects have a total of 150 credits. Table 5.3 shows the percentage of these credits then Section 5.3.2 provides further information about the credits – the use and definition – time and academic calendar.

5.3.2 Credits, Time and Academic Calendar

Credits (the most popular term in Indonesian higher education institutions is "*Satuan Kredit Semester*" or SKS) can be used to determine a study load of the tertiary student, a recognition of the degree of student achievement, an indication of what the student needs to finish his or her programme, and for the lecturer to prepare and implement the teaching programme. It has specific goals, that is (1) to give higher achieving students the opportunity to finish their study quickly, (2) to give students the opportunity to choose subjects that correspond with their interests and capabilities, (3) to give more possibilities to implement education with multifaceted inputs, (4) to enable change of the curriculum associated with the rapid growth of science and technology, (5) to enable the implementation of good evaluations of student achievement, and (6) to give the possibility to transfer credits among study programmes, faculties, or universities.

Because the number of credits describes the study load, the greater the number of credits, the larger or deeper the content of the subject, and the more time needed for studying. Theoretically, learning activities involve three parts, i.e., attending lectures in a class or doing scheduled practical work in a laboratory, doing structured assignments (self-directed learning), and doing unstructured assignments (self-learning or independent activities in studying). For conceptual knowledge or a non-practical work subject, one credit is equivalent to study load per week for one semester, comprising one hour of scheduled activities to attend lectures (including a 5-10 minute break), one hour of self-directed learning (for example, completing homework assigned by lecturers), and one hour independent learning (for example, reading a book reference and deepening the material). On a practical work subject or procedural knowledge, one credit is equivalent to study load per week for one semester consisting of two hours of practical activities in the laboratory, one hour of self-directed learning (for example completing homework or practical reports assigned by lecturers), and one hour independent learning. By referring to the number of credits, pre-service teachers can easily know how long they should study in a week. For example, Mechanics has four credits which means those pre-service teachers who took Mechanics must attend the lectures/classes that were scheduled around four hours per week; they also need to do some structured assignments and unstructured assignments for two hours for each. Therefore, in total, pre-service teachers should study Mechanics approximately 12 hours per week.

In semester 1 (year 1), for example, there are six subjects (see Appendix 6) with a total of 19 credits (including two credit of practical work), their codes are UNJ 101, UNJ 102, KIP 101, FIS 101, FIS 102, and FIS 103. By referring to the previous definition of credit, pre-service teachers must attend approximately 21 hours lectures and practical activities in a week plus doing 19 hours structured assignments and 19 hours unstructured assignments. So they should study about 59 hours in a week. If they learn six days a week (except Sunday) then the average time for learning are nine point eight (9.8) hours a day.

Another example, in semester 5 (it can be said the *odd-semester of year 3*), there are nine subjects with a total of 24 credits (including one credit of practical work) provided. Therefore, the pre-service teachers should learn about 73 hours per week during this semester. If we assume they study six days a week, similar to the previous assumption, then the average time they should spent for learning are more than 12 hours a day.

In Indonesia, the academic calendar begins in the middle of the year, normally starting in July. Physics pre-service teachers must register in July or August (explicit dates are announced on the website and may slightly vary between new and continuing students). In the 2010-2011 school years, lectures and practical work started from 17 September 2010 until 15 January 2011, this semester is called the odd-semester of 2010-2011 academic years. The following semester (the even-semester of 2010-2011 academic years) began in February 2011 and finished in June 2011. Normally, there are 17 or 18 weeks of study in every semester before the final examination, but the lecturers are advised to complete their lecturing in 16 weeks. Table 5.4 presents the relation between credits and time of study with an assumption of 16 weeks of effective courses.

Table 5.4

Total credits, Physics education hours, and contact hours in Physics Pre-service Teachers' Programme

Semesters	Total Credits	Total Physics Education Hours	Self-Learning Hours	Total Contact Hours
1	19	944	608	336
2	19	944	608	336
3	22	1072	704	368
4	23	1136	736	400
5	24	1168	768	400
6	22	1088	704	384
7*	11	528	352	176
8*	10	480	320	160
Mean	18.75	920	600	320

* These semesters include teaching practice at schools and thesis so its need more time than what are appeared in this table.

There is considerable variation in the amount of physics education programmes in the different semesters (see Table 5.4). Excluding semesters 7 and 8, the total hours allocated to physics education programmes varied from 944 hours (semester 1 and 2) to 1168 hours (semester 5). In semester 1, 19 credits were fixed and should be taken by all pre-service teachers. In other semesters, there were prerequisites for taking the amount of credits, for example, the pre-service teachers' grade in the previous semester. Therefore, some pre-service teachers could take more credits, but some only took less than those scheduled.

How much time do pre-service teachers need to study? Based on data from Table 5.2, Table 5.3 and Appendix 6, it can be calculated that the number of credits for the entire Physics Education Bachelor Programme is 150 (including 10 credits of practical work). Since the number of study weeks in one semester is 16 weeks, one can generally determine the total hours of study for the Physics pre-service teachers by multiplying 150 and 16 which has the result of 2400. By referring to these numbers, pre-service teachers are supposed to finish their study successfully after carrying out 2560 hours activities in lecture rooms and labs, 2400 hours activities in doing structured assignments, and 2400 hours activities in doing unstructured assignments. The whole time is 7360 hours. Are these too much? Do the pre-service teachers implement this rule? To answer these questions, we need to know what the lecturers, the pre-service teachers, and the graduates' comments (see the next chapters). Comparing these hours to other similar study programmes is important, but as all programmes are following the same government regulations, it might not provide significant differences in the number of credits.

5.3.3 Aims and Objectives

The terms of aims, ends, purposes, functions, goals, outcomes, and objectives may be used synonymously in common language. However, it is helpful if distinctions are made in pedagogical language. According to Oliva (2009), the term "outcomes" applies to terminal expectations generally. Aims are equated with "ends," "purposes," "functions," and "universal goals." The aims of curriculum are the broad, general statement of the purposes of the implementation of a curriculum in education; while curriculum objectives are specific, programmatic targets with criteria of achievement and, therefore, are measurable. Furthermore, Oliva (2009) mentioned that the curriculum objectives are developed from the curriculum aims or goals.

As described in the institution document, the Physics education study programme has a formal set of aims and objectives. The broad programme aims are to prepare pre-service teachers who have (1) good personalities related to the aims of national education, (2) the basis of scientific thinking, so they can communicate among physicists or scientists, (3) the basis of physics knowledge which can be taught comprehensively, solidly, and deeply, and (4) a broad insight about education, ability, and skills in designing, implementing, and managing teaching and learning in physics.

The purposes of learning objectives is to be explicit about what it is the lecturers want the pre-service teachers to do, and what they need them to learn in order for the aim to be achieved. Learning objectives may be written with respect to knowledge, skill, and attitudes. For objectives to be claimed it must be assessed therefore there must be an alignment between objectives and assessments. Learning objectives should be related to the objectives of the physics pre-service teacher curriculum.

General objectives, described in one of the Physics pre-service teachers' curriculum documents, are that pre-service teacher can (1) understand physics concepts, (2) use methods and equipment to understand the physics concepts, (3) understand physics comprehensively and know the relation among concepts and theory, (4) understand the characteristics of junior and senior high school students, (5) understand the basic concepts of education, physics education, and teaching and learning process, and (6) continue further study.

5.3.4 Curriculum Guides, Courses of Study, and Syllabi

Although not many written documents are available in the physics pre-service teacher programme, curriculum guides, courses of study and syllabi are the common existing documents related to the physics education curriculum. A curriculum guide is the most general of the three types of documents. It may cover a single subject (for example, Mechanics or Thermodynamics); two or more subjects at a particular semester that a lecturer has to teach; or an area of interest applicable to two or more subjects (e.g., laboratory safety). When a curriculum guide covers a single subject, it may also be called a course of study. A course of study is a detailed plan for a single course, including text materials (content) – in summary or in complete text. A syllabus is an outline of topics to be covered in a single course (Oliva, 2009).

Commonly, every physics teacher educator develops the curriculum guide which covers a single subject or course. A comprehensive curriculum guide format is shown in Figure 5.2. This format is not prescriptive. Guides of this nature are supplementary aids for the professional lecturer. The faculty offer the flexibility to the lecturer, who may choose or reject any of the suggested aims, objectives, activities, evaluation techniques, or resources.

Some lecturers also describe standards of competences in the course description and use basic competences and indicators instead of aims and objectives in the table. These replacements were made by these lecturers to implement the government policies about the curriculum reforms (the new curriculum in Indonesia is competence-based).

Curriculum Guide

A. General Information
1. Programme :
2. Course title :
3. Course code :
4. Credits :
5. Lecturer :

B. Course Description
1. The course is mandatory for :
2. Synopsis :
3. Preceding course :

Week	Topic	Aims	Objectives	Activities	Evaluation Techniques	Resources

Figure 5.2 Comprehensive curriculum guide format

Due to a large number of subjects and the lecturer's flexibilities in creating the curriculum guides, it is an enormous task to analyse every curriculum guide or even though the syllabi developed by the lecturers. However, in this research, the researcher attempted to analyse and compare some syllabi of "General Physics I" and "Mechanics". The researcher also made observations of the teaching practices in these subjects (see Chapter 7 about the operational curriculum).

General Physics I consists of some physics sections such as, mechanics, electricity, and magnetism. This subject is provided in the first semester and is intended to underpin students' knowledge about general physics related to the three sections. The subject of Mechanics consists of some sections related to classical mechanics for example, motion, energy, gravitation, and momentum.

General Physics I is a prerequisite subject and some topics in this subject are still available in Mechanics. However, the content of these topics in Mechanics is deeper than in General Physics I. A summary of topics' outline of General Physics I (in the section of mechanics) and the availability of these topics in Mechanics are provided in Table 5.5.

Table 5.5

Some topic outlines of General Physics I and Mechanics

An outline of topics in General Physics I (in the section of mechanics)	The availability in Mechanics
Vector	-
Motion in one dimension	√
Motion in two dimensions	√
The law of motion	√
Circular motion and other application of Newtons laws	√
Energy and energy transfer	√
Potential energy	√
Linear momentum and collisions	√
Rotation of a rigid object about a fixed axis	√
Angular momentum	√
Static equilibrium and elasticity	√
Universal gravitation	√
Fluid mechanics	-

In Table 5.5, there are thirteen topics related to the section of mechanics. Every topic can be divided into several sub-topics, for example, the topic "Motion in one dimension" consists of (1) position, velocity, and speed, (2) instantaneous velocity and speed, (3) acceleration, (4) motions diagrams, (5) one-dimensional motion with constant acceleration, (6) freely falling objects, and (7) kinematic equations. The topic "The laws of motion" includes (1) the concepts of force, (2) Newton's first law and inertial frames, (3) mass, (4) Newton's second law, (5) the gravitational force and weight, (6) Newton's third law, (7) some applications of Newton's laws, and (8) forces of friction. The topic "Angular momentum" consists of (1) the vector product and torque, (2) angular momentum, (3) angular momentum of a rotating rigid object, and (4) conservation of angular momentum.

As has been mentioned previously, General Physics I includes not only mechanics but also electricity and magnetism sections. Consequently, this subject contains many physics concepts and theories.

5.3.5 *Teaching and Learning Strategy*

It was assumed that all teaching staff would use lectures and tutorials as the main teaching strategy. Additional teaching strategies could be included for example, laboratory sessions, small-group discussion, independent study, mediated instruction (including PowerPoint presentations and computer-assisted instruction), and library research. To this list, lecturers can include inquiry or discovery, inductive, and deductive methods. They can also add case studies, problem solving, and problem based learning. Suffice to say that the lecturer has privilege to choose a strategy for implementing instruction in teaching and learning.

How does the lecturer decide which strategy or strategies to use? Although no specific guidelines about teaching and learning strategies to be employed were mentioned in many written documents of the physics pre-service teacher programme, the lecturer can use for example, objectives, subject matter, student, community, or even lecturer him or herself as the sources of the strategies (Oliva, 2009).

According to one of the physics lecturers, there are many teaching and learning strategies that are depended on the objectives and subject matter. If an objective is to enable students to recognise the difference between displacement and distance travelled, a physics lecturer may tell the students or give a chalk talk using the blackboard. Alternatively, the students can observe some demonstrations about the movements of an object along various directions and they are asked to calculate the displacement and distance. Yet again, the students can practice using vector quantity and scalar quantity concepts.

Students are also an important factor as in deciding a teaching and learning strategy source because the strategies must be appropriate for the students. According to Oliva (2009), educators who underestimate the capability of learners and talk down to them or who overestimate the aptitude of learners and talk over their heads follow approaches that do not acknowledge the student as a source of a teaching strategy.

A teaching and learning strategy must also conform to the lecturer's personal style of lecturing and the model of instructing the lecturer follows. Large group discussion, for example, will not be suitable for the lecturer who prefers to work one-to-one with students.

5.3.6 Assessment Strategies and Methods

Pre-service teachers' progress and achievement are assessed by referring to the academic guidelines of the physics study programme. In the academic guidelines, some strategies and methods to evaluate the pre-service teachers' progress and achievement are described. The assessments can be divided into three forms which are used to assess all pre-service teachers during their study in the institution. The first form is written tests which involve quizzes, assignments, semester middle test, and the semester final test. The second form is a practical test or special test to evaluate a part of subjects which include practical activities, for example, in Electronics or Teaching Practice. The last form of the assessments is a thesis examination in which a pre-service teacher is able to take this after he/she meets all requirements. If a pre-service teacher passes the thesis examination then he/she will received the Bachelor degree (S.Pd.) in Physics education.

5.4 Summary of the Chapter

Based on an analysis of the documents for pre-service physics teacher educator, the original vision or the rationale underlying the physics education curriculum (the *ideal* curriculum) was similar to other *ideal* curricula in various higher education institutions in Indonesia. The physics education curriculum to be developed and implemented is competency-based. Some competency elements related to the physics education curriculum are the basis of personality, the mastery of science ("physics education"), the ability and skills to work, the attitudes and behaviour in working, and the ability to live in society.

Further analysis on the institution documents resulted in the *written* curriculum that represented the core and the institutional curriculum. The percentage of the core curriculum was around 80% which is the maximum range of the government recommendation while the percentage of the institutional curriculum was around 20%. Other written documents are (1) curriculum structure including credits, time and academic calendar, (2) aims and objectives of the physics education curriculum, (3) curriculum guides, courses of study, and syllabi, (4) teaching and learning strategy, and (5) assessment.

Chapter 6
THE PERCEIVED CURRICULUM

6.1 Introduction

The last chapter (Chapter 5) presented the data related to the *ideal* curriculum that is determined by the Education Minister, and to the *formal/written* curriculum that is documented by the higher education institution. This chapter presents the data relating to the second research question.

Research Question 2

What are academic teaching staff perceptions of the physics education curriculum (the *perceived* curriculum)?

This chapter is based on results from the PPEC questionnaire administered to the physics lecturers and from one-on-one interviews with selected participants. The PPEC-questionnaire examines lecturers' perceptions of their approaches to teaching, their interest in physics, aims and objectives of the physics education curriculum, and their student approaches to learning physics. The information from interviews provides further data which has equal weight with the data gathered from the questionnaire. The last section of this chapter summarises the findings and aligns the data from the case study with the background literature presented in Chapter 2.

6.2 The Perceived Curriculum: The Physics Education Curriculum as Interpreted by Academic Teaching Staff

The academic staff members (lecturers) who responded to the PPEC-questionnaire were predominantly involved in teaching physics and related subjects in the physics education programmes and who had personal experiences of working with students in the area of the curriculum.

Lecturers' perceptions of the physics education curriculum were measured with the PPEC questionnaire followed by one-on-one interviews. In order for the questionnaire to be suitable for lecturers, the words on some items were changed (see

Chapter 4). Table 6.1 presents a statistical summary of the number, mean, and standard deviation for the four PPEC scales. Mean values for PPEC could range from 1 to 5, with high values indicating that the lecturers interpreted physics education curriculum to be a more valuable curriculum.

Table 6.1

Mean rating and standard deviation for the four PPEC scales

Scales	Mean	Standard Deviation
Approaches to Teaching	3.97	0.30
Aims & Objectives	3.99	0.18
Interest in Physics	4.16	0.22
Students' Approaches to Learning	3.45	0.43

6.2.1 Characteristics of Physics Pre-service Teacher Educators and Their Interest in Physics

Table 6.2

Characteristics of the physics pre-service teacher educators (n=7) responding to the PPEC questionnaire-2

Number and percentages of physics educators in each categories		n %
Age group	Age 28-32 years	1 – 14%
	Age 33-37 years	1 – 14%
	Age 38-42 years	0
	Age 43-47 years	4 – 57%
	Age 48-52 years	1 – 14%
Gender	Male	4 – 57%
	Female	3 – 43%
Qualification	Bachelor degree	0
	Master degree	7 – 100%
	Doctoral degree	0
Educator experience in years	Mean	17.57 years
	Standard deviation	6.58 years
	Range (minimum)	9 years
	Range (maximum)	26 years
Physics sections are liked (from the highest to the lowest)	Mechanics	1
	Oscillations and Mechanical Wave	2
	Electricity and Magnetism	3
	Light and Optics	4
	Thermodynamics	5
	Modern Physics	6

This group of physics pre-service teacher educators was experienced and well qualified (Table 6.2). The majority of educators (57%) were aged between 43 and 47 years. Their teaching experience ranged from nine to 26 years (mean 17.57 years) and they were also well-qualified academically: 100% of physics pre-service teachers' educators who had responded to the questionnaire had qualifications at the master degree level. Associated with the six physics sections that they were asked to order, most lecturers had the highest liking for Mechanics and the lowest liking for Modern Physics.

Lecturer interest in physics had the highest mean rating of 4.16 (Table 6.1), indicating that in general the lecturers had a strong interest in physics. The high value of this scale implied that the content of physics is interesting and a favourite for them. They like to do physics experiments, enjoy learning physics, and solve new problems in physics. A high percentage of lecturers (86%) agreed or strongly agreed that they want to spend more time reading physics books, but 14% disagreed with this statement (see Appendix 7).

The results of interviews (detailed of NVivo reports in Appendix 8) showed that almost all respondents stated that they liked physics since they were in high school.

> I chose to study and to teach physics because I like physics.
>
> (LA, LB, LC)

Nevertheless some of the lecturers claimed that liking for physics caused by their environment such as parents, teachers, etc.

> I like physics because my father was a physics teacher and he is my idol. My interest in physics grew further because I had a good physics teacher when I was a student in senior high school.
>
> (LC)

> My junior high school mathematics teacher also had a major influence on my interest in physics. He often gave examples in his teaching by using physics when he taught mathematics.
>
> (LB)

One lecturer gave the reason on why she likes physics.

> I like concepts and theories of physics because of the logical thinking involved.
>
> (LC)

According to this respondent, many concepts and theories of physics are rational or reasonable. It can be thought about logically and most of the ideas or concepts can be proved through experiments or mathematical methods.

6.2.2 Perceptions of Aims and Objectives of Physics Education Curriculum

Lecturers were asked to describe their perceptions about the aims and objectives of the physics education curriculum by responding to a series of statements. Based on the descriptive data at Table 6.1, the aims and objectives received the next highest rating of 3.99, indicating that in general the lecturers were in agreement with the aims and objectives of the physics education curriculum.

Detailed information from the questionnaire results (Appendix 7) showed that all lecturers agreed or strongly agreed that physics is one of the most important subjects for people to study (AO1) and useful to interpret many aspects of their everyday life (AO2). They also agreed or strongly agreed that the physics education curriculum can support their students to have a successful career. (AO14). They understand that their students' future job will likely be related to schools or learning societies (AO5). A high percentage of lecturers (86%) agreed or strongly agreed that learning physics can help their students' career (AO3) and that the physics education curriculum can support their students to be professional teachers (AO4), to be skilled-teacher researchers (AO7), and to be lifelong learners (AO11). However, the curriculum for physics pre-service teacher education is not congruent with the curriculum of secondary schools. Therefore, it is necessary to revise the pre-service teacher curriculum to meet the curriculum for secondary education.

> In my view, our curriculum is powerful and is an essential tool in the learning programme, but we do not make adjustment to the stakeholders' needs such as their needs to provide our graduates' understanding about the changes in the Physics secondary school curricula. Our responses to cater their needs are usually late.
>
> (LC)

> In my opinion, the curriculum should be related to the needs of stakeholders.
>
> (LB)

> I think the curriculum should be more related to students' daily lives. It also needs to be relevant to the needs and expectations of stakeholders.
>
> (LA)

Since the implementation of the Act of the Republic of Indonesia number 20 year 2003 (about the new National Education System), secondary school curriculum development is no longer the authority of the central government and there was no single curriculum for all secondary schools (SMP or SMA). Each level of schools in every region or district needs to develop its own curriculum based on the national standards of education. Consequently, the stakeholders need physics education graduates who have greater competence, knowledge and skills regarding the new policies. Unfortunately, as the lecturers said previously, the university physics education curriculum is less adaptable to this change.

In the previous quote, lecturer A said that the physics education curriculum should be related to pre-service teachers' daily lives, but lecturer B who taught General Physics subject said that students' willingness to analyse and to apply physics concepts will be the most important factor in the application of physics in their daily lives.

> I think the physics curriculum is useful and can be applied in our daily lives, like some topics do in general physics. Therefore, it depends on students' willingness to analyse the concept and to apply it
>
> (LB)

However, to establish the relevance of graduate competencies and the stakeholders' needs, all lecturers agreed that the physics education curriculum need to be revised.

> I think our curriculum needs to be further revised to fulfil the requirement of the stakeholders
>
> (LC)

> I think our curriculum is good, but still needs some revision.
>
> (LB)

6.2.3 Perceptions of Students' Approaches to Learning

The scale with the lowest mean rating was students' approaches to learning, with a mean rating of 3.45, indicating that the lecturers' perceptions of the pre-service teachers' and graduates' approaches to learning physics ranged between 'not sure' and 'agree'. The lower score implied that the pre-service teachers and graduates only had surface approaches in their learning. One-on-one interviews with lecturers confirmed that students demonstrate a lack of effort in their learning. According to some lecturers, they usually provide students with assignments to enhance their comprehension about physics concepts and theories, but this aim cannot be reached successfully because several students only copy their friend's work. It seemed that they were just doing the task because it is compulsory for them. It was mentioned in the assessment guidelines that doing the assignment is one of the assessment components.

Lecturer A believed that his students did not have a high motivation in learning as he found many students were less engaged in teaching and learning process.

> I think the students are less engaged and less motivated than they could potentially be. They are completing their assignments, but there appears to be a lack of effort in the students' work.
>
> (LA)

Lecturer C usually gives students assignments or tasks on a regular basis to make the content of lectures become more meaningful for them. Her students completed the assignments and submitted them. However, lecturer C found that some students' work were similar with other students.

> In my opinion, most students just want to finish their study without much effort. I give assignments every week to the students, most students keep doing their assignments, but some of them only copy their friends' work.
>
> (LC)

Sometimes, she asked the student to do homework problems taken from the textbook that included the answers.

> If students are asked to complete homework which is given from the textbook (which usually includes answers in it) they will copy the answers without first attempting to understand the concepts.
>
> (LC)

Lecturer C, however, believed that students' motivation to learn varied, as some students have good motivation to learn, while the learning motivation of other students is poor. Interestingly, the lecturers found that students who sit in the front row have more motivation to learn than those sitting in the back row.

> Some students are engaged and motivated whereas the others aren't as motivated. I have found that students who sit in the front row are generally the more enthusiastic students.
>
> (LC)

Why were the students who sit in the front row more engaged and motivated? How does the position of sitting in the classroom play an important role in the teaching and learning process? These questions will be discussed in Chapter 8 which examines the experiential curriculum.

Lecturer B also provided assignments for her students on a regular basis. Specifically, she discussed students' difficulties in understanding the learning material of her lectures including some difficult problems in the assignments. In addition, she tried to help student success in their examination by setting the substances of that test similar to the revised topic. However, the students' results were still unsatisfactory.

> I usually distribute assignments every week then shortly prior to their exam days, we discuss the students' difficulties in understanding the learning material. I will generally put similar revised topics in their test, but their results still tend to be disappointing. The students still seem to have problems in understanding the topics.
>
> (LB)

The detailed questionnaire data also established that a high percentage of lecturers (86%) were not sure that their students prepare well for the physics test and labs. Only 43% of lecturers agreed that the students put enough effort into learning physics and use strategies that ensure they learn the physics well.

Finally, it was agreed that the lecturers' perceptions of the pre-service teachers' and graduates' learning were more likely to be surface approaches in their learning of physics rather than a deep approaches; the previous quantitative and qualitative results and discussions confirmed this finding.

6.2.4 Approaches to Teaching

Lecturers' approaches to teaching might vary between two broad approaches – content-centred and learning-centred (see Chapter 4). As shown in Table 6.1, lecturer approaches to teaching ranked third in mean rating, with a value of 3.97. This high value implied the lecturers believed they motivated their students and used strategies that led to the learner-centred category. Some points made by the interviews with the lecturers seem to support this, for example:

> To improve the teaching and learning process, I use power point to explain the topics. Assignments are then distributed to the students, which are based on current topics as well as topics which are to follow. Therefore, they will find the integration of each topic as they progress through their assignments.
>
> (LA)

This lecturer tried to encourage his students to construct knowledge by providing the integration of each topic in their assignments.

Some other examples were related to accommodating students' learning characteristics. The following excerpt shows the lecturers' attempts to remediate students' weaknesses:

> If the students have difficulty in finding the appropriate sources, I provide further assistance by showing them ways to find the sources on the internet, and will occasionally lend them books.
>
> (LA)

> If a large number of students have results with low scores, I try to find ways to help them improve.
>
> (LB)

> Formerly, I used the Waves and Optics book by Tjia. This book is written in Bahasa Indonesia, but it can be difficult to understand and it has limited explanations. Therefore I've tried to use another book that is an English version, Introduction to Wave phenomena by Akira Hirose. The content of this book can be understood much more easily by the students, but there are still some problems because not all students are familiar with English. To overcome this problem, I insist that the students work in groups to discuss and solve problems.
>
> (LB)

Although the lecturers tried to help the students in their learning, in terms of motivation, there were also lecturers who provided extrinsic motivation that tends to lead to content-centred approaches.

> My students consider the subject I teach as difficult, however, they tend to be lazy to study. To overcome their laziness, I put pressure on them by giving them regular assignments to keep them studying. If I do not put any pressure on them, they will not study.
>
> (LC)

The assessment conducted by the lecturers consists of several components including students' participation in the classroom. However, the type of assessment was likely to lead to the content-centred approach because the lecturers did not adopt a more flexible assessment strategy in which students were given choices that matched their interests or needs.

> I use faculty assessment guidelines to measure students' achievement.
>
> (LA)

> I arrange several assessment components such as students' participation in the classroom, portfolio, quiz, mid-test, final test, and practicum (for some subjects). An active student (for example in explaining the subject matter in front of the class to his or her friends) tends to achieve higher scores in student participation.
>
> (LB)

> The assessment is not only by the written tests, but also by the performance tests.
>
> (LC)

6.2.5 Other Comments from Lecturers

Lecturers also have comments about the number of classrooms, lecturers, and faculty support.

> Besides the limited number of textbooks available, we have other limitations such as inadequate classrooms, lecturers, and faculty support.
>
> (LB)

> We also have limited rooms and facilities. The physics pre-service teachers' study programme needs a standard room for conducting micro teaching. However, in general, our facilities are improving compared to last year. Now, we have more support from the faculty

> for conducting good teaching and learning. For example, every classroom has an InFocus LCD Projector and the lecturers are able to obtain funds for creating teaching materials.
>
> (LC)

According to lecturer C, although the faculty had given the opportunity for the lecturers to obtain the fund for creating teaching materials, physics education lecturers did not use the fund because they had to teach too many subjects and as a result they did not have enough time to create additional teaching material.

> Many Physics lecturers don't use the opportunity to obtain funds, since they don't have enough time to create teaching materials because of their work load in teaching too many subjects.
>
> (LC)

6.3 Summary of the Chapter

This chapter has summarized the views of pre-service teachers' educators (the *perceived* curriculum) of the physics education programme.

The majority of lecturers involved in teaching physics have high interest in physics and they feel that the physics education curriculum is useful and powerful. They agree with the aims and objectives of physics education curriculum; they believe that they had motivated, helped, and supported their students in learning. Nevertheless, they believed that their students in general only demonstrated surface approaches in learning physics.

Despite the lecturers perceiving that the physics education curriculum is useful, they think it still needs to be revised. Additional comments from the lecturers highlighted the limitation of resources and facilities. Library books and other teaching resources still need to be completed to support teaching and learning in physics education. The number and type of laboratory equipment (to support practical works) as well as adequate rooms incorporating important facilities to support practical works still need to be increased.

Chapter 7
THE OPERATIONAL CURRICULUM

7.1 Introduction

The previous chapter (Chapter 6) presented the data related to the *perceived* curriculum that is documented by the higher education institution. This chapter presents the data related to the third research question.

Research Question 3

What are the actual process of teaching and learning in terms of the physics education curriculum (the *operational* curriculum)?

The operational curriculum data were collected from the physics pre-service teacher classroom observations during semester 1 in 2010 and from one-on-one and focus group interviews with selected participants. Lecturers have their own perceptions of the physics education curriculum and these perceptions are likely to affect the way they give their lectures and the way they work with their students. Observations made in this study showed that each lecturer demonstrated his or her individual style in organising the teaching and learning process. The researcher made four observations for every lecturer during this semester and all four lessons of each lecturer were transcribed (see topics and calendar in Appendix 9). While each lecturer had different methods and strategies compared to each other, he or she showed almost similar methods and strategies from the first to the fourth observations. Consequently, as an example of teaching and learning activities performed by each lecturer, the researcher chose one observation of each lecturer teaching one subject which is described in the following sections.

7.2 The Operational Curriculum: The Actual Process of Teaching and Learning

In this section I describe the operational curriculum enacted by the three lecturers: LA, LB, and LC. Each of these lecturers taught different physics subjects to different students. LB gave lectures on General Physics I to year one of the pre-service teachers, LC provided lectures in Mechanics and LA gave lectures of Laboratory Management to year three of the pre-service teachers.

Observations made in this study focused only on lecturing in the classrooms. In addition, there were some one-on-one interviews (Subsection 7.2.4) about practical work or laboratory activities as additional information concerning institution facilities. Four observations were made for each lecturer so the total number of observations was 12. As mentioned previously, in the following sections, the researcher presents one observation for every subject.

7.2.1 General Physics I Teaching in Practice for Year One Pre-Service Teachers

7.2.1.1 General Information

Two classes of the new physics pre-service teachers enrolled in year one in 2010. Since both classes were taught by the same lecturer for General Physics I, the researcher only observed one class. This class had a total of 35 pre-service teachers (15 male and 20 female).

General Physics I consisting of theoretical knowledge and laboratory activities is designed as the beginning course in the physics education curriculum. This subject comprises many general concepts of physics which are very useful as a foundation for further physics knowledge. Based on the schedule, lecturing of General Physics I (for the theory) was held once a week on Friday from 8 am to 10:30 am while the practicum was held on other days. The theoretical material was taught by LB while the laboratory activities were led by several senior pre-service teachers selected by the head of the physics study programme. These pre-service teachers received guidance from LB before supervising the laboratory activities. Observations made in this study were only the lecturing which was done directly by the lecturer, in this case by LB.

The classroom had a lecturer's desk, dozens of chairs for university students, whiteboard, adequate ventilation, and the connection to a portable LCD projector. This room is part of a large room in a new library. According to the explanation of the head of the study programme, this room is used as a temporary classroom to address the shortage of lecture rooms because the construction of additional classrooms has not yet been completed. Outside the room there were many students waiting to enter the class.

7.2.1.2 Teaching in Practice

On the first day, the lecturer was not using the LCD projector because the appliance was not available – it was being used by another lecturer in the Department. The lecturer had planned to use computer animations but these could not be implemented.

After introducing the observer to the students, the lecturer said that the initial material to be covered was about vectors. The lecturer checked or reviewed the students' prior knowledge about vectors and scalar quantities through the debriefing process. The lecturer explained that the materials on the vector were the bases for physics of matter that require a deep understanding. The discussion continued with the operation on a vector, such as addition and subtraction of vectors. To recall their knowledge of pre-existing vectors in high school, the lecturer invited students to revisit some of the operations on these vectors using the whiteboard and asking questions. Some students participated but most tended to be quiet. Among other procedures, the operation of vector addition was discussed by the method of triangles, parallelograms, and polygons to find the resultant (magnitude and direction).

During the instructional or teaching and learning process, the voices of other students in other parts of the building and outside of the room could be heard because there was no wall insulation.

One or two students were asked to work on the vector operation on the whiteboard under the guidance of the lecturer and other students were asked to pay attention. However, what was being done by the students was not perfect and so the lecturer gave an explanation of how to perform the vector operations either graphically or analytically.

While lecturing had been taking place, after half an hour another student who came late was not allowed into the classroom and follow the lectures because it had been agreed previously that tolerance was only for 15 minutes late.

The discussion with the students continued using the same method as before to obtain the solution of some problems. In general, the questions posed by the lecturer were classical questions to whole class and were not intended for individual students. To strengthen students' understanding of the operation of vector addition, the lecturer explained its application in the field of mechanics.

The next issue after completion of the vector addition was "whether or not the vector addition commutes?" Students were asked to prove the properties of these vector operations by giving some problems to work in the classroom. Some students tried to find answers and discuss with nearby friends; several other students just waited for the answer.

Having acquired the properties of commutative operation for the sum of vectors, the discussion continued with the operation on reduction. In between time the lecturer checked some students' records. One student did not record the material that had been discussed. The next discussion was about the vector multiplication operation that began with a discussion of the unit vector, followed by vector and scalar multiplication, dot product of two vectors and cross product of two vectors.

The lecturer asked some questions related to the previous vector analysis and wrote answers provided by the students. At this session, the questions provided by the lecturer were not directed to evaluate individual student understanding so that students answered every question in unity.

The next way was to use a matrix of the vector components; students were given questions and given time to work and write on the whiteboard. Then to increase students' understanding, the lecturer provided additional problems to be solved. Once students understood how to find the value and direction of the resultant vector, the lecturer gave students the opportunity to ask questions. One student asked a question about the relationship between the direction and value of the resultant vector. This was discussed through an example using a problem solving procedure showing that the vector sum could not be done by simply adding the value regardless of the direction.

The next material was integral and differential calculus. Just like the previous method, the lecturer invited students to recall or review high school material on the basis of differential formulations. After discussing the forms of the formula required, the activities continued with a discussion of the questions given by the lecturer. Students were asked to write their answers on the whiteboard in front of the class. Because no one wanted to work on a voluntary basis, the lecturer called the names of some students to find the solution but no one stood from his or her chair. They said that they were not sure about the correct answer. Since there were no students who were able to respond, the problems were used as homework coupled with some other assignments.

The lectures finished promptly at 10:30 am when the lecturer told the students that the material would be discussed in subsequent weeks on the topic of particle dynamics. Some students were also asked to borrow and prepare the LCD projector for the next lecture.

7.2.1.3 Interpretative Commentary on the Curriculum-in-Action

Content

The content that had been delivered during the observations had several objectives: (1) to equip students with the knowledge of calculus which was required for General Physics I and (2) to develop the same conception of the new students, many of whom had different high school backgrounds.

As a lecturer for the first physics course in year-one for physics education students, Lecturer B had been trying to convey the content of the curriculum in accordance with the syllabus which was shown to the observer after the lecture was over. Because LB did not provide a lesson plan in writing, the observer could not assess in detail the match between the content of the lesson plan and the material presented in class. However, based on what had been seen, the content of the curriculum taught at these inaugural lectures was a basic knowledge of calculus and some examples of its application to physics using vectors. This becomes important because the function of mathematics was the language of physics; if a student could master the mathematics it would be relatively easy for him or her to master the physics in this topic.

Actually there was a special subject namely Calculus in the same semester in year one which was taught by a mathematics lecturer. But according to LB it took a long time to reach such knowledge - vector, differential and integral - in the calculus subject, while the students needed it sooner in order to understand kinematics and dynamics of particles contained in the course of General Physics I. That was why calculus had become part of the General Physics I syllabus.

Learning activities and the lecturer's role

The curriculum is a programme of planned activities. The nature of a plan can be quite broad ranging. One way to view the extensiveness of this concept is from two positions, one viewing curriculum as a written document and the other acknowledging plans that are in the minds of educators but remain unwritten. Lecturer B, who had been a lecturer on the subject of General Physics I for several years, knew what a lesson plan was and could quickly recall its familiar categories: general purpose, specific goals, material needed, procedures, evaluation, and so on.

In creating worthwhile learning activities the lecturer gave several examples of vector problems that were realistic, relevant and based on practice. Theoretically when students can see the links between their study and the real world, their learning becomes more meaningful and they are more motivated. However, it seemed not every student can be active and motivated. Due to student lack of responsiveness, she tried to engage as many students as possible in the teaching and learning process by using questioning techniques from closed to open question. She gave all students the opportunity to answer the question before she pointed to a student to respond.

Lecturer B also understood how to respond to questions from students as can be seen when one of her students asked a question about the relationship between the direction and value of the resultant of vectors. She did not immediately provide an answer, but invited the students to find answers through discussion of related problems; so the students were taking part in finding the answer. It seemed that the lecturer tried to encourage the students to construct their own understanding and of course this kind of learning process becomes more meaningful for the students.

Teaching resources and facilities

The teaching resources used for the course were books. According to LB there were no problems with teaching resources for the subject of General Physics I because there were many books related to this subject. When observing the lectures, some students used "Physics" (textbook by Halliday & Resnick) that had been translated into Bahasa Indonesia. However, existing facilities were very limited, for example, the LCD projector and computer was not available in the lecture hall probably because this was not a permanent room for lectures. Lecturer B carried and used her own laptop as an additional teaching facility.

Assessment

Although at the beginning of lectures the lecturer had been trying to find out prior knowledge of students, it seemed likely during her lectures that she had not been so able to successfully use assessment for learning in her classroom. This was evident by the number of students who still had not been actively engaged in the learning process.

Assessment for learning is different from the assessment of learning, because it can help learners to learn better (J. Gardner, 2012). It can help learners and educators to identify where the learners are in their learning, what the learning goals and criteria are where each learner is in relation to the goals, where they need to go next, and the ways to get there. Lecturer B said that, in general, the type of assessment usually used by lecturers was the second type – assessment of learning – such as an assessment of the assignment, midterm, and final examination for each subject.

7.2.2 Mechanics Teaching in Practice for Year Three Pre-Service Teachers

7.2.2.1 General Information

The number of students enrolled in the third year is 56, but for several reasons not all could take the Mechanics course. One reason is that they achieved a low mark in the previous semester so that they were not qualified to be able to take all offered courses in the third year. However the numbers of participants in the mechanics course at the time of observation carried out were 58. Additional students were those second year students who were performing with good result in their previous studies and were eligible to sign up, and several fourth-year students who received low marks on the Mechanics course and wanted to improve their mark.

The visited classroom was on the second floor which had a teacher's desk, dozens of chairs for university students, two whiteboards, an air conditioner, and LCD projector. This room was one of the two rooms used as a fixed place for teaching and learning of physics for pre-service teachers.

7.2.2.2 Teaching in Practice

After introducing the observer to her students, lecturer C began the Mechanics lecture by explaining the syllabus, the lecture plans for 16 weeks, the textbooks that would be used, and the assessment system. Students listened to their lecturer's explanations and made notes in their notebooks.

Then the activity was a discussion of the kinematics of particles associated with the motion of objects without reviewing the force which caused the motion. According to the syllabus that had been explained, this material was a continuation of the kinematics of particles in the General Physics I subject. For half an hour, the lecturer explained some concepts in the kinematics and reviewed the prior knowledge of students. After that, the lecturer gave several problems to the students as the application of these concepts. The problems ranged from simple to complex. Students were given time to find their solutions in the classroom.

After the prescribed time limit, the lecturer asked students who were willing to come forward to record the results of their work for problem number one and problem number two on the whiteboards. Because the first two problems were not so difficult, two of the students who raised their hands and were willing to go forward, were chosen to write down solutions of such questions. One student worked on the left whiteboard and the other on the right whiteboard. While the other students seemed to pay attention to the work of their friends and some continued thinking and writing in their books.

Once this work was completed by the two students, the lecturer examined the steps, the results, and then confirmed with other students. One of the questions posed by the lecturer was "do you understand what your friends did?" Most of the students answered "yes we do".

Similar to the previous activity, the lecturer asked students to report the results on the whiteboards, but only one student was willing because it was a relatively difficult problem for most students. This student was given a chance to write his work on the whiteboard and several other students paid attention to what he did. When he discontinued writing on the whiteboard, the lecturer checked the steps and the results. Apparently there were some false steps therefore the results were wrong. She explained the right methods and all students were asked to examine their work and find the correct answers.

This method of teaching continued for a period of time until several Mechanics problems and their solutions were correctly done. At the end of the course, the lecturer divided the students into several groups and each group was given several problems to be worked as their homework to be discussed in the following week.

7.2.2.3 Interpretative commentary on the curriculum-in-action

Content

According to the curriculum, Mechanics is one of the advanced courses of General Physics I, but any observations showed that some content of this course was a repetition of concepts contained in the General Physics I. It was also confirmed by the lecturer.

> Based on my experiences, I prefer to teach the general concepts as well as the mechanics concepts to the students. It helps students to understand the basic concepts.
>
> (LC)

This comment gave the impression that the lecturer usually found obstacles in teaching Mechanics because her students' knowledge of the general concepts was insufficient. She discovered that many students lacked an understanding of basic concepts that had been taught in the course of General Physics I. Consequently, she needed to include or repeat a few general concepts in her lecturing because it assisted her students in learning Mechanics. Furthermore, the lecturer gave the explanation about how she differentiated the substances for the students in the Mechanics and the General Physics I courses.

> One of the differences between General Physics and Mechanics as a subject is the application of the concepts. In the mechanics subject, we need to solve more complicated problems than in the general physics subject.
>
> (LC)

Her answer seemed to correspond with the level of problem difficulties in her lectures, where the first two problems were relatively easy, while the others were quite complicated and difficult to be solved by most students.

Learning activities and the lecturer's role

The lecturer was qualified in Mechanics. Nevertheless, she was not able to make the lectures interesting. Based on several observations the dominant method of teaching was setting tasks to solve problems in Mechanics. She gave the students several problems and then the students were asked to solve them individually or in groups. The students received a more extrinsic motivation rather than motivation arising from themselves. Interviews with group-five of the students confirmed this statement.

> Lecturers should find ways of delivering the subject topics in a more interesting manner.
>
> (IRA, FG-5)

In order to be able to observe the entire class which contained many students, the observer usually took the rearmost position. It was seen that the more active students in learning and doing their task were students who sat in the front row. The lecturer also made this observation.

> Students' motivation in learning are different between individuals. Some students are engaged and motivated whereas the others aren't as motivated. I have found that students who sit in the front row are generally more enthusiastic students
>
> (LC)

It was interesting to find out and look for the cause why the students who sat in the front had greater motivation and were more active than those sitting at the back. To get information about it, in the next class, the observer came early to the classroom and observed every incoming student. Apparently several students chose places in the front row, but some students chose instead seats in the back until all students came in and the lecture started. This observation implies that those students who really want to learn will choose to sit in the front.

However student motivation was not the only factor that influenced students' engagement in learning activities. The environment also affected the activities of the students, such as (1) the room was quite hot because the air conditioner did not work, (2) the large number of students meant limited interaction between the lecturer and the students, and (3) the voices of other students from outdoors was audible and annoying. Perhaps these factors caused some students who had strong desires to learn choose seats in the front row. Further interviews with students supported this assumption.

> Sometimes, there would be up to sixty or seventy students attending a single lecture in a classroom. In these situations, the lectures were not very effective, and only the students sitting in the first and second rows could listen well and participate. Students who were sitting in the back rows could not listen and take part in the lecture as much. The classroom was not a very suitable learning environment as it was also uncomfortable and very hot considering there was no air conditioning and the room was densely occupied by students.
>
> (AM, FG-5)

> I could not get a grasp what the lecturer was discussing when I sat towards the back of the classroom.
>
> (IR, FG5)

Teaching resources and facilities

The teaching resources used for the course were books and lecturer's handouts. Besides the textbook that was specific to the Mechanics resource, the lecturer also used some general physics books (i.e., Physics by Halliday & Resnick and Physics: Principles with application by Giancoli). Several chapters of these general physics books are related to Mechanics (e.g., kinematics in one and two dimensions, dynamics, circular motion, work and energy, linear momentum, and rotational motions).

One question was, whether or not the books held by the lecturer also were available in the library? Lecturers and students revealed that this was not the case and that there were insufficient resources in the library.

> The problem is we don’t have enough textbooks in the library
>
> (LC)

> Because of limited textbooks in the library, I also lend books to the students, so they can use them for alternative learning resources.
>
> (LB)

> It was quite difficult to get the books since there were a few references. To solve this problem, we ordered the books from our friends who study in another province such as in Jogjakarta. There were some books which were ordered such as Physics book written by Halliday.
>
> (TLI, FG-4)

> Our lecturers often lend books and also their handout if we only had a few minutes to take notes.
>
> (RFD, FG-4)

> The supporting text books, however, were sufficient, as some lecturers advised me to purchase some important books, for example 'Physics' by Halliday, 'Fundamentals of Physics' by Giancoli, 'University Physics' by Sears & Zemansky, and 'Wave' by Tjia.
>
> (EFH, FG-5)

> We also have limited rooms and facilities. The physics pre-service teachers' study programme needs a standard room for conducting micro teaching. However, in general, our facilities are improving compared to last year. Now, we have more support from the faculty for conducting good teaching and learning. For example, every classroom has an InFocus LCD Projector and the lecturers are able to obtain funds for creating teaching materials. Many Physics lecturers don't use the opportunity to obtain funds, since they don't have enough time to create teaching materials because of their work load in teaching too many subjects.
>
> (LC)

> Classroom numbers were also unaccommodating, we had large number of students, but the classroom capacity was limited as the number of lecturers who taught physics was low.
>
> (IRA, FG-5)

Assessment

In the beginning of the course when talking about the syllabus, the lecturer also mentioned the assessment method which consisted of several components including assignments, a mid-test, and a final test and as previously described by her, she thought the assessment is not only by the written test, but also by the performance tests. An active student who was able to do various tasks assigned to him or her would receive additional merit in his or her grade.

7.2.3 Laboratory Management Teaching in Practice for Year Three Pre-Service Teachers

7.2.3.1 General Information

The laboratory management course aims to enable students to understand (1) the meaning and function of the physics laboratory, (2) the minimum standards of facilities, infrastructure, laboratory equipment, and standard operational procedure of working in the physics laboratory, (3) the arrangement, maintenance, and repair of laboratory equipment, (4) the administration of the laboratory, work safety, and laboratory safety, and (5) laboratory management information systems and laboratory's quality management quality management system. This subject has two credits (see Appendix 6); it means, in total, the pre-service teachers should learn the laboratory management approximately six hours per week includes doing the assignments (Chapter 5 Section 5.3.2). The lectures were conducted in the same room as the Mechanics lectures which was on the second floor of the building.

7.2.3.2 Teaching in Practice

At the beginning of the course, the lecturer turned on his laptop and connected it with the LCD projector. When the lecture was ready to begin, he asked the question to the students "What is the definition of laboratory management?" Because there was no student who could explain, the lecturer then displayed some key words with a power point programme to develop a general meaning of laboratory management.

> Management is to manage and organise all the variables (such as human resources, finance, equipment, facilities, etc.) in such a way as to achieve goals effectively and efficiently. That is an understanding of general management. When talking about the management of laboratory it would be a more narrow sense. We will talk about planning, structuring, administration, security, maintenance, and supervision.
>
> (LA)

> Now we start from the first points of the plan. What should be planned when one want to make a laboratory building?
>
> (LA)

Then the lecturer showed images of a good and ideal physics laboratory layout. He asked, "Do you have these kinds of laboratory facilities?". "No" answered the students. "How about if you have physics laboratory facilities like that?". "It must be wonderful, luxurious and our practical work would be comfortable".

The planning of a laboratory building should be in line with the rules of the National Education Minister number 24 of 2007 (Standard of Facilities and Infrastructure for Primary and Secondary Schools). In the section on secondary school physics laboratory, it is stated that the minimum ratio of physics laboratory is 2.4 square meters per student. "If there are five students, what is the required square footage?". "12 square meters," replied the student. The lecturer continued the question, "Can we make laboratory buildings as wide as that?" The students were silent, then the lecturer explained that the minimum area is 48 square meters for learners whose number is less than 20 people. Furthermore, the minimum width of the physics laboratory is five meters and it must also have adequate lighting for reading books and making observations.

Furthermore, the lecturer explained the type, ratio, and the description of the physics laboratory facilities mentioned in the regulations of the Minister of Education through the media LCD projector and verbal explanation or discussion of information. The first discussion was about the "furniture" (like chairs, desk, tables for demonstration, preparation table, cupboard, and cupboard for materials). The lecturer explained that the Minister of Education mentioned a minimum standard in the regulations. Along with this explanation, the lecturer assigned tasks to the students in groups to visit some schools in order to observe the school laboratories.

The activities continued with a discussion of "the educational equipment" that also included in these rules, such as a variety of materials and basic measuring devices (for example, ruler, calliper, micrometre, and oscilloscope), various experimental tools (for example, Atwood machine, train experiment, sliding experiment, and Hooke's experiment). Once completed, the lecturer assigned tasks to the student to seek the names of physics experiment tools, specifications, and how to store them, at least one tool for one person.

After giving the assignment, the lecturer signed the lecture attendance cards for each student which were place in the lecturer's desk. This activity took about ten minutes while students chatted with each other during this time. Having checked the attendance cards, the lecturer continued with the design or layout of the laboratory. The lecturer displayed the "Laboratory safety design guide" issued by the University of Washington with sub-heading – General requirements for laboratories – written in

English. Lecturer and students translated and discussed the contents of this handout, including (a) scope, (b) building design issues, (c) laboratory design considerations, (d) building requirements, (e) hazardous materials design issues, (f) entries, exits, and aisle width, (g) electrical and utility issues, etc. The lecturer complemented the explanation and discussion by displaying various images related to each issue using the LCD projector. The lecturer ended the lecture by giving students the opportunity to ask questions. But no one asked, then the lecturer said "we will discuss section number two – arrangement – next week".

7.2.3.3 Interpretative Commentary on the Curriculum-in-Action

Content

Lecturer A created the syllabus as a "learning contract" between the lecturer and the students. It sets the ground rules for all classroom goals, objectives, activities, and assessment tools. The lecturer said that it was available to the students on the first day of the class. During the first observation, the lecturer tried to help the students receive more advantages in learning for example by asking the students to visit and observe schools' laboratories. However, on several other observations, some contents was still provided theoretically, for example about how "maintenance and repair of laboratory equipment". It would be better if this kind of material was explored through hands-on activities.

Learning activities and teacher role

Short answers to questions which review the content of the course associated with lectures, was useful to provide opportunities for students to reflect on the content of the course. The lecturer also designed the learning activities based on power point media and photographs. Furthermore, making local laboratory observations as the assignment for the students will be advantageous to integrate student knowledge with a real circumstance.

Teaching resources and facilities

The teaching resources that the lecturer used were books (i.e. the Laboratory techniques book and the laboratory work skills book from two different university publishers in Indonesia), websites and blogs. The interview with the lecturer also confirmed the finding of this observation.

> From the subjects that I teach, the teaching resources I use include textbooks as well as online resources.
>
> (LA)

However, the teaching facilities were deemed to be unsatisfactory. One inadequate facility was a reliable source of electrical power; at the time that the course was running, suddenly there was a power failure so that the projector for the media stopped for a while until the power was on again. In addition, it was mentioned by the lecturer that the access speed of wireless internet networks were also limited.

> Teaching facilities in the university alone are currently insufficient. The university at which I teach provides internet facilities, however, the internet speed is very slow and is hence time consuming.
>
> (LA)

Assessment

It was stated in the "learning contract" between the lecturer and the students that the assessment will be done by accumulating the process and learning outcomes. The learning process will be evaluated by students' activities to express opinions and idea in an active learning approach. The learning outcomes will be accessed through the assignments, quizzes, and tests. Based on the formula it was seen that the total percentage of tests was 70%.

7.2.4 Physics Education Laboratory Facilities

As a part of all physics education facilities, the laboratory performs an important role in teaching and learning, especially for several subjects associated with practical work (i.e., General Physics I, General Physics II, Practicum of General Electronics I, Practicum of General Electronics II, Methods of Experimental Physics, the Introduction of Computer, etc.). The laboratory must contain adequate equipment, but the reality seemed to be far from the expectations of lecturers and students; the interviews showed much discontent related to the physics education laboratory facilities.

> We need various laboratory facilities to support teaching and learning. At the moment, our students cannot do practical work in the field of modern physics, because we do not have any facilities for that.
>
> (LC)

> Some equipment for practical work of General Physics I and General Physics 2 subjects were broken and has not been repaired.
>
> (LB)

> Laboratory equipment are limited. For example, we don't have items such as ticker timers to facilitate teaching in the topic of objects' movement. If we wish to purchase equipment for teaching purposes, it can involve a lengthy process as we have to deal with the complicated bureaucracy.
>
> (LA)

What lecturer A said was understandable because most study programmes in higher education institutions did not have much money. The university had the policy to not distribute money to be managed by every study programme or department. If the study programmes or the departments want to buy something associated with the resources and facilities, they have to ask the faculty and the faculty needs to process this application then forward it to the university. The study programme has to wait for the process which can take an unpredictable amount of time. Most of the applications were unsuccessful to be accepted because no funds were allocated. The difficulties to get support became greater if the request was for more expensive facilities.

Although the students did not know the facilities in particular, they can describe it based on their learning experiences during their study. The following reports from the students are used as evidence for the limitations of laboratory facilities.

> I also think that the laboratory facilities were insufficient, although I didn't know the overall condition in detail, but based on my experiences, we were only able to conduct a few experiments throughout the course.
>
> (EFH, FG-5)

> Laboratory facilities are also not enough, since in the group (consist of six people) there are only three who can use the facilities.
>
> (EG,FG-2)

> We sometimes could only learn the theories instead of doing the experiment because we do not have the tools. Most of the tools in the laboratory were broken, so that some students cannot use it at the same time. We took turn in doing the experiment. We hope that all the tools are completed and hope that the broken tools are repaired or renewed.
>
> (EN, FG-2)

7.3 Summary of the Chapter

The observations of the actual process of teaching and learning or the *operational* curriculum for the three different subjects – General Physics I, Mechanics, and Laboratory Management – were focused on (1) content, (2) learning activities and lecturer role, (3) teaching resources and facilities, and (4) assessment. The observations were made four times for every subject. However, as noted in Section 7.1 in this chapter the researcher only reports one observation for every subject.

General Physics I does not only contain several physics topics but also includes vectors, differential, and integral calculus as well as their applications in physics. This content was presented to equip pre-service teachers with the knowledge of Calculus as a basic language of physics and to provide new pre-service teachers with the same basic skills that are needed in physics.

The content of Mechanics should be more advanced then General Physics I. However, the lecturer needed to repeat some physics concepts and theories in General Physics I because her students did not understand these basic concepts and theories. Laboratory Management contained administration of the laboratory, work safety, laboratory safety, and maintenance and repair of laboratory equipment, etc.

In general, learning activities of the three subjects were almost similar, for which not many students or pre-service teachers showed enthusiasm for the teaching and learning. Teaching resources and facilities for all three subjects were also limited. To overcome the limitation of textbooks in the library, some lecturers asked their students to buy some essential books and/or lend them the books. Lecturer A asked his student to use internet facilities. Lecturer C created some handouts and asked her students to copy them.

The lecturers used faculty guidelines for assessment methods which included some components (for example, assignment, mid-test, and final test). According to some lecturers, the assessment was not only by the written test but also by the performance test. The pre-service teacher activities in class to express opinions and idea would be another component. Active students who were able to do the task assigned by lecturer would receive additional merit in their grade.

Chapter 8
THE EXPERIENTIAL CURRICULUM

8.1 Introduction

This chapter examines the pre-service teachers' and graduates' perceptions of their learning experiences while enrolled in the higher education physics education curriculum. These data can provide valuable information about their views on the aims and objectives of physics education curriculum, their lecturers' approaches to teaching, their interest in physics, and their approaches to learning physics as well. Furthermore, by examining their perceptions of the physics education curriculum, it may be possible to understand what they have learned and how they learned it, what particular subject areas are meaningful to them and what impact they might have. Therefore, this chapter (especially Section 8.2) addresses the fourth research question.

The comparison between the *experiential* curriculum and the *perceived* curriculum (Chapter 6) is examined in Section 8.3. This section describes further tests and analyses to find whether or not any differences emerged in the perceptions of the physics education curriculum related to the four scales for the *students* and their *lecturers*.

Research Question 4

What are pre-service teachers' and graduates' perceptions of the physics education curriculum (the *experiential* curriculum)?

8.2 The Experiential Curriculum: The Learning Experiences as Perceived by Learners

This section reports data from the PPEC questionnaire and several focus group interviews carried out in the Institution. The PPEC questionnaire was administered to pre-service teachers and graduates of the physics education programme. All current students and many graduates were identified as being eligible to participate in the survey. However, not all of these students and graduates were accessed, as some students were not present in the lecture rooms when the questionnaire was administered and some graduates worked and lived in different places. Furthermore, some of them chose not to participate in the survey. In total, 201 (84%) questionnaires were returned, identified by numbers and coded according to the subject group. All the data received and coded were entered onto the SPSS software programme for analysis.

Five focus groups were conducted for physics pre-service teachers and graduates, with a total of 23 participants (Focus Groups 1, 2, 3, 4, and 5). Each focus group consisted of 4-5 participants and the discussion was approximately one hour length. Similar to that done with the lecturers, the results of the recorded interviews were transcribed and then translated into English. Coding was then performed to gather material by using the NVivo9 computer software.

8.2.1 Physics Pre-Service Teachers' and Graduates' Characteristics and Their Interest in Physics

The characteristics of the pre-service teachers and graduates who responded to the questionnaire are summarised in Table 8.1. A high percentage of these participants were aged 17 to 19 years (45%), and were mainly female (70%).

Table 8.1

Characteristics of physics pre-service teachers and graduates (n=201) responding to the PPEC questionnaire-1

Categories		No. %
Age group	Age 17-19 years	91 – 45%
	Age 20-22 years	86 – 44%
	Age 23-25 years	14 – 8%
	Age 26-28 years	3 – 1.5%
	Age 29-31 years	3 – 1.5%
Gender	Male	56 – 30%
	Female	132 – 70%
Status	Pre-service teacher	177 – 88%
	Graduate	24 – 12%

Table 8.2

Mean rating and standard deviation for the four PPEC scales

Scales	Mean	Standard Deviation
Lecturers' Approaches to Teaching	3.46	0.57
Aims & Objectives	4.18	0.40
Interest in Physics	3.83	0.45
Approaches to Learning	3.96	0.42

Pre-service teachers' and graduates' interest in physics had a relatively high mean score (3.83), indicating that in general the respondents had a strong interest in physics. The high value of this scale meant that the content of physics is interesting and a favourite for them. They like to do physics experiments and enjoy learning physics. Interview results (NVivo reports in Appendix 8) showed that about half of the participants really enjoyed physics and made it a choice from the time they were in high school.

> I like physics and I want to be a physics teacher since I have been in the third grade of Senior High School.
>
> (WAP, FG-3)

> Although it is rather difficult, I think physics is more enjoyable than other subjects and the knowledge is very useful for other subjects.
>
> (SB, FG-1)

> I like analysis and mathematical methods in physics. I still love physics even though it is now more difficult to learn.
>
> (AWDS, FG-1)

However, a high percentage of the pre-service teachers and graduates (55%) were not sure that they are willing to spend more time reading physics books and 46% were not sure that they like trying to solve new problems in physics (Appendix 7). Almost a quarter of the respondents had physics education as a second choice for many reasons.

> I chose physics as my major, but it is not my first option. I am more interested in the Department of Psychology at North Sumatera University. However, my parents did not allow me to study there and

> suggested me to choose physics. So, I try to follow my parents' suggestions and try to enjoy it.
>
> (MF, FG-3)

> I like Math. I chose Physics because of (1) the big opportunity for getting a job, (2) the big opportunity for passing the admission test. I also chose it because of my parents advised me to.
>
> (EN, FG-2)

> I study it to make my parents proud of me.
>
> (M, FG-3)

> I became more inspired to be a physics teacher knowing that the employment opportunities were greater than other subject areas.
>
> (N, FG-5)

> I chose Medical Faculty but I did not pass. Second choice – it was Physics in Jambi University – was successful.
>
> (RFD, FG-4)

There are also a few physics' pre-service teachers who do not like physics.

> I do not really hope to have career in the field of physics or be a physics teacher. I am more interested in trading or have a career in economics.
>
> (DS, FG-2)

Physics teachers in secondary school also influence students' interests in learning. Based on the interviews, the influence of secondary physics teachers on their students' interests in physics can be divided into two: (1) Teachers who perform good role models, are ideal educators and are able to motivate their students to be successful learners and become more interested in physics, (2) Teachers who perform their role in such a way as to create a boring learning atmosphere, become overwrought or even unwittingly can cause students to be stressful and be liable to lower their students' interest in physics.

Several interview results with pre-service teachers and graduates confirmed the first assertion.

> I would like to learn physics because I had an exciting student teacher in my Junior High School. Initially, I knew that being a physics teacher was not a good choice, but since I met her (this institution's

physics alumni) she encouraged me and she changed my mind about physics.

(SB, FG-1)

I chose physics because I enjoyed studying this subject and my secondary school teachers encouraged me to study physics education so that I could become a physics teacher.

(N, FG-5)

Interestingly, there was a physics pre-service teacher (LP from focus group 1) who decided to learn physics further and wanted to be a physics teacher just because her learning experience with the school physics teacher did not make her happy.

I chose physics because I had a smart physics teacher in senior high school but he was a very strict teacher. I and some other students were stressful and unhappy when studying with this physics teacher. Now I learn physics and would like to be a physics teacher with the intention of being able to develop a pleasant teaching and learning programme of physics in secondary schools. In other words, that is different from what I felt.

(LP, FG-1)

8.2.2 Perceptions of Aims and Objectives of Physics Education Curriculum

Aims and objectives had the highest mean rating of 4.18, indicating that in general the students and graduates were in agreement with the aims and objectives of the physics education curriculum. They think that the physics education curriculum provides knowledge and skills for their career and can enable the students to become professional teachers.

I think the physics education curriculum provides knowledge and skills for our career and I have obtained the basic competences required in teaching physics. However, I think that I still need to acquire a deeper level of knowledge and understanding to further develop my skills.

(EFH, FG-5)

Generally, the curriculum is useful to broaden our knowledge.

(AWDS, FG-1)

Studying in the Physics Education programme helped to develop my career as a Physics teacher. Now, I've begun my career as a Physics teacher at the Secondary School and a Physics tutor at a tutoring institution. I have gained a significant amount of knowledge and skills whilst studying in the Physics Education Study Programme.

(EFH, FG-5)

> I have obtained a great deal of my competencies during my study, i.e. physics knowledge and teaching skills, especially when I was trained as a pre-service teacher.
>
> (N, FG-5)

Although many pre-service teachers and graduates realised that the aims and objectives of the curriculum are useful, 37% were not sure that the physics education curriculum can support the pre-service teachers and graduates to be lifelong learners and 23% were also not sure that the curriculum can support students and graduates to be emphatic intelligent members (Appendix 7). On the other hand, it was acknowledged that some students are still having problems or difficulties in learning physics. To some extent, it was due to the difficulty of the course materials and the lack of lecturer's attention or his or her ability to find solutions to student learning difficulties.

> After studying in physics study programme, I realise that physics is not as easy as before. It is more and more difficult.
>
> (DMSR, FG-1)

> During the course of my study I often found it difficult to grasp concepts of physics in the pursuit of furthering my knowledge. Some subjects consisted of many theories and difficult concepts.
>
> (IRA, FG-5)

> I think my capabilities as a new teacher – especially in managing the classrooms – are insufficient. In my opinion, there was up to 50% of my peers who experienced learning difficulties for example, with mathematical methods in physics or quantum physics.
>
> (AM, FG-5)

> I think we need more physics content related to our future job as junior or senior high school physics teachers rather than study the difficult physics concepts and theories.
>
> (TLI, FG4)

8.2.3 Approaches to Learning

For the Approaches to Learning Physics scale, the mean response was 3.96, indicating that the respondents on the average agreed with the approaches to learning physics portrayed by the items.

Physics pre-service teachers' and graduates' approaches to learning vary between deep approaches and surface approaches. As mentioned in Chapter 2 and Chapter 6, students who are relying on a surface approach actively prefer, and rate more favourably, for example a lecturer who provides information ready for 'learning' and study is only for the final examination or doing the assignment. On the other hand, students with a deep approach prefer lecturers and the course that challenges and stimulates their thinking.

Only a few pre-service teachers and graduates demonstrated that they studied enthusiastically and had a deep learning approach. One student showing this characteristic was AWDS from FG-1, who liked the analysis and mathematical methods in physics and she still loved physics even though it is more and more difficult to learn. Another example of an engaged student in her learning was WAP from FG-3.

> I prefer to find the materials from the books because they have complete information and it is clear. I have already had some books entitled *Mekanika* (1 edition) and *Listrik Magnet dan Termodinamika* (2 edition) by Sutrisno. I also have *Fisika* by Halliday. I often visit the university library.
>
> (WAP, FG-3)

Some detailed information from the questionnaire results (Appendix 7) showed that 25% of the pre-service teachers and graduates were not sure that they put a lot of effort into trying to understand things which initially seem difficult; 28% were not sure that they use strategies to learn the physics well, and 25% were also not sure that they prepare well for the physics test and labs. It seems some pre-service teachers did not put much effort into studying.

> Some students don't mind to buy or borrow the books, they just want to access easily using google engine to find the materials.
>
> (MF, FG-3)

> In studying, I only concentrate during the first hour. I get sleepy in the next hours especially when facing the questions which need math computing.
>
> (S, FG-2)

Why did some pre-service teachers make less effort in studying physics? Did they not have a strong or enough interest in learning physics? If we compare the data of IP and AL in Table 6.2, we find that the score of the pre-service teachers' and graduates' interest in physics was lower than their approaches to learning. Based on these facts, it can be said that their approaches to learning were more directed to surface approaches rather than deep approaches. Surface approaches are performed for an activity or assignment because it is a set task and the course cannot be passed unless the assignment is completed. The task does not arouse a great deal of interest and as a result the minimum possible time and effort is allocated to the task (Kember & McNaught, 2007).

> I never used to study regularly. I would only study for exams and assignments. Sometimes, when I was bored of studying, I would go and find interesting places where I could walk.
>
> (N, FG-5)

> I used to study when I had exams and assignments. There were many assignments, because we had too many subjects – around seven or eight subjects each semester.
>
> (IRA, FG-5)

> I studied one day before the test since I only study when I had a test. I never took notes so to prepare the examination, I borrowed friend's notes. I also answered previous test questions since our lecturers usually gave similar questions with different numerals.
>
> (TLI, FG-4)

A very intelligent graduate, EFH from FG-5, said that she only studied during the examination periods like most other students did, but now being a graduate she understands that what she did was not a high-quality learning technique.

> I realise now that I did not practice enough learning techniques during my time of study at university. I only studied during exam periods and when the lecturers gave homework that we had to complete.
>
> (EFH, FG-5)

Several students usually studied or focussed only on the question that often came out in the test:

> I did answer some questions which always came out in the test. Furthermore, I also did concept mapping in order to help me to comprehend the Physics subjects well.
>
> (JN, FG-4)

> Study also depends on the lecturer. If the lecturer asked us to read the material before we learn it at class, I will do it to anticipate the questions asked by the lecturer.
>
> (S, FG-2)

A pre-service teacher, LP from FG-1, who did not like a strict teacher during her study at senior high school (see section 8.2.1) said:

> If the teaching and learning process is enjoyable, I will enjoy and understand it. But, if I meet the strict lecturer I tell to myself, "I must understand, must understand" but in fact, I do not understand.
>
> (LP, FG-1)

Some graduates had difficulty understanding references which were written in English.

> It was very difficult to find references. There were some references but they were written in English. So, we had difficulty comprehending them.
>
> (JN, FG-4)

Most students liked to study in a group:

> I study with my friends, sometimes in the library or at my friends' house. My group consists of around 3 to 4 students whose houses are close to each other.
>
> (DS, FG-2)

> I preferred studying with my friends at home, because we had the opportunity to discuss the difficult problems and issues amongst one another and exchange ideas at the same time.
>
> (EFH, FG-5)

> If I could not understand the materials in the book, we plan to study in a group.
>
> (DMSR, FG-1)

However, there were a few students who enjoyed studying alone:

> I liked to study by myself. I felt that studying in groups was not effective because the students did more talking than learning.
>
> (IRA, FG-5)

8.2.4 Perception of Lecturers' Approaches to Teaching

Perceptions of pre-service teachers and graduates toward their lecturers' approaches to teaching obtained the lowest score, 3.46, among all scales (Table 8.2), indicating that respondents' perceptions of the approaches to physics teaching that their lectures used ranged between 'not sure' and 'agree'. A high percentage (49%) of the pre-service teachers and graduates were not sure that their lecturers' teaching methods keep them interested in physics and 40% were also not sure that the lecturers use interesting methods to teach physics topics. However, 68% agreed or strongly agreed that the lecturers use familiar examples to explain physics concepts and 77% agreed or strongly agreed that the lecturers provide opportunities for the students to express their point of views (Appendix 7). As a comparison, the results of focus group interviews with participants on their motivation and strategies for learning are provided in the following quotes.

> I think that each of my lecturers had very different characteristics and teaching styles. Therefore, I do not feel that I am able to give a generalisation about my lecturers' teaching approaches. Some lecturers showed great efforts in teaching their students. Others seemed to have only delivered the subject material and did not care whether the students understood it or not.
>
> (EFH, FG-5)

> The teaching and learning materials by some lecturers is more fun, however, some lecturers make us more stressful. If we have the course with these lecturers, we have to study first at home in order to be well prepared to follow the lesson.
>
> (DY, FG-1)

Although, an important part of the role of a teacher is to enthuse, inspire, and motivate their students (see for example: Kember & McNaught, 2007), some of the lecturers were not perceived as being able to help or motivate students who were experiencing problems or lacking motivation for learning.

> Many students studied because they were motivated to study. I think that the lecturers did not put enough effort into helping students who had difficulties with their learning process.
>
> (AM, FG-5)

Other participants commented on some components associated with lecturers' strategies such as instruction, assessment, and so on. The following quote determined that some lecturers focussed on what was important for the students to learn and provided them with a lot of materials (notes, examples, handouts, library references, etc.) without having enough interaction and recognition of their students' understanding. These approaches to teaching seemed to be content-centred rather than learner-centred.

> Some lecturers only focused on their lectures and didn’t know whether their students understood the material or not. Students would write about topics from their lectures even though they couldn’t fully comprehend the information.
>
> (N, FG-5)

> When the lecturer came into the class, she/he explained materials by writing on the whiteboard. If the subject had correlation with mathematics, the lecturer wrote and explained the formulas. The students were then asked to answer questions in front of the class.
>
> (RFD, FG-4)

> The lecturers are competent and well qualified in physics. But, some explanations from the lecturers are difficult to be understood and the interaction between the lecturers and the students are not good enough.
>
> (MF, FG-3)

> Not all lecturers would give detailed information or specifics of the syllabus about the subjects that they taught. Therefore, I didn’t know exactly what materials would be taught. Nevertheless, I still maintained good progress during my time of study. Until that time, I could not solve and understand many problems in physics but I can solve them now.
>
> (IRA, FG-5)

One respondent said, however, physics lecturers were still good compared to the ‘external lecturers’ whose their main job are in other study programmes or departments.

> In my opinion, the internal lecturers who taught physics subjects are better than the lecturers who taught us other subjects (the external lecturers). The external lecturers would often use a boring method of discussion and would then request that the students write a summary of the subject.
>
> (EFH, FG-5)

> In my opinion, the role of lecturers is very important because my lecturers will explain the materials from the books to help me understand the materials. I do not like the kind of lecturer who just directs me to write a paper. I prefer to have a lecturer who explains the materials and gives some examples and then assigns me the work.
>
> (WAP, FG-3)

As information, not all subjects were taught by physics education lecturers. All compulsory subjects whose code UNJ and KIP (see Chapter 5) were taught by some ‘external lecturers’. Those subjects that had the codes UNJ (six subjects) were compulsory by the university and the codes of KIP (five subjects) were compulsory by the faculty. As described in Chapter 5, the total numbers of subjects of physics education study programme were 52 and 11 of them were not taught by physics education lecturers.

Other lecturers' strategies associated with the accommodating student characteristics were mentioned by the following respondent:

> I think the interaction between lecturers and students needs to be improved in order for all students – not only the smart students – to have good progress in their studies.
>
> (EFH, FG-5)

According to IRA from FG-5, however, in general the physics education lecturers still had good social skills with all students.

> Although the lecturers didn’t pay enough attention to all students in their learning, they generally had good social skills with all students which should be maintained.
>
> (IRA, FG-5)

Another component of the lecturers' teaching strategy was assessment which could be frequent tests and quizzes in the content-centred approaches or a more flexible assessment (often with choices) in the learning-centred approaches. To measure pre-service teachers' achievement, there was a general faculty assessment guideline which included: written tests (in the middle and final semester), practical work test (if any), assignments' assessment, quiz, and students' participation in the classroom.

The lecturers' assessment was perceived to be unfair by some students.

> In assessment, some lecturers assess in a very objective manner, but some of them did not. We studied hard, but the result was far away from our expectations.
>
> (JN, FG-4)

> In my opinion about assessment, we do not know how we will be assessed by the lecturers. I mean that we know about our classmates' achievement. We have studied hard and we consider to get A or at least B+, but we just get B. Sometimes students think in their mind that the grade is a luck. Not all the results of the tests are given back to the students.
>
> (DY, FG-1)

According to some participants, the lecturers did not know precisely the ability of each student and the following quote indicates that some students cheated during the examination time.

> The lecturers do not know well about the students and they do not know how we perform in the subject. We have studied seriously and did the tasks, while one of the students cheats and she gets a good score such as A. Even we know our friends' ability, so we can determine those who could understand the materials and those who could not.
>
> (DMSR, FG-1)

The large number of participants taking the test would be a possible factor which caused some students to cheat without being recognised by the lecturers.

> Having a large number of students, we sit close in the test. So, if one student is cheating, it is possible that lecturers do not know it.
>
> (DMSR, FG-1)

8.2.5 Other Comments from Pre-Service Teachers and Graduates

The pre-service teachers and graduates also gave additional comments about rooms, physics lecturers, and laboratory equipment.

> Classroom numbers were also unaccommodating, we had a large number of students, but the classroom capacity was limited as the number of lecturers who taught physics were low.
>
> (IRA, FG-5)

> We have had awful experiences during experiments that took place in the laboratory, as some laboratory equipment has been unsuitable and we have not been able to conduct numerous experiments.
>
> (N, FG-5)

> I would like to suggest that the number of physics lecturers need to be increased. Physics pre-service teachers' programme has the fewest number of lecturers among all study programmes. This can be seen that the physics lecturer didn't have enough time to supervise his or her students in the final research project.
>
> (IRA, FG-5)

8.3 Some Comparisons between the *Experiential* and the *Perceived* Curriculum Related to the Four Scales

As described in Chapter 4 (Section 4.3), the lecturers' questionnaire was developed based on the pre-service teachers' and graduates' questionnaire (PPEC) and it has the same scales and very similar items. Therefore, it is appropriate to see the comparison between the *students'* and their lecturers' perceptions of the physics education curriculum or between the *experiential* and the *perceived* curriculum whether or not they have statistically significant differences.

The Mann-Whitney U Test is a non-parametric statistic which can be used to measure the differences between two independent groups on a continuous measure (Pallant, 2007). Although, the collection of data was not from a single instrument, it is still reasonable to use this statistic because both questionnaires measure the same issues in physics education. To reduce the incorrect interpretations in comparison, the researcher omitted some responses to items of student questionnaire (for example, data from AO6 and AL5) because these items were deleted from the lecturer questionnaire (see Chapter 4). Therefore, all data were measured by the same items and scales. In order to use the Mann-Whitney U test procedure, the researcher combined the data in one continuous variable associated with each scale and used **1** as a code for the pre-service teachers' and graduates' group then **2** as a code for the lecturers' group. Table 8.3 presents the Mean Ranks of each scale and Table 8.4 presents test statistic (the Mann-Whitney U, Z, and significance levels p).

The mean ranks in Table 8.3 can be used to describe the direction of difference (which group is higher). Because the Mann–Whitney U Test actually compares the median, it would be better to report the median values for each group when presenting the results (Pallant, 2007). Table 8.5 provides the median values for the pre-service teachers and graduates and the lecturers.

Table 8.3

Mean ranks of scales for the two groups of participants

	Status	N	Mean Rank
Total IP	1 Pre-service teacher or graduate	201	102.68
	2 Lecturer	7	156.71
	Total	208	
Total AO	1 Pre-service teacher or graduate	201	105.44
	2 Lecturer	7	77.43
	Total	208	
Total AL	1 Pre-service teacher or graduate	201	106.65
	2 Lecturer	7	42.64
	Total	208	
Total AT	1 Pre-service teacher or graduate	201	102.45
	2 Lecturer	7	163.36
	Total	208	

Table 8.4

Test statistic of U, Z, and p

	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
Total IP	338	-2.348	.019
Total AO	514	-1.214	.225
Total AL	270.5	-2.778	.005
Total AT	291.5	-2.636	.008

Table 8.5

Median (Md) for each group in every scale

Group	Total IP	Total AO	Total AL	Total AT
1 Pre-service teachers and graduates	27	42	32	39
2 Lecturers	29	40	28	44

An approximate value of effect size (r) can be calculated by dividing Z with square root of N, where N is the total number of cases. A Mann-Whitney U test revealed no significant differences in the aims and objectives of the physics education curriculum levels of the pre-service teachers and graduates (Md = 42, n = 201) and the lecturers (Md = 40, n = 7), U = 514, z = –1.21, p = .23, r = .08. This result statistically confirms that all participants (educators and students) on the average agreed with the aims and objectives of the physics education curriculum portrayed by items in AO scale. They had the same perception about this scale.

However, the test showed significance differences for the other scales. The significance levels p are .02, .01, and .01 for interest in physics, approaches to learning, and approaches to teaching respectively (Table 8.4). The probability values are less than .05, so the results are statistically significant. In the level of interest in physics, the medians are 27 (n = 201) for the pre-service teachers and graduates and 29 (n = 7)) for the lecturers, U = 338, z = –2.35, and r = .16; For the level of students' approaches to learning physics, the medians are 32 (n = 201) for the pre-service teachers and graduates and 28 (n = 7)) for the lecturers, U = 270.5, z = –2.78, and r = .19; and for the level of lecturers' approaches to teaching physics, the medians are 39 (n = 201) for the pre-service teachers and graduates and 44 (n = 7)) for the lecturers, U = 291.5, z = –2.64, and r = .18.

These results statistically confirm that the pre-service teachers and graduates had different perceptions regarding their interest in physics, approaches to learning, and of the lecturers' approaches to teaching. Pre-service teachers' and graduates' interests in physics were lower than their lecturers' (see medians, mean ranks, and qualitative data). They perceived that the lecturers did not use learner-centred strategies in their approaches to teaching; this is where their perceptions were different from those of the lecturers' views. Although, the medians and mean ranks about the pre-service teachers' and graduates' approaches to learning also showed different values (Table 8.3 and Table 8.5), the qualitative and qualitative results related to both groups of participants confirmed that the students' approaches to learning were surface approaches.

8.4 Summary of the Chapter

The pre-service teachers and graduates perceived their learning experiences which reflects their prior knowledge and experiences about physics education curriculum. In general, the pre-service teachers and graduates were in agreement with the aims and objectives of the physics education curriculum; their interests in physics were lower than their approaches to learning physics; and some pre-service teachers were not satisfied with the lecturers' approaches to teaching physics.

Even though the aims and objectives of physics education curriculum are quite good, some pre-service teachers and graduates had problems in learning due to the difficulty of the course materials and the lack of their lecturers' attention, support, and ability to overcome the students' problems in learning. Other results highlighted that many pre-service teachers and graduates study only for examinations or doing the assignments. Even though on the average they agree with the approach to learning portrayed by the items, their approaches to learning seemed to be surface approaches because the students did not show a high interest in learning physics. The pre-service teachers and graduates also had additional comments related to resources and facilities: their learning experiences dealt with the limited availability of textbooks, laboratory equipment, rooms, and the number of physics education lecturers as well.

Further analysis using the Mann–Whitney *U* test revealed no statistically significance differences for the prescribed levels of aims and objectives of physics education curriculum. However, this test showed statistically significance differences for the levels of interest in physics, students' approaches to learning, and lecturers' approaches to teaching between the *pre-service teachers and graduates* and their *lecturers*. These groups of participants had different views about these three scales.

Chapter 9
DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

9.1 Introduction

The last four chapters (Chapters 5, 6, 7, and 8) presented the results of this research related to each curriculum representation and research questions. The purpose of this final chapter is to synthesise the results in relation to the literature to answer the research questions proposed in the first chapter, to summarise the major findings of this research, and to discuss the implications of the results in terms of physics pre-service teacher education. Key recommendations are made for changes that should be implemented. The significance and limitations of the study are discussed and some suggestions are made for further research in this area.

9.2 Research Question 1 – What is the framework for the physics education curriculum? – The *ideal* and the *formal/written* curriculum

9.2.1 The Ideal Curriculum for Physics Education in One Higher Education Institution in Indonesia

Although the government had provided some guidelines for higher education curriculum (Chapter 5, Section 5.2), the documents produced do not indicate the specific curriculum for physics education study programmes. The *ideal* curriculum is generic and can be appropriate for all institutions because it was expressed in very general and flexible terminologies. The terms "kemampuan dan keterampilan berkarya" (the ability and skills to work) in Government Regulation (No. 17 of 2010, Article 97, p. 73) is an example of general terms related to the competency element. All higher education institutions can use this general competence in the intended meaning associated with their programmes (in physics education or physics pre-service teachers' programme of the higher education institution, the competence become 'the ability and skills to work as a physics teacher').

The *ideal* curriculum also has some general aims, for example:

> "menyiapkan peserta didik untuk menjadi anggota masyarakat yang memiliki kemampuan akademik dalam menerapkan, mengembangkan,

> dan atau memperkaya khasanah ilmu pengetahuan, teknologi dan/ atau kesenian" (to enable the learner to be a member of societies and to have the academic ability to apply, to develop, and/or to enrich knowledge, technology, and/or art) (MoNE Resolution Number 232/U/2000, Article 2).

By rewording this general aim, the physics pre-service teachers' programme and other programmes in the institution can use the aim as their intended curriculum.

MoNE Resolution No. 232 of 2000 revealed that Bachelor programmes in all higher education institutions should provide the number of credits in a range of 144 - 160 credits. The programmes are directed to educate the students to have qualifications in the nature of knowledge and skills, be able to apply their knowledge and skills, have good attitudes and behaviours, and be able to keep on track with the development of knowledge, technology, or art (Chapter 5, Section 5.2). Again, by simply adding or modifying some words, these attributes are suitable for the physics education programme i.e., to educate physics pre-service teachers to have qualifications in the nature of physics knowledge and skills, be able to apply their knowledge and skills as physics teachers, have good attitudes and behaviours related to physics, and be able to keep in track with the development of physics knowledge. Although no specific guidelines or written document mentioned these attributes, some broad aims of the physics education curriculum (Chapter 5, Section 5.3.3) seem to be appropriate with these ideal attributes (for example, to prepare pre-service teachers who have the basics of physics knowledge which can be taught comprehensively, solidly, and deeply).

As mentioned in Article 9 of Government Regulation number 19 Year 2005, the basic framework and structure of the curriculum shall be developed by each higher education institution for every programme of study. This article also mentioned that the depth of the curriculum is governed by the respective institution. Furthermore, MoNE Resolution number 232 Year 2000 and Government Regulation number 17 Year 2010 state that the higher education curriculum should be competency-based. In addition, every higher education institution must decide what subjects are to be included in the core or institution curriculum. Although these guidelines provide five generic competency elements (Chapter 5, Section 5.2), this is not helpful information for physics education lecturers to reform their curriculum. The lack of guidelines and the great privilege for physics education or pre-service teacher programme to revise or improve the curriculum presents more challenges for physics lecturers or curriculum specialists because there are frequent opportunities to participate actively in the curriculum reform. On the other hand, this situation may cause disadvantages for example, by creating a great variation in curricula among similar physics education programmes in other institutions. Due to the lack of specific guidelines for developing the physics pre-service teachers' curriculum, differences can occur in the written curriculum, and therefore the curriculum frameworks will vary among similar higher education institutions. In particular, every physics pre-service teachers' study programme has its own core curriculum, the number of credits, the competency elements, the process, etc., based on their views and interpretations of the generic guidelines.

9.2.2 The Formal/Written Curriculum for Physics Pre-service Teachers

9.2.2.1 Curriculum Structure

Concerning the government policies about the higher education curricula, the physics pre-service teachers' programme has developed the core and the institutional curriculum which are distributed into several subjects or courses which are made compulsory by the university, the faculty, the study programme, and into several subjects as options or choices. Unfortunately, the curriculum structure and other documents do not mention or label every subject as the core or institution curriculum. It took much time for the researcher to identify the differentiations among all subjects based on the topics or syllabi of every subject and the definition as well as criteria of the core or institution curriculum that is in the MoNE resolution Number 232 Year 2000. The percentage of the core and institution curriculum was around 80% and 20% respectively (Table 5.1). Appendix 6 provides the details of the curriculum structure for physics pre-service teachers in every semester consisting of (1) subject codes which give information about what subject is compulsory by the university, faculty, study programme, or subject of choice, (2) subject names, (3) number of credits, and (4) the availability of subject prerequisite.

9.2.2.2 Credits and Time

Analysis of the curriculum documents in this study (Chapter 5, Section 5.3.1) indicate that physics pre-service teachers are required to take too many subjects (50 compulsory subjects plus two subjects of choice) to complete their bachelor programme. Consequently, this situation creates an overcrowded syllabus, so pre-service teachers do not have enough time to study every subject comprehensively. Theoretically, as it has been calculated in Chapter 5, if the pre-service teachers allocate their time six days a week to study then they must learn between 9.8 hours (in semester 1 and semester 2) to more than 12 hours (in semester 5) a day. It can be imagined that they have no time for any other activities if they have to study, for example, from 8am to 8pm constantly?

Another consequence is that the pre-service teachers' learning focused only on factual recall rather than on deep understanding, especially when they did not fulfil the requirement time for studying. Ideally, the pre-service teachers have to attend lectures; they also have to allocate their time for doing structured and unstructured assignments based on the number of credits for every subject (see Chapter 5, Section 5.3.2). The *written* curriculum in semester 5 mentioned that there were nine subjects with a total of 24 credits (Appendix 6). Based on the guidelines, the pre-service teachers were required to attend 25 hours lectures and practical activities in a week plus doing 24 hours structured assignments and 24 hours unstructured assignments. Therefore, they should allocate 73 hours in a week or more than 10 hours every day (including weekend) for study. Having to take too many subjects or credits would put the pre-service teachers under pressure for effective learning and it is possible that they skipped some topics or touched on them only briefly. The interview results confirmed that some students did not prepare well for the assessment and focussed only on some topic that they perceived would appear in the assessments (Chapter 8, Section 8.2.3).

Although the total number of credits is still in the range of the *ideal* curriculum (according to the Government guidelines), the previous analysis indicates that the *written* curriculum of the pre-service teachers' programme is overloaded. Furthermore, this overloading of the curriculum is worsened by the rapid changes in local, national, and international dynamics. Stinner and Williams (2003) mentioned that the science curriculum has become overcrowded because new ideas and scientific information keep being included, but hardly anything is removed. A heavy workload is a characteristic of courses associated with surface approaches (Gibbs, 1992). Therefore, an overloading of this curriculum will become a barrier for the pre-service teachers to become successful learners in their study. This fact will also be an obstacle for the pre-service teachers' study programme to achieve the aims successfully and effectively.

9.2.2.3 Aims, Objectives, Curriculum Guides, and Syllabi

The aims of the curriculum are the broad, general statement of the purposes of the implementation of a curriculum in education; while curriculum objectives are specific, programmatic targets with criteria of achievement and, therefore, are measurable. As portrayed in Chapter 5, Section 5.3.3, the physics education study programme has a formal set of aims and objectives. The broad programme aims are to prepare pre-service teachers who have good personalities related to the aims of national education, the basis of scientific thinking, the basis of physics knowledge which can be taught comprehensively, solidly, and deeply, and a broad insight about education, ability, and skills in designing, implementing, and managing teaching and learning in physics.

In summarise, general objectives are that pre-service teacher understand physics comprehensively including the relation among concepts and theory, use methods and equipment to understand the concepts of physics, understand the characteristics of junior and senior high school students, understand the basic concepts of education, physics education, teaching and learning process, and continue further study. These objectives are related to content knowledge and pedagogical knowledge of physics education.

As described in the results, not many written documents are available in the physics pre-service teacher programme. However, curriculum guides, courses of study and syllabi are the common existing documents related to the physics education curriculum. According to Oliva (2009), a curriculum guide is the most general of the three types of documents. It may cover a single subject (for example, Mechanics or Thermodynamics in physics education); two or more subjects at a particular semester that a lecturer has to teach; or an area of interest applicable to two or more subjects (e.g., laboratory safety). When a curriculum guide covers one subject, it may also be called a course of study. A course of study is a detailed plan for a single course, including text materials (content) – in summary or more complete text. A syllabus is an outline of topics to be covered in a single course.

Generally, every physics teacher educator develops the curriculum guide which covers a single subject or course. A comprehensive curriculum guide format which is not prescriptive is presented in Figure 5.2. The faculty offer the flexibility to the lecturer, who may choose or reject any of the suggested aims, objectives, activities, evaluation techniques, or resources.

As mentioned previously in Chapter 5, Section 5.3.4, some lecturers also describe standards of competences in the course description and use basic competences and indicators instead of aims and objectives in the table. These replacements were made by these lecturers to implement the competence-based curriculum.

Because of a large number of subjects and the lecturer's flexibilities in creating the curriculum guides, it is an enormous task to analyse all curriculum guides or even the syllabi developed by the lecturers. However, in this research, the researcher attempted to analyse and compare some syllabi of "General Physics I" and "Mechanics" (Table 5.5). Although they have some similar topics (for example, motion in one and two dimensions, potential energy, and gravitation), the content of Mechanics is deeper than General Physics I. On the other hand, General Physics I includes not only mechanics but also electricity and magnetism sections. Consequently, this subject contains many physics concepts and theories.

9.3 Research Question 2 – What are academic teaching staff perceptions of the physics education curriculum? – The *perceived* curriculum

As illustrated in Table 3.2 and described in Chapter 6, this research question was answered using information from the questionnaire for assessing lecturers' Perceptions of the Physics Education Curriculum (PPEC) and the one-on-one interviews with lecturers. The questionnaire measured four scales which involve lecturer interest in physics, aims and objectives of the physics education curriculum, approaches to teaching, and students' approaches to learning.

9.3.1 Characteristics of physics pre-service teacher educators and their interest in physics

The group of physics pre-service teacher educators (three male and four female) who had responded to the questionnaire was experienced and well qualified (Table 6.2). The majority of educators were aged between 43 and 47 years, their teaching experience ranged from nine to 26 years, and they had qualifications at the master degree levels. Most educators or lecturers had the highest liking for Mechanics and the lowest liking for Modern Physics.

Lecturers' interest in physics had the highest mean rating of 4.16 (out of 5) (Table 6.1), indicating the lecturers had a strong interest in physics. The high value of this scale implied that the content of physics is interesting and a favourite for them. They like to do physics experiments, enjoy learning physics, and solve new problems in physics. Appendix 7 shows that a high percentage of lecturers (86%) agreed or strongly agreed that they want to spend more time reading physics books, but 14% disagreed with this statement.

The lecturers' perceptions of their interest in physics were further supported by the lecturers' answers on the interviews (Chapter 6, Section 6.2.1, detailed of NVivo reports in Appendix 8). All lecturers who were interviewed chose to study and to teach physics because they liked physics. Their liking for physics was influenced by various factors, for example their background (parent or teacher) and the rationalisation of physics' concepts and theories. Because interest is an important variable (Krapp, 1999) that contributes to future endeavours (Hidi, 1990) and links to high-quality learning and achievement (Hidi et al., 2004; Mikkonen, Heikkilä, Ruohoniemi, & Lindblom-Ylänne, 2009), lecturers' interest in physics seems to be a good starting point for improving the physics education curriculum.

9.3.2 Lecturers' perceptions of aims and objectives of physics education curriculum

The lecturers agreed with the aims and objectives of the physics education curriculum, as indicated by the mean rating of 3.99 for Aims and Objectives (Table 6.1).

Chapter 6, Section 6.2.2, provided detailed information of the questionnaire results (Appendix 7), and the NVivo report of interviews (Appendix 8) showed that the lecturers perceived that the physics education curriculum can support their students to have a successful career. They also have perceptions that learning physics can help their students' career and that the physics education curriculum can support their students to be professional teachers, to be skilled-teacher researchers, and to be lifelong learners. However, the curriculum still needs to be revised in order to meet the curriculum for secondary education and to establish the relevance of graduate competencies and the stakeholders' needs. As mentioned previously, the implementation of the Act of the Republic of Indonesia number 20 year 2003 (about the new National Education System) determined that secondary school curriculum development is no longer the authority of the central government. Every level of schools in every region or district needs to develop its own curriculum based on the national standards of education. Consequently, the stakeholders need physics education graduates who have greater competence, knowledge and skills regarding the new policies. In other words, the revision is important to make the curriculum more related to graduates' future work and career. The lecturers' comments are similar to what Hill et al. (2003) mentioned that the Higher Education curricula should be more appropriate to the world of work to be experienced by their graduates.

9.3.3 Lecturers' perceptions of their approaches to teaching

Approaches to teaching had a mean rating of 3.97, representing the lecturers' beliefs that they motivated, helped, and supported their students in learning and used strategies that were learner-centred (Chapter 6, Section 6.2.4). Detailed information from the questionnaire (Appendix 7) showed that a high percentage (86%) of physics lecturers agreed that they used interesting methods to teach physics topics and 100% agreed or strongly agreed that they used familiar examples to explain physics concepts and provided their students with opportunities to express their points of view.

Interview results showed that Lecturer A encourages his students to construct knowledge by providing the integration of each topic in their assignments. Lecturer B tries to find ways to help her students improve when a large number of them have results with low scores (for example, by discussing the students' difficulties in understanding the learning material). Dissimilar to the two previous lecturers' strategies, Lecturer C put pressure on her students by giving them regular assignments to keep them studying. The lecturers' approaches to teaching seem to be appropriate with an argument that different university teachers have different intentions and strategies concerning what and how students will learn (Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2000; Trigwell, 1994). The strategies ranged from teacher-focussed to student-focussed. According to Martin, et al., (2000), in terms of lecturers' strategies and the intention underlying the strategies, there are six categories of approaches to teaching (Table 9.1).

Table 9.1

Categories of lecturers' approaches to teaching

Lecturer's strategy	Lecturer's intention		
	Information transmission	Conceptual development	Conceptual change
Teacher focus			
Presenting material	A		
Covering material	B		
Clarifying material	C		
Student focus			
Engaging with discipline knowledge		D	
Practicing discipline knowledge		E	
Challenging discipline understanding or professional practice			F

Generally, in this study, all lecturers perceived that they enabled the students to learn the material through the use of familiar examples related to the students' own experiences. They perceived that they engaged their students with the discipline knowledge with the intention of helping students develop their conceptual understanding. It seems that they adopt student focussed approach category D (Table 9.1). However, they were not always successful in motivating their students in learning (see Section 9.2.3 and Section 9.2.4.4). Furthermore, although some lecturers included their students' participation as one of the assessment components, the type of assessment was likely to lead to the content-centred approach because the lecturers did not adopt a more flexible assessment strategy in which students were given choices that matched their interests or needs.

9.3.4 Lecturers' perceptions of approaches to learning of their students

Students' approaches to learning had the lowest mean rating of 3.45, indicating that the lecturers' perceptions of the pre-service teachers' and graduates' approaches to learning physics varied between not sure and agree. The lower score indicated the lecturers believed that their students in general only had surface approaches for learning physics. The surface approach does not include intrinsic motivation such that students do not attempt to make sense of what is to be learnt (Gibbs, 1992).

Further interviews with lecturers confirmed that students demonstrate a lack of effort in their learning. Lecturer A believed that his students did not have a high motivation for learning as he found many students were not fully engaged in the teaching and learning process. Lecturer C had the opinion that most students just want to finish their study without much effort because some students only copy their friends' work. Lecturer C, in spite of this, believed that students' motivation to learn was diverse, because some students were engaged and motivated whereas the others were not motivated. Lecturer B usually distributes assignments weekly then prior to students' examination days she and her students discuss the students' difficulties in understanding the learning material. However, when she put similar revised topics in the test, students' results still tend to be disappointing, indicating that the students still seem to have problems in understanding the topics. The detailed questionnaire data (Appendix 7) also recognised that a high percentage of lecturers were not sure that their students prepare well for the physics tests and labs. Only 43% of lecturers agreed that the students put sufficient effort into learning physics and use strategies that ensure they learn the physics well.

Additional comments from the lecturers highlighted the limitation of resources and facilities. Library books and other teaching resources still need to be provided to support teaching and learning in physics education. Although recently the faculty provided funds for the lecturers to create some teaching resources (for example, modules), unfortunately, the physics lecturers were not able to take this opportunity because they had to teach too many subjects and did not have enough time for creating the teaching resources. The number and type of laboratory equipment (to support practical work) as well as adequate rooms for important facilities to support practical work need to be increased. To some extent, these findings are similar to previous studies in other countries that showed a lack of relationship between policy and practice (Bekalo & Welford, 2000; Friedel & Treagust, 2005). In general, the lecturers' perceptions of the physics education curriculum (the *perceived* curriculum) do not demonstrate coherencies with the *ideal* or the *formal/written* curriculum.

9.4 Research Question 3 – What are the actual process of teaching and learning in terms of the physics education curriculum? – The *operational* curriculum

As illustrated in Table 3.2 and presented in Chapter 7, Section 7.2, this research question was answered using information from classroom observations. The actual process of teaching and learning General Physics I, Mechanics, and Laboratory Management which had been observed includes the content, the learning activities and lecturer's role, the teaching resources and facilities, and the assessment. Although detailed content of each subject is not provided in this thesis, a general report has been described.

9.4.1 General Physics I (lecturer, LB)

The content of General Physics I in four weeks' contact hours consists of vectors, differential and integral calculus as well as their applications in physics. This content was presented to equip pre-service teachers with the knowledge of Calculus as a basic language of physics and to provide new pre-service teachers with the same basic skills that are needed in physics. The session commenced with an overview of what was to be covered in the session and a brief reminder of what had been covered in the previous education of the pre-service teachers. Frequent questions were addressed to the pre-service teachers. They responded by calling out the answers and when pre-service teachers asked questions these were redirected back to the class for a response or discussion that would be made to include the students in finding the answers.

Lecturer B provided several examples of vector problems that were realistic, relevant and based on practice to create worthwhile learning activities and engage the students. The lecturer seemed to adopt category D of the lecturer's approach as mentioned by Trigwell (1994)(see Table 9.1). However, she did not use any demonstration methods during her lecturing. According to Martin, et al. (2000) in category D, the teacher's intention is to enable the student to discover and develop the concepts of the discipline not only through the use of examples related to the student's own experiences but also through the demonstration of the principles to be understood. Consequently, it seemed not every student can be active and motivated, even though, she also used questioning techniques from closed to open questions.

The main teaching resources for General Physics I were books. According to Lecturer B, there were more books related to General Physics I compared to textbooks of other subjects. Existing facilities were very limited, for example, the LCD projector and computer were not available in the lecture room.

The lecturer used faculty guidelines for assessment methods which included several components such as assignments, mid-test, and final test. As stated by the lecturer, the assessment was not only by the written test but also by the performance test. The pre-service teacher activities in class to express opinions and ideas would be another component. Active students who were able to do some tasks assigned by the lecturer would get additional worth or merit in their grade.

9.4.2 Mechanics (lecturer, LC)

The content of Mechanics in four weeks' contact hours consists of kinematics and dynamics particles. These materials were also provided in the syllabi of General Physics I. It should be more advanced, but due to the need of pre-service teachers, Lecturer C repeated a few general concepts in her lecturing.

Unlike General Physics I, the dominant method of teaching was setting tasks to solve problems in Mechanics which were taken from textbooks. Students were asked to study concepts and theories which were mentioned in the syllabi and to solve related problems individually or in groups. It seemed that Lecturer C adopted category B of the teaching approaches (Table 9.1). In this approach, the knowledge is quantified by the curriculum – there is a given amount of knowledge to be acquired (Martin et al., 2000) and students are expected to be able to recall facts, relate concepts and solve problems (Trigwell, 1994).

It is not surprising that learning activities of the two subjects were almost similar, in which case not many students or pre-service teachers were shown interesting activities for teaching and learning. Most pre-service teachers learned passively and only a few demonstrated their eagerness to know or to participate in the lecturing. The role of lecturers did not appear to be able to successfully increase the pre-service teachers' motivation.

Furthermore, teaching resources and facilities for this subject were still limited. However, to overcome the limitation of textbooks in the library, the lecturer asked her students to buy some essential books and/or lend students her own books. The lecturer also created some handouts and asked her students to copy them (Appendix 8).

Associated with the assessment method, Lecturer C used faculty guidelines for the assessment which included components such as, assignments, mid-test, and final test. Like Lecturer B, the assessment was not only by the written test but also by the performance test. The pre-service teacher activities in class to express opinions and ideas would be another component.

9.4.3 Laboratory Management (lecturer, LA)

Another subject was Laboratory Management. This subject contained, for example, administration of the laboratory, work safety, laboratory safety, and maintenance and repair of laboratory equipment (see Chapter 7, Section 7.2.3).

Lecturer A used the media LCD projector and verbal explanation or discussion of information to develop his students' understanding. He also gave his students assignment to observed laboratory facilities in secondary schools. This assignment creates opportunities for his students to begin to engage in thinking and reasoning within the discipline and to come to know the discipline. Additionally, during the lecture, Lecturer A demonstrated his ability to make good interactions with his students. As a consequence, students enjoyed studying and had experiences with the practice of the discipline as well as constructing their own meaning. Lecturer A seems to adopt category D in his lecturing approach which focused on engaging students with discipline knowledge to develop their own concepts. In this case, the actual process of teaching and learning (the *operational* curriculum) of this lecturer was the same with the *perceived* curriculum as mentioned in Chapter 6, Section 6.2.4.

Similar to the two previous subjects, teaching resources and facilities for this subject were still limited. To overcome the limitation of textbooks in the library, Lecturer A asked his student to use internet facilities as alternative learning resources. Lecturer A also used faculty guidelines for assessment methods which included components such as, assignments, mid-test, and final test.

9.5 Research Question 4 – What are physics pre-service teachers' and graduates' perceptions of the physics education curriculum? – The *experiential* curriculum

As illustrated in Table 3.2 and described in Chapter 8, Section 8.2, this research question was answered using information from the questionnaire for assessing pre-service teachers' and graduates' Perceptions of the Physics Education Curriculum (PPEC) and the focus groups discussion.

All participants perceived their learning experiences differently, reflecting their prior knowledge and experiences about the physics education curriculum. Their perceptions are related to the aims and objectives of the physics education curriculum, the lecturers' approaches to teaching, their interest in physics, and their approaches to learning physics.

9.5.1 Physics pre-service teachers' and graduates' interest in physics

The PPEC data indicated that in general the pre-service teachers and graduates had interest in physics. The content of physics is interesting and a favourite for them, but around half of the participants were not sure that they are willing to spend more time reading physics books and trying to solve new problems in physics (Appendix 7). In this case, they seemed to be different from their lecturers. The comparison between the *pre-service teachers' as well as graduates'* and *their lecturers'* interest in physics showed statistically significance differences with the probability value less than .05.

The medians are 27 (n = 201) for the pre-service teachers and graduates and 29 (n = 7) for the lecturers, U = 338, z = –2.35, and r = .16. These results statistically confirm that the pre-service teachers and graduates had different perceptions regarding their interest in physics. Pre-service teachers' and graduates' interests in physics were lower than their lecturers' (see medians, mean ranks, and qualitative data). Interview results indicated that almost a quarter of the respondents had physics education as a second choice for many reasons (for example, job opportunity as physics teachers and external motivation from parents or secondary school teachers) (Chapter 8, Section 8.2.1).

9.5.2 Perceptions of aims and objectives of physics education curriculum

It is surprising that the pre-service teachers and graduates were in agreement with the aims and objectives of physics education curriculum as indicated by the highest mean rating of 4.18 (out of 5). Detailed information from the questionnaire (Appendix 7) showed that the pre-service teachers and graduates perceived that the physics education curriculum provides knowledge and skills for their career and can enable the students to become professional physics teachers. Nevertheless, some of them were not sure that the physics education curriculum can support the pre-service teachers and graduates to be lifelong learners.

In general, it seems that the pre-service teachers had the same perceptions as their lecturers concerning the aims and objectives of physics education curriculum. It is also surprising that although the median of the aims and objectives for pre-service teachers and graduates (42) was higher than that the median for the lecturers (40), the difference in median was not statistically significant. As previously mentioned in Chapter 8, Section 8.3, a Mann-Whitney U test revealed that there was no statistically significant differences in the aims and objectives of the physics education curriculum levels of the pre-service teachers and graduates (n = 201) and the lecturers (n = 7), U = 514, z = –1.21, p = .23, r = .08. This result statistically confirms that all participants (educators and students) had the same perception about the aims and objectives of the physics education curriculum.

The results of the PPEC questionnaire were further described and supported by the pre-service teachers' and graduates' answers to the interview questions which highlighted that the physics education curriculum can support the students to have career opportunities in education. However, interview results also showed that some pre-service teachers and graduates perceived that they had problems or difficulties in learning physics due to the difficulties or complexities of the course materials and the lack of their lecturers' attention to find solutions to student learning difficulties. In addition, they would like more physics content related to their future job as school physics teachers rather than study the difficult physics concepts and theories.

Like the lecturers, pre-service teachers and graduates also had additional comments related to resources and facilities. Their learning experiences also dealt with the limitation of textbooks, laboratory equipment, rooms, and the number of physics education lecturers as well.

9.5.3 Perceptions of approaches to learning

Pre-service teachers' and graduates' approaches to learning had the mean rating of 3.96, indicating that on average they agreed with the approaches to learning physics described by the items. Further interviews showed that only a few pre-service teachers and graduates perceived they studied enthusiastically and had a deep approach to learning. Some detailed information from the questionnaire (Appendix 7) showed that 25% of the pre-service teachers and graduates were not sure that they put a lot of effort into trying to understand things which initially seemed difficult and 28% were not sure that they used strategies to learn the physics well.

It is worrying that the focus group interview results showed many pre-service teachers and graduates study only for examinations or when doing the assignments. Even though, on the average they agreed with the approach to learning portrayed by the items, their approaches seemed to be surface approaches. Marton and Saljo (1976) stated that a surface approach is one in which students attempt to rote learn material in order to subsequently reproduce it. In this approach, students memorise the course materials (for example, for the purposes of assessment). Pre-service teachers and graduates approaches to learning did not include a high interest in learning physics which is linked to high-quality learning (Hidi et al., 2004; Mikkonen et al., 2009). This result seems to confirm empirical studies in the field of physics education which have examined the relation between students' learning or individual experiences and specific interests (Fischer & Horstendahl, 1997; von Aufschnaiter et al., 1999)(Chapter 4, Section 4.2.2).

9.5.4 Perceptions of lecturers' approaches to teaching

Even though the aims and objectives of the physics education curriculum are valuable, some pre-service teachers and graduates had problems in learning due to the difficulty of the course materials and the lack of their lecturers' attention, support, and ability to overcome students' problems in learning. Furthermore, some pre-service teachers and graduates felt that some results of their lecturer' assessments were not unfair. It seemed that all of these factors influenced their perception about their lecturers' approaches to teaching. Table 8.2 showed that the perceptions of pre-service teachers and graduates toward their lecturers' approaches to teaching achieved the lowest score, 3.46, among all scales, indicating that respondents' perceptions of the approaches to teaching that their lectures used ranged between 'not sure' and 'agree'.

Detailed information from the questionnaire (Appendix 7) showed that a high percentage (49%) of the pre-service teachers and graduates were not sure that their lecturers' teaching methods keep them interested in physics and 40% were also not sure that the lecturers use interesting methods to teach physics topics. It is surprising that their perceptions are different from the lecturers' own perceptions, that is the lecturer perceives that they motivate students and used the learner-centred strategy. Similar to what Friedel and Treagust (2005) found, in this case, there is a difference between the *perceived* and the *experiential* curriculum.

Nevertheless, 68% agreed or strongly agreed that the lecturers use familiar examples to explain physics concepts and 77% agreed or strongly agreed that the lecturers provide opportunities for the students to express their points of view. Associated with the assessments, the questionnaire results in Appendix 7 shows 31.8% of pre-service teachers and graduates are not sure that lecturers' assessment methods evaluate students' understanding and 32.3% are not sure that lecturers' assessments encourage students to be self-regulated learners. Rust (2002) mentioned that if students see that an assessment task has no relevance or importance to them beyond passing the assessment, it seems that they are likely to take a surface approach.

Further interviews (Chapter 8, Section 8.4.2) described that some lecturers showed great effort in teaching and motivating their students. Others seemed to have only delivered and focussed on their lectures and did not care whether the students understood it or not. Some lecturers concentrated on what was important for the students to learn and provided them with a lot of materials but without having enough interaction and recognition of their students' understanding. This approach to teaching seemed to be content-centred rather than learner-centred. In this approach an educator's strategy focussed on the intention of transmitting information (concepts of the syllabus) to students. Furthermore, this type of approach only satisfies external demands not internal demands or students' needs (Trigwell & Prosser, 1996).

The findings from this study indicate that students would like the lectures to be interestingly presented, teaching methods to be more interactive and motivating, detailed information of the syllabus to be clearly presented (by all lecturers), assessment processes to be more objective, and physics content to be more related to their future job as secondary physics teachers. These results are consistent with the idea that in order to change the way higher education teachers' approach their teaching, there is need to focus more on their students rather than their own performance (Trigwell & Prosser, 1996). Lecturers should encourage participation from their students (Norton, Richardson, Hartley, Newstead, & Mayes, 2005), play their important role to enthuse, inspire, and motivate their students (Kember & McNaught, 2007; Roychoudhury & Rice, 2012), and make assessment feedback useful (Rae & Cochrane, 2008) as well as present a clear syllabus to help students to acquire concepts (Trigwell & Prosser, 1996).

9.6 Implications for Secondary Physics Teacher Education

These implications are summarised below as four basic assertions about how the physics education curriculum can be improved.

Assertion 1: The number of subjects and credits in the curriculum should be reduced and rationalised.

The results of the written curriculum research highlighted the overloaded physics education curriculum. This result seems to confirm what Feiman-Nemser's (2001) claimed that teacher educators typically overload student teachers with too much information. Although the maximum credits for the Bachelor programme is 160 (MoNE Resolution No. 232 of 2000), based on the previous calculation, the numbers of subjects and credits (52 subjects and 150 credits) of the physics pre-service teachers' programme were too much, because the pre-service teachers must learn between 9.8 hours (in semester 1 and 2) to more than 12 hours a day (in semester 5) from Monday to Saturday consisting of contact hours and self-learning hours.

Results from the focus group interviews (Chapter 8, Section 8.2.2) showed that several students had difficulties in learning. They think some subjects consisted of many theories and difficult concepts. Some participants also think they need more physics content related to their future job as secondary school physics teachers rather than study difficult physics theories.

There is a possibility to reduce the numbers of subjects and credits since the minimum credits required by the government are 144 credits (Chapter 5 Section 5.2). Two or three subjects still could be excluded from the curriculum. One or two very difficult subjects (for example, Statistical Physics, Mathematical Physics, or Quantum Physics) that have no strong relation to the pre-service teachers' future careers should be removed or reduced from the physics education curriculum. At the moment there are three subjects related to mathematical physics (see Appendix 6). Physics lecturers and curriculum specialists might carefully re-evaluate these subjects and make a decision to remove one or two subjects.

Another solution can also be made by rearranging the syllabi of each subject. Classroom observation results showed that some content of one subject were similar to the contents of other subjects, for example, kinematic and dynamic particles in General Physics I were similar to some content in Mechanics; vectors, differential, and integral calculus in General Physics I were also similar to some content in Calculus. If these similar contents between the two subjects can be allocated to one subject only, then the number of credits can be reduced and the time for learning can be rationalised.

Assertion 2: The physics education curriculum should always be related to the need of stakeholders.

Physics education programmes in higher education institutions are the programmes to educate schools' physics teachers. Over the last decade, the schools' curriculum has changed several times due to the change of government policies. Besides developing generic capabilities – self-managed learning ability, analytical skills, team-work, leadership, and communication skills – (Chapter 5, Section 5.2) and competence elements (for example, the mastery of physics education) (Chapter 5, Section 5.4), the higher education institution also needs to educate teachers who have knowledge and skills related to the secondary schools' curricula. The institution should make adjustment to the stakeholders' needs (Chapter 6, Section 6.2.2). The result of this research highlights the importance of good relations between the physics education curriculum and the needs of stakeholders.

Assertion 3: The physics methods course should address the individuality of the pre-service teachers.

In order to encourage and support changes within the programme for pre-service secondary teachers, to provide appropriate learning experiences, to achieve the aims of curriculum, and to increase their interest in physics, physics teaching approaches are recommended to address the individuality of the pre-service teachers. This approach acknowledges the importance of many factors, for example, the role of the lecturers in motivating their students, the lecturers' teaching strategy, the resources and assessment. The lecturers should change their approaches to teaching to focus more on their students rather than the content or their own performance. They need to address the individuality of the pre-service teachers and provide more interaction with him or her who had problems in learning.

The results of this research showed that many pre-service teachers still had difficulty in learning physics and they need more interaction with the lecturers in teaching and learning (Chapter 8, Section 8.2.4). Furthermore, what influenced pre-service teachers' motivation to choose or learn physics was quite different for each pre-service teacher (Chapter 8, Section 8.2.1). By addressing the individuality of the pre-service teachers, all pre-service teachers, not only the knowledgeable ones, may have a higher interest in learning to gain more knowledge and skills about teaching physics.

Assertion 4: The physics education resources, facilities, and the number of lecturers should be increased

This research has demonstrated that books and laboratory equipment are limited. Pre-service teachers had difficulties in finding books in the library. Due to the lack of textbooks, they needed to buy some important books or borrow their lecturer's.

As reported by pre-service teachers and graduates, they were also not able to do some practical work activities because of the lack of practical equipment. This finding is still related to what Monk, Fairbrother, and Dillon (1993) mentioned that the constraints on the use of practical activities in some developing countries include lack of equipment, large classes, overcrowded syllabi, and an examination system focused on factual recall.

Rustad, Munandar, and Dwiyanto (2004) found that around 51% of physics teachers in secondary schools (SMP and SMA) in Indonesia are not able to use laboratory equipment in their schools. Therefore, if the physics pre-service teachers are not familiar with the laboratory activities during their study at the university, then they will likely be the teachers who are not able to use and organise practical work in the schools. This will become a more serious problem in the future.

Furthermore, this research showed that the physics pre-service teachers’ programme does not have many physics lecturers (Chapter 2, Section 2.3). Therefore, the lecturers had to teach many subjects and did not have time to create new teaching materials (Chapter 6, Section 6.2.5). If the number of teacher educators can be increased then they may have enough time to prepare material to improve their teaching.

9.7 Distinctive Contributions and Significance of the Research

This research makes several distinctive contributions within the fields of secondary physics teacher education, evaluation research, case study research, and mixed methodology research.

This study provided a highly detailed insight into how the physics pre-service teachers and graduates perceived their learning experiences, how the lecturers perceived their teaching experiences as well and how those experiences contributed to their increasing perceptions of the physics education curriculum and physics teaching in one higher education institution.

The current study is the first to evaluate the physics education curriculum in Indonesia associated with the five levels of curriculum representations (the *ideal,* the *formal/written*, the *perceived*, the *operational*, and the *experiential curriculum*). The significance of this research is that it provides the first more comprehensive data about physics pre-service teachers' curriculum in Indonesia. In general, these data are expected to be useful for all science pre-service teachers' programmes in higher education institutions throughout Indonesia by setting these data within the context. In particular, the findings of this research provide valuable information for the author's institution which is currently developing a new physics pre-service teachers' curriculum.

The data gathered in this research identifies some ways in which the physics pre-service teachers' or physics education curriculum in Indonesia could be improved. The improvement can be made by (1) reducing the number of subjects or credits, (2) selecting and rearranging syllabi among all subjects, (3) creating more relationship to the stakeholders' needs, (4) addressing the individuality of the pre-service teachers, and (5) increasing the resources, facilities, and also the number of teacher educators. Therefore, by taking these issues into account the curriculum may meet the needs of stakeholders and relate to government guidelines to produce qualified graduates who have holistic competencies (e.g. professional, pedagogy, social and personal competencies).

9.8 Limitations of the Research

The underpinning purpose of this research was to evaluate the physics pre-service teachers' curriculum in a higher education institution in Indonesia associated with five of six representations of the curriculum as described by van den Akker (2003). One representation (the *learned* curriculum) was not included in this research to fit the purposes and research questions. The results of this research show the importance of each of these five representations on the evaluation of the physics pre-service teachers' curriculum. However, a limitation of this research is that the number of lecturers involved in the research was small. The graduates involved in this study may also not be representative of all physics education graduates. There were not many graduates being able to join this research as participants. Another limitation is related to the variance described by the questionnaire. The four-scale solution of the PPEC questionnaire only explained a total of 34.93% of variance (Chapter 4, Section 4.2.4).

9.9 Further Research

A number of issues arise from this research that merit further investigation. An important suggestion for future research is to conduct a more comprehensive study (especially for quantitative research) with a much larger sample of lecturers, pre-service teachers, and graduates by including other physics education programmes in various higher education institutions in Indonesia. The larger and greater variety of participants may more closely reflect the various higher education institutions in Indonesia. Another suggestion is to include the pre-service teachers' learning outcomes or the *learned* curriculum; involving assessment data would be desirable to furnish needed information about the last representation of the curriculum and relate other aspects of the curriculum to what has been learned.

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Appendix 1 Interview Protocol

The interview aimed to scrutinise the pre-service teachers', graduates', and lecturers' views of the physics education curriculum. The following questions will guide the focus group or one-on-one interviews to probe the pre-service teachers' and graduates' learning experiences or the lecturers' teaching experiences. Sample interview items for these purposes are provided below.

Pre-Service Teachers

1. Why have you chosen to study physics education?
2. Why are you learning and toward which goals are you learning?
3. What and with what are you learning?
4. How are you learning?
5. How is your teacher teaching?
6. What is your opinion about the aims and objectives of the physics education curriculum?
7. What is your opinion about physics education curriculum in terms of viability, legitimacy and efficiency?

Graduates

1. Why did you choose to study physics education?
2. Why were you learning and toward which goals were you learning?
3. What and with what were you learning?
4. How were you learning?
5. How was your teacher teaching?
6. What is your opinion about the aims and objectives of the physics education curriculum?
7. What is your opinion about physics education curriculum in terms of viability, legitimacy and efficiency?

Lecturers

1. Why did you choose to study and teach physic education?
2. What and with what are you teaching?
3. How are your students learning?
4. How are you facilitating your students' learning?
5. What subject do you teach and what teaching resources are you using?
6. What is your opinion about input, process, and outcomes?
7. What is your opinion about the aims and objectives of the physics education curriculum?
8. What is your opinion about physics education curriculum in terms of viability, legitimacy and efficiency?

Appendix 2. Information Sheets and Consent Forms

Appendix 2 contains the information sheets and consent forms for the lecturers, pre-service teacher (student), and graduates. Consent forms relates to completion of the PPEC questionnaires (pre-service teachers' and graduates' questionnaire and lecturers' questionnaire) and participation in one-on-one interview (lecturers) and focus group interviews (pre-service teachers and graduates).

Curtin University of Technology
Science and Mathematics Education Centre

LECTURER Information Sheet

My name is Maison. I am currently completing a piece of research for my Doctor of Philosophy degree in Science Education at Curtin University of Technology, Perth, Australia

Purpose of Research

I am investigating the research topic: " *Curriculum Evaluation in Higher Education: A Case Study of a Physics Pre-service Teachers' Curriculum in Indonesia"*

Your Role

I will conduct research by asking for you to take part in a Physics Pre-service Teachers' Curriculum Survey. Teachers involved will be asked to complete a teachers' questionnaire. I may also ask for your participation in a short interview about your perception of the physics pre-service teachers' curriculum. All participation will be voluntary and will take 25 minutes for questionnaire and 25 minutes for one on one interview.

Consent to Participate

Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without affecting your rights or my responsibilities. When you have signed the consent form, I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality

The information that you provide will be kept separate from your personal details, and only myself and my supervisor will only have access to this. The interview transcript will not have your name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

Further Information

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-21-10). If you would like further information about the study, please feel free to contact me on +61 401711806 or by email: maisonchaniago@gmail.com. Alternatively, you can contact my supervisor Professor David Treagust on +61 92667924 or email: d.treagust@curtin.edu.au.

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

LECTURER Consent Form

- I understand the purpose and procedures of the study.
- I have been provided with the participation information sheet.
- I understand that the procedure itself may not benefit me.
- I understand that my involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to participate in the study outlined to me.

Name: ____

Signature: ____

Date: ______________________

Curtin University of Technology

Curtin University of Technology
Science and Mathematics Education Centre

STUDENT Information Sheet

My name is Maison. I am currently completing a piece of research for my Doctor of Philosophy degree in Science Education at Curtin University of Technology, Perth, Australia

Purpose of Research

I am investigating the research topic: " *Curriculum Evaluation in Higher Education: A Case Study of a Physics Pre-service Teachers' Curriculum in Indonesia"*

Your Role

I will conduct research by asking for you to take part in a Physics Pre-service Teachers' Curriculum Survey. The Dean of Faculty of Education and Teachers' Training and the Head of Physics Pre-service Teachers' Programme in your institution have already been contacted and have agreed in principle to the project. Students involved will be asked to complete a students' questionnaire. I may also ask for your participation in a short interview (group) about your perception of the physics pre-service teachers' curriculum. All participation will be voluntary and will take 30 minutes for questionnaire and 45 minutes for focus group interview.

Consent to Participate

Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without affecting your rights or my responsibilities. When you have signed the consent form, I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality

The information that you provide will be kept separate from your personal details, and only myself and my supervisor will only have access to this. The interview transcript will not have your name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

Further Information

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-21-10). If you would like further information about the study, please feel free to contact me on +61 401711806 or by email: maisonchaniago@gmail.com. Alternatively, you can contact my supervisor Professor David Treagust on +61 92667924 or email: d.treagust@curtin.edu.au.

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

Curtin University of Technology

STUDENT Consent Form

- I understand the purpose and procedures of the study.
- I have been provided with the participation information sheet.
- I understand that the procedure itself may not benefit me.
- I understand that my involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to participate in the study outlined to me.

Name: ____

Signature: ____

Date: ______________________

Curtin University of Technology
Science and Mathematics Education Centre

GRADUATE Information Sheet

My name is Maison. I am currently completing a piece of research for my Doctor of Philosophy degree in Science Education at Curtin University of Technology, Perth, Australia.

Purpose of Research

I am investigating the research topic: " *Curriculum Evaluation in Higher Education: A Case Study of a Physics Pre-service Teachers' Curriculum in Indonesia*"

Your Role

I will conduct research by asking for you to take part in a Physics Pre-service Teachers' Curriculum Survey (PPSTCS). Graduates involved will be asked to complete a graduates' questionnaire. I may also ask for your participation in a short interview (group) about your perception of the physics pre-service teachers' curriculum. All participation will be voluntary and will take 30 minutes for questionnaire and 45 minutes for focus group interview.

Consent to Participate

Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without affecting your rights or my responsibilities. When you have signed the consent form, I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality

The information that you provide will be kept separate from your personal details, and only myself and my supervisor will only have access to this. The interview transcript will not have your name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

Further Information

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-21-10). If you would like further information about the study, please feel free to contact me on +61 401711806 or by email: maisonchaniago@gmail.com. Alternatively, you can contact my supervisor Professor David Treagust on +61 92667924 or email: d.treagust@curtin.edu.au.

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

Curtin University of Technology

GRADUATE Consent Form

- I understand the purpose and procedures of the study.
- I have been provided with the participation information sheet.
- I understand that the procedure itself may not benefit me.
- I understand that my involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to participate in the study outlined to me.

Name: ____

Signature: ____

Date: ______________________

Appendix 3. Scales and Items for Questionnaires

A. PRE-SERVICE TEACHER AND GRADUATE

Scales		Items
IP	IP2	Physics subjects are interesting.
	IP3	I like to do physics experiments.
	IP5	Physics is one of my favourite subjects.
	IP6	I really enjoy learning physics.
	IP8	I am willing to spend more time reading physics books.
	IP9	I like trying to solve new problem in physics.
AO	AO1	Physics is one of the most important subjects for people to study.
	AO2	Physics knowledge is useful to interpret many aspects of our everyday life.
	AO3	I think learning physics can help my career.
	AO4	I think physics education curriculum can support me to be a professional teacher.
	AO5	I understand that my major future job will likely be related to schools or learning societies.
	AO6	Earning a good physics grade was/ is important to me.
	AO7	I think physics education curriculum can support me to be a skilled teacher researcher.
	AO8	I really wanted/ want to become a physics teacher.
	AO10	I expected/ expect to do as well as or better than other students in the physics course.
	AO11	I think physics education curriculum can support me to be a lifelong learner.
	AO12	I think learning physics can help me to be a good physics teacher.
	AO13	I think physics education curriculum can support me to be an emphatic intelligent member.
	AO14	I think physics education curriculum can support me to have career ability in educational area.
AL	AL1	I put enough effort into learning the physics.
	AL2	I prepared/ prepare well for the physics test and labs.
	AL3	I used/ use strategies that ensure I learn the physics well.
	AL5	If I am/was having trouble learning the physics, I try/tried to figure out why.
	AL6	I generally put a lot of effort into trying to understand things which initially seem difficult.
	AL8	I believe I can master the knowledge and skills in the physics course.
	AL9	I try to have good attitudes and behaviours related to my knowledge and skills.
	AL11	I usually memorise the model of answer which I perceive as likely to appear in tests or examinations
AT	AT1	My teacher's teaching methods keep me interested in physics.
	AT2	The physics material in the physics course was/ is covered in too much depth.
	AT3	My teacher provides opportunities for me to express my point of view.
	AT4	My teacher uses text books and any other supporting materials to teach physics
	AT5	My teacher uses interesting methods to teach physics topics.
	AT6	My teacher uses physics laboratory facilities to encourage me to discover and construct knowledge.
	AT7	My teacher's tests evaluate my understanding of a topic
	AT8	My teacher uses familiar examples to explain physics concepts.
	AT9	My teacher's questions evaluate my understanding of a topic.
	AT10	My teacher's assessment methods evaluate my understanding.
	AT11	My teacher's assessments encourage me to be a self regulated learner

B. LECTURER

Scales	Items	
IP	IP2	Physics subjects are interesting.
	IP3	I like to do physics experiments.
	IP5	Physics is one of my favourite subjects.
	IP6	I really enjoy learning physics.
	IP8	I am willing to spend more time reading physics books.
	IP9	I like trying to solve new problem in physics.
AO	AO1	Physics is one of the most important subjects for people to study
	AO2	Physics knowledge is useful to interpret many aspects of our everyday life.
	AO3	I think learning physics can help my students' career.
	AO4	I think the physics education curriculum can support my students to be professional teachers.
	AO5	I understand that my students' major future job will likely be related to schools or learning societies.
	AO7	I think the physics education curriculum can support my students to be skilled teacher researchers.
	AO8	I think my students really want to become physics teachers.
	AO11	I think the physics education curriculum can support my students to be lifelong learners.
	AO12	I think learning physics can help my students to be good physics teachers.
	AO13	I think the physics education curriculum can support my students to be emphatic intelligent members.
	AO14	I think the physics education curriculum can support my students to have career ability in educational area.
	AO15*	I think the physics education curriculum can support my students to be creative thinkers.
AL	AL1	I think my students put enough effort into learning the physics.
	AL2	I think my students prepare well for the physics test and labs.
	AL3	I think my students use strategies that ensure they learn the physics well.
	AL6	I think my students generally put a lot of effort into trying to understand things which initially seem difficult.
	AL8	I believe my students can master the knowledge and skills in the physics course.
	AL9	I think my students try to have good attitudes and behaviours related to their knowledge and skills.
	AL11	I think my students usually memorise the model of answer which I perceive as likely to appear in tests or examinations.
AT	AT1	My teaching methods keep my students interested in physics.
	AT2	The physics material in the physics course is covered in too much depth.
	AT3	I provide my students opportunities to express their point of view.
	AT4	I use text books and any other supporting materials to teach physics.
	AT5	I use interesting methods to teach physics topics.
	AT6	I use physics laboratory facilities to encourage my students to discover and construct knowledge.
	AT7	My tests evaluate my students understanding of a topic.
	AT8	I use familiar examples to explain physics concepts.
	AT9	My questions evaluate my students understanding of a topic.
	AT10	My assessment methods evaluate my students understanding.
	AT11	My assessments encourage my students to be self-regulated learners.
	AT12*	I prepare well for assessing students' achievement and progress.
	AT13*	I prepare well for the teaching of physics.
	AT14*	I use strategies that ensure I teach my students well.

(*) additional items

Appendix 4. Perceptions of the Physics Education Curriculum (PPEC) Questionnaires

Appendix 4 contains questionnaire for assessing pre-service teachers' and graduates' Perceptions of the Physics Education Curriculum (PPEC) and questionnaire for assessing lecturers' Perceptions of the Physics Education Curriculum (PPEC-survey2). In this appendix, both questionnaires are portrayed in English and Bahasa Indonesia.

PERCEPTIONS OF THE PHYSICS EDUCATION CURRICULUM (PPEC)

PRE-SERVICE TEACHERS' AND GRADUATES' QUESTIONNAIRE

Science and Mathematics Education Centre (SMEC)
Curtin University of Technology
GPO Box U1987, Perth
Western Australia 6845
Phone: +61 8 9266 3365
Fax: +61 8 9266 2503
Web: www.smec.curtin.edu.au
Email: maisonchaniago@gmail.com
maison@postgrad.curtin.edu.au

PERSONAL DATA

1. Status: Pre-service Teacher / Graduate (circle one)
2. Group of age: 17-19 / 20-22 / 23-25 / 26-28 / 29-31 / 32-34 (circle one group)
3. Gender: Male / Female (circle one)
4. Year of Enrollment in Physics Programme: _____
5. Number of credits for this semester: _____ SKS (for pre-service teachers only)
6. Number of passed credits: _____ SKS
7. Grade Point Average (GPA): _____
8. Graduation: ____ /____(write month and year of graduation, for graduates only)

INSTRUCTIONS:

This questionnaire contains the statements that relates to the Physics Education Curriculum. There are 5 choices for each statement.

Encircle the number;

- **1** If you **strongly disagree** with the statement
- **2** If you **disagree** with the statement
- **3** If you are **not sure** with the statement
- **4** If you **agree** with the statement
- **5** If you **strongly agree** with the statement

If you want to change your choice, please cross out (X) your wrong choice, and encircle your right choice.

Please give the answer to each statement based on your actual feeling and experiences. The questionnaire consists of 38 statements.

QUESTIONNAIRE:

No	Statements	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1.	I really enjoy learning physics.	1	2	3	4	5
2.	Physics is one of my favourite subjects.	1	2	3	4	5
3.	Physics subjects are interesting.	1	2	3	4	5
4.	I like trying to solve new problem in physics.	1	2	3	4	5
5.	I like to do physics experiments.	1	2	3	4	5
6.	I am willing to spend more time reading physics books.	1	2	3	4	5
7.	Physics is one of the most important subjects for people to study.	1	2	3	4	5
8.	Physics knowledge is useful to interpret many aspects of our everyday life.	1	2	3	4	5
9.	I understand that my major future job will likely be related to schools or learning societies.	1	2	3	4	5
10.	I think physics education curriculum can support me to have career ability in educational area.	1	2	3	4	5
11.	I think physics education curriculum can support me to be a professional teacher.	1	2	3	4	5
12.	I think physics education curriculum can support me to be a skilled teacher researcher.	1	2	3	4	5
13.	Earning a good physics grade was/ is important to me	1	2	3	4	5
14.	I think physics education curriculum can support me to be a lifelong learner.	1	2	3	4	5
15.	I think learning physics can help my career.	1	2	3	4	5
16.	I expected/ expect to do as well as or better than other students in the physics course.	1	2	3	4	5
17.	I think learning physics can help me to be a good physics teacher.	1	2	3	4	5
18.	I think physics education curriculum can support me to be an emphatic intelligent member.	1	2	3	4	5
19.	I really wanted/ want to become a physics teacher.	1	2	3	4	5
20.	I prepared/ prepare well for the physics test and labs.	1	2	3	4	5

21.	I put enough effort into learning the physics.	1	2	3	4	5
22.	I try to have good attitudes and behaviours related to my knowledge and skills.	1	2	3	4	5
23.	If I am/was having trouble learning the physics, I try/tried to figure out why.	1	2	3	4	5
24.	I generally put a lot of effort into trying to understand things which initially seem difficult.	1	2	3	4	5
25.	I believe I can master the knowledge and skills in the physics course.	1	2	3	4	5
26.	I used/ use strategies that ensure I learn the physics well.	1	2	3	4	5
27.	I usually memorise the model of answer which I perceive as likely to appear in tests or examinations	1	2	3	4	5
28.	My teacher uses interesting methods to teach physics topics.	1	2	3	4	5
29.	My teacher's teaching methods keep me interested in physics.	1	2	3	4	5
30.	The physics material in the physics course was/ is covered in too much depth.	1	2	3	4	5
31.	My teacher uses familiar examples to explain physics concepts.	1	2	3	4	5
32.	My teacher uses physics laboratory facilities to encourage me to discover and construct knowledge.	1	2	3	4	5
33.	My teacher uses text books and any other supporting materials to teach physics.	1	2	3	4	5
34.	My teacher's assessment methods evaluate my understanding.	1	2	3	4	5
35.	My teacher's tests evaluate my understanding of a topic.	1	2	3	4	5
36.	My teacher provides opportunities for me to express my point of view.	1	2	3	4	5
37.	My teacher's assessments encourage me to be a self regulated learner.	1	2	3	4	5
38.	My teacher's questions evaluate my understanding of a topic.	1	2	3	4	5

Thanks for your participation

PERSEPSI TERHADAP KURIKULUM PENDIDIKAN FISIKA

KUESIONER MAHASISWA DAN ALUMNI

Science and Mathematics Education Centre (SMEC)
Curtin University of Technology
GPO Box U1987, Perth
Western Australia 6845
Phone: +61 8 9266 3365
Fax: +61 8 9266 2503
Web: www.smec.curtin.edu.au
Email: maisonchaniago@gmail.com
maison@postgrad.curtin.edu.au

DATA PRIBADI

Untuk data nomor 1 s.d 3 lingkarilah pilihan anda

1. Status: Mahasiswa / Alumni (lingkarilah salah satu)
2. Kelompok usia: 17-19 / 20-22 / 23-25 / 26-28 / 29-31 / 32-34

   (lingkarilah kelompok usia anda)
3. Jenis Kelamin: Laki-laki / Perempuan (lingkarilah salah satu)
4. Masuk ke Prodi Fisika tahun: _______ (isikan angka sesuai tahun masuk)
5. Total SKS yang sedang diambil: _______ SKS (khusus untuk mahasiswa)
6. Total SKS yang sudah lulus: _______ SKS
7. Indeks Prestasi Kumulatif (IPK): _______
8. Periode wisuda: ______ /_____ (tuliskan bulan dan tahun, khusus untuk alumni)

PETUNJUK:

Kuesioner ini berisi pernyataan-pernyataan yang berhubungan dengan Fisika dan Kurikulumnya. Ada 5 pilihan yang berhubungan dengan setiap pernyataan.

Lingkarilah angka:

1 jika anda **sangat tidak setuju** dengan isi pernyataan
2 jika anda **tidak setuju** dengan isi pernyataan
3 jika anda **ragu-ragu** terhadap isi pernyataan
4 jika anda **setuju** dengan isi pernyataan
5 jika anda **sangat setuju** dengan isi pernyataan

Jika anda mau merubah pilihan, berikanlah tanda silang (X) pada angka yang sudah terlanjur dilingkari tersebut. Selanjutnya lingkarilah angka yang cocok dengan pilihan anda.

Berikanlah pilihan/ respon terhadap setiap pernyataan sesuai dengan apa yang anda rasakan dan anda alami. Jumlah semua item adalah 38 buah.

KUESIONER:

No	Pernyataan	Sangat tidak setuju	Tidak setuju	Ragu-ragu	Setuju	Sangat setuju
1.	Saya sangat senang belajar fisika.	1	2	3	4	5
2.	Ilmu Fisika merupakan salah satu bidang ilmu favorit saya.	1	2	3	4	5
3.	Matakuliah fisika menarik untuk dipelajari.	1	2	3	4	5
4.	Saya suka mencoba menyelesaikan masalah yang baru dibidang fisika.	1	2	3	4	5
5.	Saya suka mengerjakan eksperimen-eksperimen fisika.	1	2	3	4	5
6.	Saya mau menghabiskan waktu lebih untuk membaca buku-buku fisika.	1	2	3	4	5
7.	Fisika merupakan salah satu matakuliah yang sangat penting untuk dipelajari.	1	2	3	4	5
8.	Pengetahuan fisika bermanfaat untuk menginterpretasikan banyak aspek dalam kehidupan kita.	1	2	3	4	5
9.	Saya tahu bahwa pekerjaan saya nantinya akan berhubungan dengan sekolah dan masyarakat belajar.	1	2	3	4	5
10.	Menurut saya kurikulum pendidikan fisika dapat membantu saya memiliki kemampuan dalam berkarir dibidang pendidikan.	1	2	3	4	5
11.	Menurut saya kurikulum pendidikan fisika dapat membantu saya menjadi guru yang professional.	1	2	3	4	5
12.	Menurut saya kurikulum pendidikan fisika dapat membantu saya menjadi guru yang mampu melakukan penelitian dibidang pendidikan.	1	2	3	4	5
13.	Mendapatkan nilai yang baik adalah penting bagi saya.	1	2	3	4	5
14.	Menurut saya kurikulum pendidikan fisika dapat membantu saya untuk dapat belajar sepanjang hayat (*lifelong learner*).	1	2	3	4	5
15.	Menurut saya belajar fisika dapat membantu karir saya.	1	2	3	4	5
16.	Saya berharap untuk bisa kuliah, sama atau lebih baik dari yang dilakukan mahasiswa fisika lainnya.	1	2	3	4	5
17.	Menurut saya belajar fisika dapat membantu saya untuk menjadi guru fisika yang baik.	1	2	3	4	5
18.	Menurut saya kurikulum pendidikan fisika dapat membantu saya menjadi guru yang memiliki kecerdasan empati.	1	2	3	4	5
19.	Saya sangat ingin menjadi guru fisika.	1	2	3	4	5
20.	Saya melakukan persiapan dengan baik untuk mengikuti ujian dan kegiatan-kegiatan laboratorium.	1	2	3	4	5

21.	Saya melakukan usaha yang cukup untuk belajar fisika.	1	2	3	4	5
22.	Saya mencoba untuk mempunyai sikap dan tingkah laku yang baik yang berhubungan dengan pengetahuan dan keterampilan saya.	1	2	3	4	5
23.	Jika saya mengalami kesulitan dalam belajar fisika, saya mencoba untuk mencari penyebabnya	1	2	3	4	5
24.	Saya biasanya berusaha keras untuk mencoba memahami sesuatu yang pada awalnya kelihatan sulit.	1	2	3	4	5
25.	Saya percaya bahwa saya akan dapat menguasai pengetahuan dan keterampilan dibidang fisika.	1	2	3	4	5
26.	Saya menggunakan strategi-strategi belajar yang memungkinkan saya dapat belajar fisika dengan baik.	1	2	3	4	5
27.	Saya biasanya mengingat/ menghafalkan model jawaban yang saya perkirakan akan muncul dalam ujian.	1	2	3	4	5
28.	Dosen menggunakan metode yang menarik dalam mengajarkan topik-topik fisika.	1	2	3	4	5
29.	Metode mengajar yang digunakan dosen membuat saya tetap menyenangi fisika.	1	2	3	4	5
30.	Materi pada matakuliah fisika sudah tercakup secara mendalam.	1	2	3	4	5
31.	Dosen menggunakan contoh-contoh yang sering ditemukan dalam kehidupan sehari-hari untuk menjelaskan konsep-konsep fisika.	1	2	3	4	5
32.	Dosen menggunakan fasilitas laboratorium untuk memotivasi saya dalam menemukan dan membangun pengetahuan.	1	2	3	4	5
33.	Dosen menggunakan buku-buku teks dan materi-materi pendukung lainnya untuk mengajar fisika.	1	2	3	4	5
34.	Metode penilaian yang digunakan dosen dapat mengevaluasi pemahaman saya.	1	2	3	4	5
35.	Ujian yang diberikan dosen mengukur pemahaman saya terhadap topik fisika.	1	2	3	4	5
36.	Dosen memberikan kesempatan buat saya untuk mengemukakan pendapat saya.	1	2	3	4	5
37.	Penilaian yang dilakukan dosen memotivasi saya untuk belajar mandiri secara teratur.	1	2	3	4	5
38.	Pertanyaan-pertanyaan yang diajukan dosen dapat mengevaluasi pemahaman saya terhadap topik fisika.	1	2	3	4	5

Terima kasih atas partisipasi anda dalam menanggapi semua pernyataan

PERCEPTIONS OF THE PHYSICS EDUCATION CURRICULUM (PPEC)

LECTURERS' QUESTIONNAIRE

Science and Mathematics Education Centre (SMEC)
Curtin University of Technology
GPO Box U1987, Perth
Western Australia 6845
Phone: +61 8 9266 3365
Fax: +61 8 9266 2503
Web: www.smec.curtin.edu.au
Email: maisonchaniago@gmail.com
maison@postgrad.curtin.edu.au

PERSONAL DATA

Age group 23-27 / 28-32 / 33-37 / 38-42 / 43-47 / 48-52 **Male / Female**

(circle one) (circle one)

GENERAL QUESTIONNAIRE

1. What is your position in your faculty? *(Please tick appropriate boxes)*
   - ☐ Principal
   - ☐ Deputy / Assistant / Associate Principal
   - ☐ Dean / Head of Faculty
   - ☐ Associate Dean
   - ☐ Head of Study Programme / Head of Department
   - ☐ Teacher

2. How many year have you been teaching?
   - ☐ Less than 2 years
   - ☐ 2 – 5 years
   - ☐ 6 – 10 years
   - ☐ 11 – 15 years
   - ☐ More than 15 years

3. What year level(s) do you currently teach? *(please tick appropriate boxes)*
   - ☐ Year 1
   - ☐ Year 2
   - ☐ Year 3
   - ☐ Year 4
   - ☐ Other: ________________

4. What subjects do you teach? *(please write the subject)*
   - ☐ ___________________
   - ☐ ___________________
   - ☐ ___________________
   - ☐ ___________________
   - ☐ ___________________

5. The followings are physics sections. Sort the section by using numbers from what you like the most to the least *(write number 1, 2, 3, etc. in appropriate boxes)*
   - ☐ Mechanics
   - ☐ Oscillations and Mechanical Wave
   - ☐ Thermodynamics
   - ☐ Electricity and Magnetism
   - ☐ Light and Optics
   - ☐ Modern Physics

PPEC QUESTIONNAIRE
INSTRUCTIONS:

This questionnaire contains the statements that relates to the Physics Education Curriculum. There are 5 choices for each statement.

Encircle the number;

1. If you **strongly disagree** with the statement
2. If you **disagree** with the statement
3. If you are **not sure** with the statement
4. If you **agree** with the statement
5. If you **strongly agree** with the statement

If you want to change your choice, please cross out (X) your wrong choice, and encircle your right choice.

Please give the answer to each statement based on your actual feeling and experiences. The questionnaire consists of 39 statements.

QUESTIONNAIRE:

No	Statements	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1.	I really enjoy learning physics.	1	2	3	4	5
2.	Physics is one of my favourite subjects.	1	2	3	4	5
3.	Physics subjects are interesting.	1	2	3	4	5
4.	I like trying to solve new problem in physics.	1	2	3	4	5
5.	I like to do physics experiments.	1	2	3	4	5
6.	I am willing to spend more time reading physics books.	1	2	3	4	5
7.	Physics is one of the most important subjects for people to study.	1	2	3	4	5
8.	Physics knowledge is useful to interpret many aspects of our everyday life.	1	2	3	4	5
9.	I understand that my major future job will likely be related to schools or learning societies.	1	2	3	4	5
10.	I think physics education curriculum can support my students to have career ability in educational area.	1	2	3	4	5
11.	I think physics education curriculum can support my student to be a professional teacher.	1	2	3	4	5
12.	I think physics education curriculum can support my student to be a skilled teacher researcher.	1	2	3	4	5
13.	I think physics education curriculum can support my student to be a lifelong learner.	1	2	3	4	5

14.	I think learning physics can help my students' career.	1	2	3	4	5
15.	I think learning physics can help my student to be a good physics teacher.	1	2	3	4	5
16.	I think physics education curriculum can support my student to be an emphatic intelligent member.	1	2	3	4	5
17.	I think my students really want to become the physics teachers.	1	2	3	4	5
18.	I think physics education curriculum can support my student to be a creative thinker.	1	2	3	4	5
19.	I think my students prepare well for the physics test and labs.	1	2	3	4	5
20.	I think my students put enough effort into learning the physics.	1	2	3	4	5
21.	I think my students try to have good attitudes and behaviors related to their knowledge and skills.	1	2	3	4	5
22.	I think my students generally put a lot of effort into trying to understand things which initially seem difficult	1	2	3	4	5
23.	I believe my students can master the knowledge and skills in the physics course.	1	2	3	4	5
24.	I think my students use strategies that ensure they learn the physics well.	1	2	3	4	5
25.	I think my students usually memorise the model of answer which they perceive as likely to appear in tests or examinations.	1	2	3	4	5
26.	I use interesting methods to teach physics topics.	1	2	3	4	5
27.	My teaching methods keep my students interested in physics.	1	2	3	4	5
28.	The physics material in the physics course is covered in too much depth.	1	2	3	4	5
29.	I use familiar examples to explain physics concepts.	1	2	3	4	5
30.	I use physics laboratory facilities to encourage my students to discover and construct knowledge.	1	2	3	4	5
31.	I use text books and any other supporting materials to teach physics.	1	2	3	4	5
32.	My assessment methods evaluate my students understanding.	1	2	3	4	5
33.	My tests evaluate my students understanding of a topic.	1	2	3	4	5

34.	I provide opportunities for my students to express their point of view.	1	2	3	4	5
35.	My assessments encourage my student to be a self-regulated learner	1	2	3	4	5
36.	My questions evaluate my students understanding of a topic.	1	2	3	4	5
37.	I prepare well for assessing student achievement and progress.	1	2	3	4	5
38.	I prepare well for the teaching of physics	1	2	3	4	5
39.	I use strategies that ensure I teach my students well.	1	2	3	4	5

Thanks for your participation

PERSEPSI TERHADAP KURIKULUM PENDIDIKAN FISIKA

KUESIONER DOSEN

Science and Mathematics Education Centre (SMEC)
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DATA PRIBADI

Kelompok usia: 23-27 / 28-32 / 33-37 / 38-42 / 43-47 / 48-52 (lingkari salah satu)

Jenis Kelamin: Laki-laki / Perempuan (lingkari salah satu)

UMUM

1. Apakah jabatan Bapak/ Ibu di kampus? *(berikan tanda √ pada kotak sesuai jawaban yang dipilih)*
   - ☐ Rektor
   - ☐ Pembantu Rektor
   - ☐ Dekan/ Ketua Lembaga/ Kepala UPT
   - ☐ Pembantu Dekan
   - ☐ Ketua Jurusan/ Ketua Prodi
   - ☐ Dosen
2. Sudah berapa-lamakah Bapak/ Ibu mengajar?
   - ☐ Kurang dari 2 tahun
   - ☐ 2 – 5 tahun
   - ☐ 6 – 10 tahun
   - ☐ 11 – 15 tahun
   - ☐ Lebih dari 15 tahun
3. Angkatan/ tahun keberapakah mahasiswa yang saat ini Bapak/ Ibu ajar? *(berikan tanda √ pada kotak sesuai jawaban yang dipilih, jawaban boleh lebih dari satu)*
   - ☐ Tahun ke-1
   - ☐ Tahun ke-2
   - ☐ Tahun ke-3
   - ☐ Tahun ke-4
   - ☐ Lainnya ________________
4. Apakah nama matakuliah yang Bapak/ Ibu ajarkan semester ini? *(tuliskan nama matakuliahnya)*
   - ☐ ____________________
   - ☐ ____________________
   - ☐ ____________________
   - ☐ ____________________
   - ☐ ____________________
5. Berikut adalah nama beberapa cabang ilmu fisika. Urutkan dengan menggunakan angka cabang yang paling Bapak/ Ibu senangi ke cabang yang kurang disenangi *(tuliskan angka 1, 2, 3, dst pada kotak sesuai urutannya)*
   - ☐ Mekanika
   - ☐ Osilasi dan Gelombang Mekanik
   - ☐ Termodinamika
   - ☐ Listrik Magnet
   - ☐ Cahaya dan Optik
   - ☐ Fisika Modern

KUESIONER PPEC
PETUNJUK:

Kuesioner ini berisi pernyataan-pernyataan yang berhubungan dengan Fisika dan Kurikulumnya. Ada 5 pilihan yang berhubungan dengan setiap pernyataan.

Lingkarilah angka:

1 jika Bapak/ Ibu **sangat tidak setuju** dengan isi pernyataan
2 jika Bapak/ Ibu **tidak setuju** dengan isi pernyataan
3 jika Bapak/ Ibu **ragu-ragu** terhadap isi pernyataan
4 jika Bapak/ Ibu **setuju** dengan isi pernyataan
5 jika Bapak/ Ibu **sangat setuju** dengan isi pernyataan

Jika Bapak/ Ibu mau merubah pilihan, berikanlah tanda silang (X) pada angka yang sudah terlanjur dilingkari tersebut. Selanjutnya lingkarilah angka yang cocok dengan pilihan Bapak/ Ibu.

Berikanlah pilihan/ respon terhadap setiap pernyataan sesuai dengan apa yang Bapak/ Ibu rasakan dan alami. Jumlah semua item adalah 39 buah.

KUESIONER:

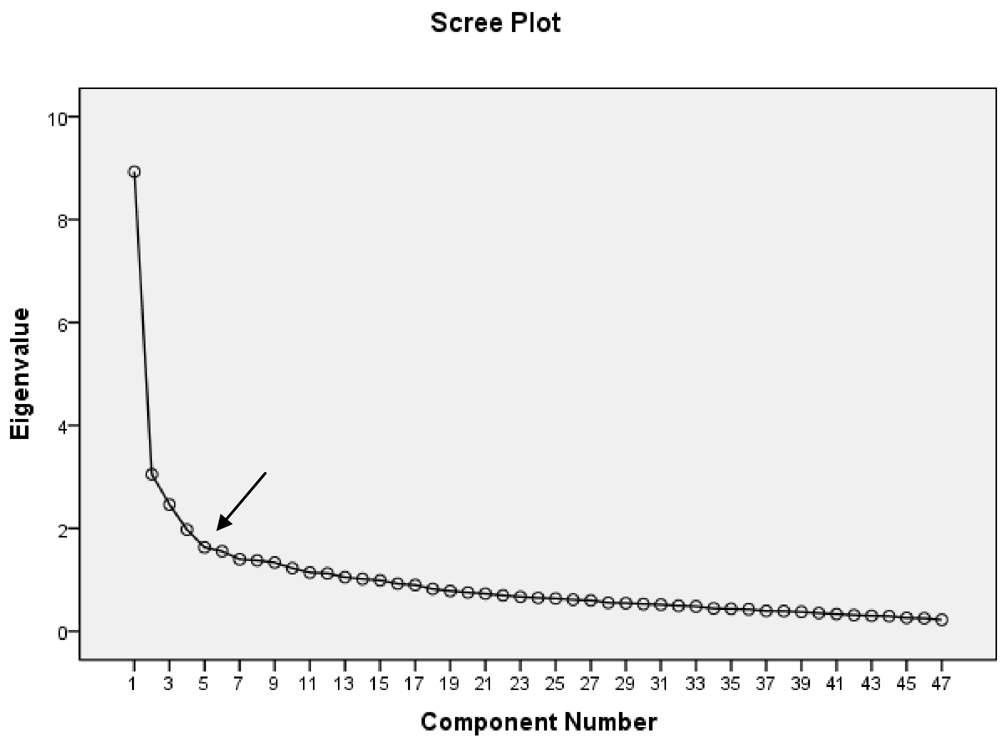
No	Pernyataan	Sangat tidak setuju	Tidak setuju	Ragu-ragu	Setuju	Sangat setuju
1.	Saya sangat senang belajar fisika.	1	2	3	4	5
2.	Ilmu Fisika merupakan salah satu bidang ilmu favorit saya.	1	2	3	4	5
3.	Matakuliah fisika menarik untuk dipelajari.	1	2	3	4	5
4.	Saya suka mencoba menyelesaikan masalah yang baru dibidang fisika.	1	2	3	4	5
5.	Saya suka mengerjakan eksperimen-eksperimen fisika.	1	2	3	4	5
6.	Saya mau menghabiskan waktu lebih untuk membaca buku-buku fisika.	1	2	3	4	5
7.	Fisika merupakan salah satu matakuliah yang sangat penting untuk dipelajari.	1	2	3	4	5
8.	Pengetahuan fisika bermanfaat untuk menginterpretasikan banyak aspek dalam kehidupan kita.	1	2	3	4	5
9.	Saya tahu bahwa pekerjaan mahasiswa saya nantinya akan berhubungan dengan sekolah dan masyarakat belajar.	1	2	3	4	5
10.	Menurut saya kurikulum pendidikan fisika dapat membantu mahasiswa saya memiliki kemampuan dalam berkarir dibidang pendidikan.	1	2	3	4	5
11.	Menurut saya kurikulum pendidikan fisika dapat membantu mahasiswa saya menjadi guru yang professional.	1	2	3	4	5

12.	Menurut saya kurikulum pendidikan fisika dapat membantu mahasiswa saya menjadi guru yang mampu melakukan penelitian dibidang pendidikan.	1	2	3	4	5
13.	Menurut saya kurikulum pendidikan fisika dapat membantu saya untuk dapat belajar sepanjang hayat (*lifelong learner*).	1	2	3	4	5
14.	Menurut saya belajar fisika dapat membantu karir mahasiswa saya.	1	2	3	4	5
15.	Menurut saya belajar fisika dapat membantu mahasiswa saya untuk menjadi guru fisika yang baik.	1	2	3	4	5
16.	Menurut saya kurikulum pendidikan fisika dapat membantu mahasiswa saya menjadi guru yang memiliki kecerdasan empati.	1	2	3	4	5
17.	Menurut saya, mahasiswa saya sangat ingin menjadi guru fisika.	1	2	3	4	5
18.	Menurut saya kurikulum pendidikan fisika dapat membantu mahasiswa saya menjadi pemikir yang kreatif.	1	2	3	4	5
19.	Menurut saya, mahasiswa saya melakukan persiapan dengan baik untuk mengikuti ujian dan kegiatan-kegiatan laboratorium.	1	2	3	4	5
20.	Menurut saya, mahasiswa saya melakukan usaha yang cukup untuk belajar fisika.	1	2	3	4	5
21.	Saya yakin bahwa mahasiswa saya mencoba untuk mempunyai sikap dan tingkah laku yang baik yang berhubungan dengan pengetahuan dan keterampilannya.	1	2	3	4	5
22.	Menurut saya, mahasiswa saya biasanya berusaha keras untuk mencoba memahami sesuatu yang pada awalnya kelihatan sulit.	1	2	3	4	5
23.	Saya percaya bahwa mahasiswa saya akan dapat menguasai pengetahuan dan keterampilan dibidang fisika.	1	2	3	4	5
24.	Menurut saya, mahasiswa saya menggunakan strategi-strategi belajar yang memungkinkannya dapat belajar fisika dengan baik.	1	2	3	4	5
25.	Menurut saya, mahasiswa saya biasanya mengingat/ menghafalkan model jawaban yang saya perkirakan akan muncul dalam ujian.	1	2	3	4	5
26.	Saya menggunakan metode yang menarik dalam mengajarkan topik-topik fisika.	1	2	3	4	5
27.	Metode mengajar yang saya gunakan membuat mahasiswa saya tetap menyenangi fisika.	1	2	3	4	5
28.	Materi pada matakuliah fisika sudah tercakup secara mendalam.	1	2	3	4	5

29.	Saya menggunakan contoh-contoh yang sering ditemukan dalam kehidupan sehari-hari untuk menjelaskan konsep-konsep fisika.	1	2	3	4	5
30.	Saya menggunakan fasilitas laboratorium untuk memotivasi mahasiswa saya dalam menemukan dan membangun pengetahuan.	1	2	3	4	5
31.	Saya menggunakan buku-buku teks dan materi-materi pendukung lainnya untuk mengajar fisika.	1	2	3	4	5
32.	Metode penilaian yang saya gunakan dapat mengevaluasi pemahaman mahasiswa saya.	1	2	3	4	5
33.	Ujian yang saya berikan dapat mengukur pemahaman mahasiswa saya terhadap topik fisika.	1	2	3	4	5
34.	Saya memberikan kesempatan buat mahasiswa saya untuk mengemukakan pendapatnya.	1	2	3	4	5
35.	Penilaian yang saya lakukan dapat memotivasi mahasiswa saya untuk belajar mandiri secara teratur.	1	2	3	4	5
36.	Pertanyaan-pertanyaan yang saya ajukan dapat mengevaluasi pemahaman mahasiswa saya terhadap topik fisika.	1	2	3	4	5
37.	Saya melakukan persiapan yang baik untuk penilaian kemajuan dan hasil belajar mahasiswa.	1	2	3	4	5
38.	Saya melakukan persiapan dengan baik untuk mengajar fisika.	1	2	3	4	5
39.	Saya menggunakan strategi-strategi yang memungkinkan saya dapat mengajar mahasiswa dengan baik.	1	2	3	4	5

Terima kasih atas partisipasi Bapak / Ibu dalam menanggapi semua pernyataan

Appendix 5 Screeplot for the PPEC questionnaire



Appendix 6. The Curriculum Structure for Physics Pre-service Teachers

Compulsory Subjects

Subjects			Semester and Number of Credits								Prerequisite
No	Code	Name	1	2	3	4	5	6	7	8	
1	UNJ 101	Religious education	3								
2	UNJ 102	Citizenship education	3								
3	UNJ 201	Bahasa Indonesia		3							
4	UNJ 202	English		3							
5	UNJ 301	Social science and culture			3						
6	UNJ 801	Social work (Kukerta)								4	
7	KIP 101	Introduction to education	3								
8	KIP 201	The development of learners		3							KIP 101
9	KIP 301	Teaching and learning			3						KIP 201
10	KIP 401	Educational profession				4					KIP 301
11	KIP 701	Teaching practice							6		
12	FIS 101	General Chemistry	4								
13	FIS 102	General Mathematics I	2								
14	FIS 103	General Physics I	4								
15	FIS 201	General Mathematics II		2							FIS 102
16	FIS 202	General Physics II		4							FIS 103
17	FIS 203	General Biology		4							
18	FIS 301	The basics of Mathematics and Science Education			2						
19	FIS 302	Media of Physics teaching			2						
20	FIS 303	Mathematical Physics I			3						FIS 103, 202
21	FIS 304	Modern Physics			4						FIS 202

22	FIS 305	Earth and space	2				FIS 202
23	FIS 306	Instrument gauges	2				FIS 202
24	FIS 307	Practicum of Instrument gauges	1				FIS 202
25	FIS 401	Physics teaching and learning strategy		3			FIS 301
26	FIS 402	Review junior high school curriculum and materials		3			
27	FIS 403	Mathematical Physics II		3			FIS 303
28	FIS 404	General Electronics I		3			FIS 306
29	FIS 405	General Statistics		3			FIS 201
30	FIS 406	The introduction of computers		2			
31	FIS 407	Practicum of General Electronics I		1			FIS 307
32	FIS 408	Practicum of computers		1			
33	FIS 501	Review senior high school curriculum and materials			3		FIS 402
34	FIS 502	Laboratory management			2		FIS 302
35	FIS 503	Assessment of learning Physics			2		FIS 401
36	FIS 504	Mathematical Physics III			3		FIS 403
37	FIS 505	Mechanics			4		FIS 403
38	FIS 506	Thermodynamics			3		FIS 201, 202
39	FIS 507	Electricity and Magnetism			3		FIS 201, 202
40	FIS 508	General Electronics II			3		FIS 404
41	FIS 509	Practicum of General Electronics II			1		FIS 407
42	FIS 601	Educational research methodology				3	FIS 503
43	FIS 602	The development of physics teaching programme				2	FIS 503
44	FIS 603	Waves and Optics				4	FIS 201, 202
45	FIS 604	Physics of atoms and nuclei				3	FIS 202, 304
46	FIS 605	Statistical Physics				3	FIS 403
47	FIS 606	Solid-state Physics				3	FIS 506
48	FIS 607	Methods of experimental Physics				2	FIS 508

49	FIS 701	Quantum Physics							3		FIS 605
50	FIS 801	Thesis								6	
		Total number of credits	19	19	22	23	24	20	9	10	

Optional Subjects

Subjects			Semester and number of credits								Prerequisite
No	Code	Name	1	2	3	4	5	6	7	8	
1	FIS 608	Health Physics						2			FIS 203
2	FIS 609	General Seismology						2			FIS 305
3	FIS 610	Advanced Electronics						2			FIS 508
4	FIS 702	Environmental Physics							2		FIS 203
5	FIS 703	Numerical methods							2		FIS 406
6	FIS 704	Computational Physics							2		FIS 504, 406
7	FIS 705	Applied Physics							2		
		Total number of selected credits						2	2		

Appendix 7 Frequencies of items' responses

Lecturers' responses

Scales	Items	1	2	3	4	5
IP	IP2	0	0	0	57%	43%
	IP3	0	0	0	100%	0
	IP5	0	0	0	57%	43%
	IP6	0	0	0	43%	57%
	IP8	0	14%	0	71%	14%
	IP9	0	0	0	86%	14%
AO	AO1	0	0	0	86%	14%
	AO2	0	0	0	71%	29%
	AO3	0	14%	0	86%	0
	AO4	0	0	14%	86%	0
	AO5	0	0	0	43%	57%
	AO7	0	0	14%	71%	14%
	AO8	0	0	29%	71%	0
	AO11	0	14%	0	86%	0
	AO12	0	0	29%	71%	0
	AO13	0	0	29%	71%	0
	AO14	0	0	0	86%	14%
	AO15*	0	0	29%	71%	0
AL	AL1	0	0	57%	43%	0
	AL2	0	0	86%	14%	0
	AL3	0	0	57%	43%	0
	AL6	0	0	29%	71%	0
	AL8	0	0	43%	57%	0
	AL9	0	0	57%	43%	0
	AL11	0	14%	43%	43%	0
AT	AT1	0	0	14%	71%	14%
	AT2	0	0	29%	71%	0
	AT3	0	0	0	57%	43%
	AT4	0	0	43%	57%	0
	AT5	0	0	14%	86%	0
	AT6	0	0	57%	43%	0
	AT7	0	0	14%	57%	29%
	AT8	0	0	0	57%	43%
	AT9	0	0	0	100%	0
	AT10	0	0	14%	71%	14%
	AT11	0	0	0	86%	14%
	AT12*	0	0	14%	86%	0
	AT13*	0	0	0	86%	14%
	AT14*	0	0	0	71%	29%

(*) additional items

Pre-service teachers' and graduates' responses

IP2

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	4	2.0	2.0	2.5
	3	22	10.9	10.9	13.4
	4	121	60.2	60.2	73.6
	5	53	26.4	26.4	100.0
	Total	201	100.0	100.0	

IP3

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	4	2.0	2.0	2.0
	3	59	29.4	29.4	31.3
	4	100	49.8	49.8	81.1
	5	38	18.9	18.9	100.0
	Total	201	100.0	100.0	

IP5

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	2	1.0	1.0	1.0
	2	2	1.0	1.0	2.0
	3	56	27.9	27.9	29.9
	4	111	55.2	55.2	85.1
	5	30	14.9	14.9	100.0
	Total	201	100.0	100.0	

IP6

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	4	2.0	2.0	2.5
	3	40	19.9	19.9	22.4
	4	123	61.2	61.2	83.6
	5	33	16.4	16.4	100.0
	Total	201	100.0	100.0	

IP8

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	16	8.0	8.0	8.0
	3	110	54.7	54.7	62.7
	4	63	31.3	31.3	94.0
	5	12	6.0	6.0	100.0
	Total	201	100.0	100.0	

IP9

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	12	6.0	6.0	6.0
	3	93	46.3	46.3	52.2
	4	84	41.8	41.8	94.0
	5	12	6.0	6.0	100.0
	Total	201	100.0	100.0	

AO1

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	1	.5	.5	.5
	3	14	7.0	7.0	7.5
	4	100	49.8	49.8	57.2
	5	86	42.8	42.8	100.0
	Total	201	100.0	100.0	

AO2

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	2	1.0	1.0	1.0
	3	19	9.5	9.5	10.4
	4	100	49.8	49.8	60.2
	5	80	39.8	39.8	100.0
	Total	201	100.0	100.0	

AO3

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	3	1.5	1.5	2.0
	3	36	17.9	17.9	19.9
	4	101	50.2	50.2	70.1
	5	60	29.9	29.9	100.0
	Total	201	100.0	100.0	

AO4

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	3	1.5	1.5	1.5
	3	42	20.9	20.9	22.4
	4	90	44.8	44.8	67.2
	5	66	32.8	32.8	100.0
	Total	201	100.0	100.0	

AO5

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	3	1.5	1.5	1.5
	3	4	2.0	2.0	3.5
	4	64	31.8	31.8	35.3
	5	130	64.7	64.7	100.0
	Total	201	100.0	100.0	

AO6

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	7	3.5	3.5	4.0
	3	21	10.4	10.4	14.4
	4	71	35.3	35.3	49.8
	5	101	50.2	50.2	100.0
	Total	201	100.0	100.0	

AO7

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	5	2.5	2.5	2.5
	3	37	18.4	18.4	20.9
	4	104	51.7	51.7	72.6
	5	55	27.4	27.4	100.0
	Total	201	100.0	100.0	

AO8

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	7	3.5	3.5	3.5
	3	22	10.9	10.9	14.4
	4	84	41.8	41.8	56.2
	5	88	43.8	43.8	100.0
	Total	201	100.0	100.0	

AO10

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	1	.5	.5	.5
	3	19	9.5	9.5	10.0
	4	89	44.3	44.3	54.2
	5	92	45.8	45.8	100.0
	Total	201	100.0	100.0	

AO11

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	8	4.0	4.0	4.5
	3	74	36.8	36.8	41.3
	4	86	42.8	42.8	84.1
	5	32	15.9	15.9	100.0
	Total	201	100.0	100.0	

AO12

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	1	.5	.5	.5
	3	8	4.0	4.0	4.5
	4	111	55.2	55.2	59.7
	5	81	40.3	40.3	100.0
	Total	201	100.0	100.0	

AO13

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	2	1.0	1.0	1.0
	3	47	23.4	23.4	24.4
	4	113	56.2	56.2	80.6
	5	39	19.4	19.4	100.0
	Total	201	100.0	100.0	

AO14

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	1	.5	.5	1.0
	3	27	13.4	13.4	14.4
	4	114	56.7	56.7	71.1
	5	58	28.9	28.9	100.0
	Total	201	100.0	100.0	

AL1

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	3	1.5	1.5	2.0
	3	43	21.4	21.4	23.4
	4	118	58.7	58.7	82.1
	5	36	17.9	17.9	100.0
	Total	201	100.0	100.0	

AL2

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	3	1.5	1.5	1.5
	3	50	24.9	24.9	26.4
	4	107	53.2	53.2	79.6
	5	41	20.4	20.4	100.0
	Total	201	100.0	100.0	

AL3

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	2	1.0	1.0	1.0
	3	56	27.9	27.9	28.9
	4	112	55.7	55.7	84.6
	5	31	15.4	15.4	100.0
	Total	201	100.0	100.0	

AL5

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	7	3.5	3.5	3.5
	3	34	16.9	16.9	20.4
	4	113	56.2	56.2	76.6
	5	47	23.4	23.4	100.0
	Total	201	100.0	100.0	

AL6

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	7	3.5	3.5	3.5
	3	50	24.9	24.9	28.4
	4	103	51.2	51.2	79.6
	5	41	20.4	20.4	100.0
	Total	201	100.0	100.0	

AL8

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	3	35	17.4	17.4	17.4
	4	120	59.7	59.7	77.1
	5	46	22.9	22.9	100.0
	Total	201	100.0	100.0	

AL9

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	2	1.0	1.0	1.5
	3	37	18.4	18.4	19.9
	4	120	59.7	59.7	79.6
	5	41	20.4	20.4	100.0
	Total	201	100.0	100.0	

AL11

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	3	1.5	1.5	1.5
	3	28	13.9	13.9	15.4
	4	125	62.2	62.2	77.6
	5	45	22.4	22.4	100.0
	Total	201	100.0	100.0	

AT1

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	5	2.5	2.5	2.5
	2	28	13.9	13.9	16.4
	3	98	48.8	48.8	65.2
	4	58	28.9	28.9	94.0
	5	12	6.0	6.0	100.0
	Total	201	100.0	100.0	

AT2

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	6	3.0	3.0	3.0
	2	19	9.5	9.5	12.4
	3	95	47.3	47.3	59.7
	4	71	35.3	35.3	95.0
	5	10	5.0	5.0	100.0
	Total	201	100.0	100.0	

AT3

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	3	1.5	1.5	1.5
	3	46	22.9	22.9	24.4
	4	118	58.7	58.7	83.1
	5	34	16.9	16.9	100.0
	Total	201	100.0	100.0	

AT4

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	5	2.5	2.5	2.5
	2	43	21.4	21.4	23.9
	3	70	34.8	34.8	58.7
	4	75	37.3	37.3	96.0
	5	8	4.0	4.0	100.0
	Total	201	100.0	100.0	

AT5

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	8	4.0	4.0	4.0
	2	38	18.9	18.9	22.9
	3	81	40.3	40.3	63.2
	4	59	29.4	29.4	92.5
	5	15	7.5	7.5	100.0
	Total	201	100.0	100.0	

AT6

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	24	11.9	11.9	11.9
	2	50	24.9	24.9	36.8
	3	61	30.3	30.3	67.2
	4	59	29.4	29.4	96.5
	5	7	3.5	3.5	100.0
	Total	201	100.0	100.0	

AT7

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	3	1.5	1.5	1.5
	2	15	7.5	7.5	9.0
	3	38	18.9	18.9	27.9
	4	119	59.2	59.2	87.1
	5	26	12.9	12.9	100.0
	Total	201	100.0	100.0	

AT8

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	5	2.5	2.5	2.5
	2	11	5.5	5.5	8.0
	3	49	24.4	24.4	32.3
	4	109	54.2	54.2	86.6
	5	27	13.4	13.4	100.0
	Total	201	100.0	100.0	

AT9

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	1	.5	.5	.5
	2	7	3.5	3.5	4.0
	3	52	25.9	25.9	29.9
	4	115	57.2	57.2	87.1
	5	26	12.9	12.9	100.0
	Total	201	100.0	100.0	

AT10

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	4	2.0	2.0	2.0
	2	26	12.9	12.9	14.9
	3	64	31.8	31.8	46.8
	4	96	47.8	47.8	94.5
	5	11	5.5	5.5	100.0
	Total	201	100.0	100.0	

AT11

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	2	7	3.5	3.5	3.5
	3	65	32.3	32.3	35.8
	4	102	50.7	50.7	86.6
	5	27	13.4	13.4	100.0
	Total	201	100.0	100.0	

Appendix 8 NVivo Report of Interviews

Coding Summary By Source
Curriculum Evaluation

Classification	Aggregate	Coverage	Number Of Coding References	Reference Number	Coded By Initials	Modified On

Document

Internals\\Lecturers' interviews\\Interview_ Lecturer A

Node

Nodes\\Assessment

	No	0.0176	1			
				1	MAISON	26/07/2011 11:54 AM

I use faculty assessment guidelines to measure students' achievement.

Nodes\\Characteristics could be improved\\Acording to Lecturer

	No	0.0697	1			
				1	MAISON	3/08/2011 1:59 PM

In addition, we also need to improve the learning process. Lecturers' work load need be reduced which means the lecturers should not teach too many subjects. The lecturers also need to improve on their attendance during teaching periods, as it is currently unsatisfactory.

Nodes\\Curriculum Document

	No	0.0438	1			
				1	MAISON	3/08/2011 1:13 PM

We have a physics curriculum document which was developed in 2007 contains only subjects in physics education. Syllabus for each subject must be developed by the lecturer.

Nodes\\Curriculum Document\Content

	No	0.0382	1			
				1	MAISON	3/08/2011 1:17 PM

I teach several subjects, i.e. Laboratory Management, Teaching and Learning Strategy, Environmental Physics, and Secondary Schools' Curriculum Study.

Nodes\\Curriculum Document\Legitimacy

	No	0.0864	1			
				1	MAISON	3/08/2011 1:24 PM

I think the curriculum should be more related to students' daily lives. It is also needs to be relevant to the needs and expectations of stakeholders. However, I think that it is difficult since our graduates are not showing satisfactory levels of competence. There is also relation between one curriculum component and other components.

Nodes\\Interest in Physics

No	0.0384	2

1	MAISON	3/08/2011 1:19 PM

I chose to study and to teach physics because I like physics more than mathematics or chemistry.

2	MAISON	3/08/2011 1:19 PM

I like physics experiments more than physics theories.

Nodes\\Interest in Physics\Lecturer interest in physics

No	0.0384	2

1	MAISON	3/08/2011 9:32 PM

I chose to study and to teach physics because I like physics more than mathematics or chemistry.

2	MAISON	3/08/2011 9:33 PM

I like physics experiments more than physics theories.

Nodes\\Learning Outcomes

No	0.0320	1

1	MAISON	3/08/2011 1:12 PM

I think the outcomes of the Physics Education Program are average which means we are not satisfied with teachers' graduates.

Nodes\\Learning Styles & Learning Experiences

No	0.0492	1

1	MAISON	3/08/2011 11:57 AM

I think the students are less engaged and less motivated than they could potentially be. They are completing their assignments, but there appears to be a lack of effort in the students' work.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No	0.1471	1

1	MAISON	3/08/2011 9:21 AM

To improve the teaching and learning process, I use power point to explain the topics. Assignments are then distributed to the students, which are based on current topics as well as topics which are to follow. Therefore, they will find the integration of each topic as they progress through their assignments. If the students have difficulty in finding the appropriate sources, I provide further assistance by showing them ways to find the sources on the internet, and will occasionally lend them books. I use faculty assessment guidelines to measure students' achievement.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No	0.0176	1

1	MAISON	4/08/2011 12:19 PM

I use faculty assessment guidelines to measure students' achievement.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.1287 2

1 MAISON 4/08/2011 12:17 PM

To improve the teaching and learning process, I use power point to explain the topics. Assignments are then distributed to the students, which are based on current topics as well as topics which are to follow. Therefore, they will find the integration of each topic as they progress through their assignments.

2 MAISON 4/08/2011 12:22 PM

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.1717 2

1 MAISON 4/08/2011 10:24 AM

Teaching facilities in the university alone are currently insufficient. The university at which I teach provides internet facilities, however, the internet speed is very low and is hence time consuming. Laboratory equipment are also limited. For example, we don’t have items such as ticker timers to facilitate teaching in the topic of objects’ movement. If we wish to purchase equipment for teaching purposes, it can involve a lengthy process as we have to deal with the complicated bureaucracy. There is little support from university to overcome such issues.

2 MAISON 4/08/2011 10:27 AM

Finally, laboratory equipment also needs to be renewed and meet the requirements of the teaching curricula.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.0771 2

1 MAISON 4/08/2011 10:21 AM

From the subjects that I teach, the teaching resources I use include textbooks as well as online resources.

2 MAISON 4/08/2011 10:27 AM

If the students have difficulty in finding the appropriate sources, I provide further assistance by showing them ways to find the sources on the internet, and will occasionally lend them books.

Internals\\Lecturers' interviews\\Interview_ Lecturer C

Node

Nodes\\Assessment

No 0.0110 1

1 MAISON 26/07/2011 11:55 AM

The assessment is not only by the written tests, but also by the performance tests.

Nodes\\Characteristics could be improved\\According to Lecturer

No 0.0188 1

1 MAISON 3/08/2011 2:00 PM

Furthermore, the learning process in physics education is not optimal. We need to prepare our students to teach Physics at a secondary level.

Nodes\\Curriculum Document

No 0.0792 1

1 MAISON 3/08/2011 1:13 PM

We have several curriculum versions. The first curriculum version was developed in 1999. Then it was revised in 2004 and 2007. The curriculum should be revised again this year (2011). For the new students in 2011, we haven't provided the micro teaching and the integrated pre-service teachers' program. Students are graduating with less credit points than before, which is around 125 to 127 credits. For Physics students who would like to become teachers or obtain a certificate in teaching physics, we provide pre-service teachers' program namely Teachers' Profession Education for one year.

Nodes\\Curriculum Document\Content

No 0.1096 1

1 MAISON 3/08/2011 1:17 PM

I teach Mathematical Physics 1, Mathematical Physics 2, Mechanics, Health Physics, and Waves & Optics. For Mathematical Physics subjects, I use "Mathematical Methods in the Physical Science" book by Mary L. Boas. Then for the mechanics subject there is "Mechanics" by Symon, but the content of this book is too difficult for our students to understand. When I tried to use this book, the students didn't understand the concepts. Based on my experiences, I prefer to teach the general concepts as well as the mechanics and waves concepts to the students. It helps students to understand the basic concepts. One of the differences between General Physics and Mechanics as a subject is the application of the concepts. In the mechanics subject, we need to solve more complicated problems than in the general physics subject.

Nodes\\Curriculum Document\Content\Difficulty of Physics

No 0.0806 2

1 MAISON 3/08/2011 1:22 PM

When I continued my study at Bandung Institute of Technology (ITB), I realised that I am particularly interested in the simple concepts in Physics. When it requires the difficult mathematics to solve the Physics problems however, I just don't enjoy Physics. Therefore, sometimes it can be a struggle for myself in having a career in physics.

2 MAISON 3/08/2011 1:22 PM

My students consider the subject I teach as difficult, however, they tend to be lazy to study. To overcome their laziness, I put pressure on them by giving them regular assignments to keep them studying. If I do not put any pressure on them, they will not study.

Nodes\\Curriculum Document\Legitimacy

No 0.0948 1

1 MAISON 3/08/2011 1:24 PM

In my view, our curriculum is powerful and is an essential tool in the learning program, but we do not make adjustment to the stakeholders' needs such as their needs to provide our graduates' understanding about the changes in Physics secondary school curricula. Our responses to cater their needs are usually late. Other things include having already revised the development of Modern Physics, whilst the development of Modern Physics has grown further. Consequently, we have difficulties to keep up with the development, since we don't have sufficient access to the new journals. In addition, the integration of the curriculum's component is good, especially the subjects that are taught by physics lecturers.

Nodes\\Interest in Physics\Lecturer interest in physics

No 0.1545 4

1 MAISON 3/08/2011 9:37 PM

I like physics because my father was a physics teacher and he is my idol. My interest in physics grew further because I had a good physics teacher when I was a student in senior high school.

2 MAISON 3/08/2011 9:38 PM

I didn't have clear aspirations when I was in senior high school. However, I knew I wanted to be a teacher because I was inspired by my father who was a teacher.

3 MAISON 3/08/2011 9:40 PM

I had chosen physics education and medical science in my university admission test. I like concepts and theories of physics because of the logical thinking involved. However, I have a weakness in conducting research in Physics. I am rather lazy in conducting the research, because usually after teaching and going home from my days work, as a woman, I am busy with household activities. Consequently, my career becomes a second priority. At least, I am still teaching.

4 MAISON 3/08/2011 9:41 PM

When I continued my study at Bandung Institute of Technology (ITB), I realised that I am particularly interested in the simple concepts in Physics. When it requires the difficult mathematics to solve the Physics problems however, I just don't enjoy Physics. Therefore, sometimes it can be a struggle for myself in having a career in physics.

Nodes\\Learning Outcomes

No 0.0429 1

1 MAISON 3/08/2011 1:12 PM

For the outcomes, we should refer to the stakeholders' assessment on the quality of our graduates. Then, I think that some of our graduate students do not fulfil the appropriate standards to becoming a teacher. It is often during the final exams that some of the students can't explain the very basic concepts of Physics.

Nodes\\Learning Styles & Learning Experiences

No 0.1112 1

1 MAISON 3/08/2011 11:57 AM

Students' motivation in learning are different between individuals. Some students are engaged and motivated whereas the others aren't as motivated. I have found that students who sit in the front row are generally more enthusiastic students. They fulfil the given learning tasks. If students are asked to complete homework which is given from the textbook (which usually includes answers in it) they will copy the answers without first attempting to understand the concepts. In my opinion, most students just want to finish their study without much effort. I give assignments every week to the students, most students keep doing their assignments, but some of them only copy their friends' work. Moreover, most students are only studying to pass the exams. If there were no assignments or exams, the students would not be studying.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Motivation Component

No 0.0349 1

1 MAISON 4/08/2011 1:19 PM

My students consider the subject I teach as difficult, however, they tend to be lazy to study. To overcome their laziness, I put pressure on them by giving them regular assignments to keep them studying. If I do not put any pressure on them, they will not study.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No 0.0110 1

1 MAISON 4/08/2011 1:16 PM

The assessment is not only by the written tests, but also by the performance tests.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Focus

No	0.0356	1

1	MAISON	4/08/2011 1:16 PM

I usually ask one or two students to solve the problems on the whiteboard in front of the classroom, other students are asked to pay attention. I use this method because I am teaching large classes. Then, I ask them whether they understand their friends' work or not.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No	0.0356	1

1	MAISON	4/08/2011 1:55 PM

I usually ask one or two students to solve the problems on the whiteboard in front of the classroom, other students are asked to pay attention. I use this method because I am teaching large classes. Then, I ask them whether they understand their friends' work or not.

Nodes\\Teaching Resources & Facilities

No	0.1198	2

1	MAISON	17/07/2011 3:08 PM

The other problem is we don't have enough textbooks in the library. We also have limited rooms and facilities. The physics pre-service teachers' study program needs a standard room for conducting micro teaching. However, in general, our facilities are improving compared to last year. Now, we have more support from the faculty for conducting good teaching and learning. For example, every classroom has an InFocus LCD Projector and the lecturers are able to obtain funds for creating teaching materials. Many Physics lecturers don't use the opportunity to obtain funds, since they don't have enough time to create teaching materials because of their work load in teaching too many subjects.

2	MAISON	23/11/2012 10:21 AM

We need various laboratory facilities to support teaching and learning. At the moment, our students cannot do practical work in the field of modern physics, because we do not have any facilities for that.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No	0.1102	2

1	MAISON	4/08/2011 10:29 AM

We also have limited rooms and facilities. The physics pre-service teachers' study program needs a standard room for conducting micro teaching. However, in general, our facilities are improving compared to last year. Now, we have more support from the faculty for conducting good teaching and learning. For example, every classroom has an InFocus LCD Projector and the lecturers are able to obtain funds for creating teaching materials. Many Physics lecturers don't use the opportunity to obtain funds, since they don't have enough time to create teaching materials because of their work load in teaching too many subjects.

2	MAISON	23/11/2012 10:21 AM

We need various laboratory facilities to support teaching and learning. At the moment, our students cannot do practical work in the field of modern physics, because we do not have any facilities for that.

Nodes\\Teaching Resources & Facilities\Teaching resources

No	0.0089	1

1	MAISON	4/08/2011 10:28 AM

The other problem is we don't have enough textbooks in the library.

Internals\\Lecturers' interviews\\Interview_Lecturer B

Node

Nodes\\Assessment

No 0.0688 2

1 MAISON 26/07/2011 1:49 PM

I try to find the best ways of assessing the students based on their achievement. If a large number of students have resulted with low scores, I try to find ways to help them improve.

2 MAISON 26/07/2011 1:48 PM

I arrange several assessment components such as students' participation in classroom, portfolio, quiz, mid-test, final test, and practicum (for some subjects). An active student (for example in explaining the subject matter in front of the class to his or her friends) tends to achieve higher scores in students participations.

Nodes\\Characteristics could be improved\\Acording to Lecturer

No 0.0215 1

1 MAISON 3/08/2011 2:00 PM

In regards to the lecturers' presence and teaching quality, I think that the physics lecturers are better than guest lecturers who come from other departments.

Nodes\\Curriculum Document

No 0.0797 2

1 MAISON 3/08/2011 1:13 PM

I set some syllabus in several subjects in physics education by referring to other universities' syllabus. For example, another university has a Nuclear Physics subject. Since our department has the Nuclear-Atom subject, I chose to combine their syllabus and other resources. I use a similar process for the Waves-Optics subject. Hence, I believe we need adaptation in our curriculum. For General Physics subject, I use a syllabus which was developed during a general physics training program for physics education lecturers several years ago.

2 MAISON 3/08/2011 1:13 PM

We use the curriculum which was developed in 2007.

Nodes\\Curriculum Document\Content

No 0.0146 1

1 MAISON 3/08/2011 1:17 PM

Currently, I teach General Physics, Wave-Optics, Nuclear-Atom, and General Science and Mathematics Education.

Nodes\\Curriculum Document\Legitimacy

No 0.1071 1

1 MAISON 3/08/2011 1:24 PM

I think the physics curriculum is useful and can be applied in our daily lives, like some topics do in general physics. Therefore, it depends on students' willingness to analyse the concept and to apply it. For example, some final assessments require the students to create learning media which are useful in education. In my opinion, the curriculum should be related to the need of stakeholders. In computer subjects, students also learn important substances, such as flash material which can be used in teaching and learning. Furthermore, there is integration among subjects in physics education. For example, topics which are taught in the Core Physics subject are related to topics in Modern Physics subject. In conclusion, I think our curriculum is good, but still needs some revision.

Nodes\\Interest in Physics\Lecturer interest in physics

No 0.0729 1

1 MAISON 3/08/2011 9:45 PM

I chose to study and to teach physics because I like physics. I have loved physics since I was a student in junior high school. My junior high school mathematics teacher also had a major influence on my interest in physics. He often gave examples in his teaching by using physics when he taught mathematics. I like theories and physics experiment, but occasionally I experience several difficulties in performing the experiments, for example: having insufficient time to complete the physics experiments and insufficient laboratory equipment.

Nodes\\Learning Outcomes

No 0.0270 1

1 MAISON 3/08/2011 1:12 PM

I think the outcomes of our student graduates were good enough, because they have showed engagement in the learning process of this university. They also have to perform teaching practicals in schools.

Nodes\\Learning Styles & Learning Experiences

No 0.1061 1

1 MAISON 3/08/2011 11:57 AM

However, in general, I believe that students have had relatively low motivation and engagement levels. I usually distribute assignments every week, then shortly prior to their exam days, we discuss the students' difficulties in understanding the learning material. I will generally put similar revised topics in their test, but their results still tend to be disappointing. The students still seem to have problems in understanding the topics. I often tell the students that they can copy and work side by side with a friend in doing their assignments and homework, provided that they have a relative understanding of what they have learnt from their friends' work. Despite this, many students appear to submit their work with minimal understanding. They just want to pass the requirement.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No 0.2086 4

1 MAISON 4/08/2011 10:38 AM

Formerly, I used Waves and an Optics' book by Tjia. This book is written in Bahasa Indonesia, but it can be difficult to understand and it has limited explanation. Therefore I've tried to use another book that is an English version, Introduction to Wave phenomena by Akira Hirose. The content of this book can be understood much easier by the students, but there are still some problems because not all students are familiar with English. To overcome this problem, I insisted that the students work in groups to discuss and solve problems.

2 MAISON 4/08/2011 2:11 PM

Occasionally, I will ask one of the high achieving students to explain to his or her friends in front of the class.

3 MAISON 4/08/2011 10:45 AM

Because of limited textbooks in the library, I also lend books to the students, so they can use them for alternative learning resources.

4 MAISON 3/08/2011 9:21 AM

I always strive to do my very best in teaching. I lend my books, and I also give students the opportunity to take a softcopy of materials from my laptop. I try to find the best ways of assessing the students based on their achievement. If a large number of students have resulted with low scores, I try to find ways to help them improve. I give equal opportunities to all my students, as I don't believe in discrimination toward them. I arrange several assessment components such as students' participation in classroom, portfolio, quiz, mid-test, final test, and practicum (for some subjects). An active student (for example in explaining the subject matter in front of the class to his or her friends) tends to achieve higher scores in students participations.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Accommodation for student characteristics

No 0.0490 1

1 MAISON 4/08/2011 1:23 PM

I've tried to use another book that is an English version, Introduction to Wave phenomena by Akira Hirose. The content of this book can be understood much easier by the students, but there are still some problems because not all students are familiar with English. To overcome this problem, I insisted that the students work in groups to discuss and solve problems.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No 0.0817 1

1 MAISON 4/08/2011 3:07 PM

I try to find the best ways of assessing the students based on their achievement. If a large number of students have resulted with low scores, I try to find ways to help them improve. I give equal opportunities to all my students, as I don't believe in discrimination toward them. I arrange several assessment components such as students' participation in classroom, portfolio, quiz, mid-test, final test, and practicum (for some subjects). An active student (for example in explaining the subject matter in front of the class to his or her friends) tends to achieve higher scores in students participations.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0388 2

1 MAISON 4/08/2011 3:05 PM

Because of limited textbooks in the library, I also lend books to the students, so they can use them for alternative learning resources.

2 MAISON 4/08/2011 3:06 PM

I always strive to do my very best in teaching. I lend my books, and I also give students the opportunity to take a softcopy of materials from my laptop.

Nodes\\Teaching Resources & Facilities

No 0.2162 3

1 MAISON 17/07/2011 1:44 PM

There are no problems with teaching resources for the General Physics subject because there are many books related to this subject. However, I have had problems in finding resources for Nuclear-Atom and Wave-Optics subjects, because there are limited teaching resources for these subjects. Formerly, I used Waves and an Optics' book by Tjia. This book is written in Bahasa Indonesia, but it can be difficult to understand and it has limited explanation. Therefore I've tried to use another book that is an English version, Introduction to Wave phenomena by Akira Hirose. The content of this book can be understood much easier by the students, but there are still some problems because not all students are familiar with English. To overcome this problem, I insisted that the students work in groups to discuss and solve problems.

2 MAISON 17/07/2011 1:50 PM

General Science and Mathematics Education" subject also doesn't have a pre-determined textbook, so I've tried to integrate several resources to create the syllabus for this subject. For example, in the topic of Teaching Methods, I looked for the book and used internet resources, then I created the syllabus. I brought and used my own laptop as an additional teaching facility. Because of limited textbooks in the library, I also lend books to the students, so they can use them for alternative learning resources. Besides the limited number of textbooks available, we have other limitations such as inadequate classrooms, lecturers, and faculty support.

3 MAISON 23/11/2012 10:15 AM

Some equipment for practical work of General Physics 1 and General Physics 2 subjects were broken and has not been repaired.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.0446 3

1 MAISON 4/08/2011 10:44 AM

I brought and used my own laptop as an additional teaching facility.

2 MAISON 4/08/2011 10:46 AM

Besides the limited number of textbooks available, we have other limitations such as inadequate classrooms, lecturers, and faculty support.

3 MAISON 23/11/2012 10:15 AM

Some equipment for practical work of General Physics 1 and General Physics 2 subjects were broken and has not been repaired.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.1711 3

1 MAISON 4/08/2011 10:39 AM

There are no problems with teaching resources for the General Physics subject because there are many books related to this subject. However, I have had problems in finding resources for Nuclear-Atom and Wave-Optics subjects, because there are limited teaching resources for these subjects. Formerly, I used Waves and an Optics' book by Tjia. This book is written in Bahasa Indonesia, but it can be difficult to understand and it has limited explanation. Therefore I've tried to use another book that is an English version, Introduction to Wave phenomena by Akira Hirose. The content of this book can be understood much easier by the students, but there are still some problems because not all students are familiar with English. To overcome this problem, I insisted that the students work in groups to discuss and solve problems.

2 MAISON 4/08/2011 10:43 AM

General Science and Mathematics Education" subject also doesn't have a pre-determined textbook, so I've tried to integrate several resources to create the syllabus for this subject. For example, in the topic of Teaching Methods, I looked for the book and used internet resources, then I created the syllabus.

3 MAISON 4/08/2011 10:45 AM

Because of limited textbooks in the library, I also lend books to the students, so they can use them for alternative learning resources.

Nodes\\Understanding on Curricula\Lecturer understanding on curriculum

No 0.0729 1

1 MAISON 4/08/2011 1:35 PM

I set some syllabus in several subjects in physics education by referring to other universities' syllabus. For example, another university has a Nuclear Physics subject. Since our department has the Nuclear-Atom subject, I chose to combine their syllabus and other resources. I use a similar process for the Waves-Optics subject. Hence, I believe we need adaptation in our curriculum. For General Physics subject, I use a syllabus which was developed during a general physics training program for physics education lecturers several years ago.

Internals\\Pre-service teachers' and graduates' interviews\\Focus Group_1

Node

Nodes\\Assessment

No 0.1025 2

1 MAISON 4/08/2011 3:11 PM

In my opinion about assessment, we do not know how we will be assessed by the lecturers. I mean that we know about our classmates' achievement. We have studied hard and we consider to get A or at least B+, but we just get B. sometimes students think in their mind that the grade is a luck. Not all the result of the tests is given back to the students.

2 MAISON 4/08/2011 3:12 PM

The lecturers do not know well about the students and they do not know how we perform in the subject. We have studied seriously and did the tasks, while one of the students cheats and she gets a good score such as A. Even we know our friends' ability, so we can consider those who could understand the materials and those who could not. By looking at the assessment of the lesson, it seems to be unfair because students who have studied seriously got C or C+. Having a large number of students, we sit close in the test. So, if one student is cheating, it is possible that lecturers do not know it.

Nodes\\Curriculum Document\Content

No 0.1669 13

7 MAISON 3/08/2011 1:17 PM

We have learned many materials, for example, Mechanics, that is related to the movement of things, Modern Physics and etc.

8 MAISON 3/08/2011 1:17 PM

There are some topics to be experimented for General Physics 1. They are Vernier Caliper, Micrometer Caliper, Spherometer, Viscosity, Mass Density, Electricity, and Pendulum. The topics for General Physics 2 are Phase Changes, Specific Heat Capacity, Mirrors, Lenses, and Refraction.

9 MAISON 3/08/2011 1:17 PM

We learn physics and learn how to teach it here. So, we get physics subjects and educational ones.

10 MAISON 3/08/2011 1:17 PM

There are many formulas and patterns in physics that have to be learned for us now.

11 MAISON 3/08/2011 1:17 PM

As far as I know that physics curriculum has a relevant part with what I have found in daily life, but there is a part of it that is not. So, I get confuse to understand it. For example, the materials in Modern Physics are somewhat out of the context.

12 MAISON 3/08/2011 1:17 PM

Generally, the curriculum is useful to broaden our knowledge.

13 MAISON 3/08/2011 1:17 PM

There are so many materials; we do not have time to understand them well.

Nodes\\Curriculum Document\Content\Difficulty of Physics

No 0.0586 4

1 MAISON 3/08/2011 1:22 PM

Having heard the word physics, most of people think that it is so difficult. When I talked to my friend, they said to me that physics is difficult.

2 MAISON 3/08/2011 1:22 PM

Although it is rather difficult, I think physics is more enjoyable than other subjects and the knowledge is very useful for others.

3 MAISON 3/08/2011 1:22 PM

After studying in physics study program, I realise that physics is not as easy as before. It is more and more difficult.

4 MAISON 3/08/2011 1:22 PM

Personally, if I read the article about the rapid development of science, I think why I just learn Mechanics that is so difficult to understand.

Nodes\\Curriculum Document\Legitimacy

No 0.0271 1

1 MAISON 3/08/2011 1:24 PM

As far as I know that physics curriculum has a relevant part with what I have found in daily life, but there is a part of it that is not. So, I get confuse to understand it. For example, the materials in Modern Physics are somewhat out of the context.

Nodes\\Interest in Physics

No 0.1480 8

1 MAISON 3/08/2011 1:19 PM

I love physics since I have been in Senior High School

2 MAISON 3/08/2011 1:19 PM

I would like analysis and mathematical methods in physics. I still love physics even now it is more and more difficult to learn.

3 MAISON 3/08/2011 1:19 PM

I love physics since I have been in Senior High School. I get encouragement from my classmate. He was good at physics and sometimes our teacher asked him to teach physics for all of my friends. I thought I could do as well as him. Because of that I want to learn physics by choosing physics as my major.

4 MAISON 3/08/2011 1:19 PM

I chose physics because I had a smart physics teacher but a strict one. So, I would like to make a nice learning and teaching process. In other words, that is different from what I felt. I followed astronomy olympiad which is one of physics branches. Now I learn physics because I want to be a physics teacher and to teach it in a good way.

5 MAISON 3/08/2011 1:19 PM

I think physics is a challenge to be a critical people in handling physics' problems.

6 MAISON 3/08/2011 1:19 PM

I would like to learn physics because I had an excited student teacher in my Junior High School. Initially, I know that being a physics teacher was not a good choice, but since I met her (Unja's physics alumni) she encouraged me and she changed my mind about physics

7 MAISON 3/08/2011 1:19 PM

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8 MAISON 3/08/2011 1:19 PM

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Nodes\\Interest in Physics\Student interest in physics

No 0.1480 8

1 MAISON 4/08/2011 10:17 AM

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2 MAISON 4/08/2011 10:17 AM

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8 MAISON 4/08/2011 10:17 AM

Generally, the curriculum is useful to broaden our knowledge.

Nodes\\Learning Styles & Learning Experiences

No 0.2730 7

1 MAISON 3/08/2011 11:57 AM

We have to find the example from other books.

2 MAISON 3/08/2011 11:57 AM

I use to study at my campus and at home. The study time is changeable, for example, if I get a lot of tasks, I have much time to study. At home I study and it will be continued at night. Then, I study at 6:30 after sholat shubuh. I think my study activities are still not sufficient. I need some help for sharing some problems that I could not solve myself.

3 MAISON 3/08/2011 11:57 AM

First, I study at my campus and go home at 2. Next, I could read my lesson at 4. After performing sholat isya about 8 pm, I will study. I seldom study in the morning because I like to sleep after performing sholat shubuh. If I get some difficulties in my subject, I will come earlier and ask for help to my friends. Sometimes we go to the library to find some books and study together at home. Sometimes we have study group at student's A house or the other students' houses.

4 MAISON 3/08/2011 11:57 AM

I study physics based on the materials. If I could understand the materials well, I am enthusiastic to study from 4 to 11 pm. But, if I could not understand it, it means that I have studied for hours but I still do not understand. So, I leave the materials and go to sleep. I will try again the next day. Suddenly, I find the solution to solve physics' problem when I am walking. If I could not solve it by myself, I will ask my friends.

5 MAISON 3/08/2011 11:57 AM

Firstly, I study my subject at my campus. If I think that I could not understand the subject, I study at home. However, if I still do not understand this, I will ask my friends the next day. If I get some tasks to do, I read them to know whether I understand or not. When I could not understand the task given, I consult with my friends to study in group. I seldom study at the library. Having done difficult questions to be answered, I would open the book again.

6 MAISON 3/08/2011 11:57 AM

If I could not understand the materials in the book, we plan to study in group. So we decide the occasions to study in group. It is impossible for me to study at home from the evening to 10 pm because I have a little brother. So, I start to study when I get up at 2 or 5 am before doing other activities. Next, I will study at my campus. But, if it is not possible to study alone, I will invite my friends to study in group. I think I could manage it and I seldom study at the library. I realize that I have not worked hard as well as I could.

7 MAISON 3/08/2011 11:57 AM

If the teaching and learning process is enjoyable, I will enjoy and understand it. But, if I meet the strict lecturer I tell to my self "I must understand, must understand" but in fact, I do not understand.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No 0.1723 5

1 MAISON 3/08/2011 9:21 AM

There are some lecturers who want to lend the students some books, especially those books which are rarely to be found. Then, we learn the books together.

2 MAISON 3/08/2011 9:21 AM

The teaching and learning materials by some lecturers is more fun, however, there is also to make us more stressful. If we have the course with this lecturer, we have to study first at home in order to be well prepared to follow the lesson. In my opinion about assessment, we do not know how we will be assessed by the lecturers. I mean that we know about our classmates' achievement. We have studied hard and we consider to get A or at least B+, but we just get B. sometimes students think in their mind that the grade is a luck. Not all the result of the tests is given back to the students.

3 MAISON 3/08/2011 9:21 AM

The lecturers do not know well about the students and they do not know how we perform in the subject. We have studied seriously and did the tasks, while one of the students cheats and she gets a good score such as A. Even we know our friends' ability, so we can consider those who could understand the materials and those who could not. By looking at the assessment of the lesson, it seems to be unfair because students who have studied seriously got C or C+. Having a large number of students, we sit close in the test. So, if one student is cheating, it is possible that lecturers do not know it.

4 MAISON 3/08/2011 9:21 AM

The lecturer encourages us to study, he usually explains about the concept of the materials by giving some examples. Then, we are given some kinds of task to do.

5 MAISON 3/08/2011 9:21 AM

It is good so far. I could not comment because I have not been working the whole process.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Motivation Component

No 0.0432 2

1 MAISON 4/08/2011 3:10 PM

The teaching and learning materials by some lecturers is more fun, however, there is also to make us more stressful. If we have the course with this lecturer, we have to study first at home in order to be well prepared to follow the lesson.

2 MAISON 4/08/2011 3:13 PM

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Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No 0.1025 2

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2 MAISON 4/08/2011 3:12 PM

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Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0263 2

1 MAISON 4/08/2011 3:07 PM

There are some lecturers who want to lend the students some books, especially those books which are rarely to be found. Then, we learn the books together.

2 MAISON 4/08/2011 3:14 PM

It is good so far. I could not comment because I have not been working the whole process.

Nodes\\Teaching Resources & Facilities

No 0.1184 4

1 MAISON 4/08/2011 11:12 AM

The main learning source is a book. Several books have been translated into bahasa Indonesia such as Fisika Universitas (by Sears, Francis W. & Mark Zemansky), Dasar-dasar Fisika Universitas (by Alonso, M. & Finn, E), Fisika (by Halliday, D. & R. Resnick) etc. however, the number of book collection is very limited. So, we sometimes have to share with those who have it.

2 MAISON 25/07/2011 5:29 PM

Instead of the books translated into bahasa Indonesia, there are some books using English. The availability of the book is so limited and the example is too basic. We have to find the example from other books. We have to buy ourselves for some titles of the book such Physics (Halliday). We order first and the books will be sent for us. Another learning source is a laboratory. The availability of device and the room's condition is not convenient enough.

3 MAISON 26/07/2011 1:50 PM

There are some lecturers who want to lend the students some books, especially those books which are rarely to be found.

4 MAISON 25/07/2011 5:34 PM

When doing the experiment, each group consists of 5 students. We take turn to use the device with other groups because the number of device is limited.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.0246 2

1 MAISON 4/08/2011 11:13 AM

The availability of device and the room's condition is not convenient enough.

2 MAISON 4/08/2011 11:17 AM

When doing the experiment, each group consists of 5 students. We take turn to use the device with other groups because the number of device is limited.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.0937 3

1 MAISON 4/08/2011 11:09 AM

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3 MAISON 4/08/2011 11:15 AM

There are some lecturers who want to lend the students some books, especially those books which are rarely to be found.

Internals\\Pre-service teachers' and graduates' interviews\\Focus Group_2

Node

Nodes\\Assessment

No 0.0274 1

1 MAISON 26/07/2011 1:56 PM

The assessment system of Physics lecturers is good. It motivated me to study harder when my mid semester score was bad. It also happened when they inform me next test schedule, it motivated me to prepare for the exam.

Nodes\\Characteristics could be improved\\According to the students

No 0.0434 1

1 MAISON 4/08/2011 11:26 AM

We sometimes could only learn the theories instead of doing the experiment because we do not have the tools. Most of the tools in the laboratory were broken, so that some students cannot use it at the same time. We took turn in doing the experiment. We hope that all the tools is completed and hope that the broken tools are repaired or renew.

Nodes\\Characteristics could be improved\\Acording to Lecturer

No 0.0434 1

1 MAISON 4/08/2011 11:25 AM

We sometimes could only learn the theories instead of doing the experiment because we do not have the tools. Most of the tools in the laboratory were broken, so that some students cannot use it at the same time. We took turn in doing the experiment. We hope that all the tools is completed and hope that the broken tools are repaired or renew.

Nodes\\Curriculum Document\Content

No 0.1990 6

1 MAISON 4/08/2011 11:22 AM

The learning material refers to some books and the internet.

2 MAISON 3/08/2011 1:17 PM

The content of curriculum is too heavy. My experience when I did my Field Teaching, the most significance knowledge was in the Basic Physic and Curriculum Analysis material. The material of physical formulas, computing and some other material were not really needed by junior and senior high school students.

3 MAISON 3/08/2011 1:17 PM

There are some subjects that are not included anymore in the curriculum such as Education philosophy and the History of Physics. I think that subjects are still needed and have some benefits in teaching.

4 MAISON 3/08/2011 1:17 PM

If possible, the subjects that significant for education are added. Some subjects such as 'Fismat' have a little significant in teaching practical. And if possible, there is a subject that explains the implementation of physics in daily life. We actually can see the implementation in some news, but that are not enough. It would be better if it is included in the study subject.

5 MAISON 3/08/2011 1:17 PM

I think General Physics 1 and 2 have enough benefits to be a teacher. Based on my experience in teaching my high school sister, my knowledge of general physics was really help. Besides General Physics and Secondary School's Curriculum Analysis, the subjects that explain the way to teach and manage the class are also needed.

6 MAISON 3/08/2011 1:17 PM

If possible, the subject discusses the way to teach and how to know the students would be better in practical not only in theories. There is actually a Micro Teaching before go to 'PPL', but it was not enough for it was only in two weeks. Some friends were not confident in teaching in the class.

Nodes\\Curriculum Document\Content\Difficulty of Physics

No 0.0178 1

1 MAISON 3/08/2011 1:22 PM

I think that the chance to have a carrier in physic field is good because of the level of its difficulties makes physics teachers are needed.

Nodes\\Interest in Physics

No 0.2932 7

1 MAISON 3/08/2011 1:19 PM

I like to observe physics phenomenon and find the answers, but I don't really like the computation. When I was at junior high school, my teacher had taught the application of torque concept of crash vehicles. It was interested me that I can still remember it well.

2 MAISON 3/08/2011 1:19 PM

Frankly, taking Physical Education Program was not my first choice. I chose Biology as my first choice on the university admission test and Physics was me second choice. I have the same opinion with Sutrisno for not interested in the computing part.

3 MAISON 3/08/2011 1:19 PM

I do not really hope to have career in the field of physics or be a physics teacher, I am more interested in trading or have a career in economy.

4 MAISON 3/08/2011 1:19 PM

To be frank, I don't really like Physics because I was taught by a scary teacher when I was in the third grade of senior high school. I had never kept in mind the lesson given by him. I chose Math for my first choice in this university. For the second choice, my father asked me to choose Physic, and I followed it because I do believe that it is good to do our parents advises. After some time study the physics in the university, I become more interested in physics even more after I did my field study (PPL) by practicing a teaching in a class. Comparing the theory and practical, I prefer the practical work because it is hard to work with the formulas.

5 MAISON 3/08/2011 1:19 PM

I like Math. I chose Physics because of; (1) the big opportunity for getting a job, (2) the big opportunity for passing the admission test. I also chose it because of my parents advised me to. In the senior high school, I was so glad when the teacher had not come, but now I feel so upset when it the teacher does not come.

6 MAISON 3/08/2011 1:19 PM

I actually wanted to be a doctor, but some consideration (among others; my father did not allow me to study in another town) made me tried to take physic and tried to like physics.

7 MAISON 3/08/2011 1:19 PM

I think General Physics 1 and 2 have enough benefits to be a teacher. Based on my experience in teaching my high school sister, my knowledge of general physics was really help. Besides General Physics and Secondary School's Curriculum Analysis, the subjects that explain the way to teach and manage the class are also needed.

Nodes\\Interest in Physics\Student interest in physics

No 0.2932 7

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Nodes\\Learning Styles & Learning Experiences

No 0.1829 5

1 MAISON 3/08/2011 11:57 AM

I had ever made a media about the process of material transformation. From that media, I can more understand about a material.

2 MAISON 3/08/2011 11:57 AM

I study almost when there is so quiet, such as at midnight. If there is so crowd, I cannot understand what I've learnt. This situation I need when I studied the lesson that needed the fully concentration. I also study with my friends. The benefit is I can discuss with my friends when I found difficulties in understanding the material.

3 MAISON 3/08/2011 11:57 AM

I study with my friends, sometimes in the library or at my friends' house. My group consists of around 3 to 4 students whose house are close to each other. At the previous semesters, we used to make an appointment to study at one of our friends' house. Being busy with our thesis, there is no more study group.

4 MAISON 3/08/2011 11:57 AM

At the campus, I study with my friends, do the assignments or essays from our lecturers. At home, I study alone. The efforts I've done in studying are not maximal. I used to skip the difficult questions and asked my friends then.

5 MAISON 3/08/2011 11:57 AM

In studying, I only concentrate at the first hour. I get sleepy at next hours especially when facing the questions which need math computing. I used to seek for a place to sleep in that situation, then ask friends the next day or make an appointment to study together. Study also depends on the lecturer. If the lecturer asked us to read the material before we learn it at class, I will do it to anticipate the questions asked by the lecturer.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No 0.0670 2

1 MAISON 3/08/2011 9:21 AM

I think the lecturer is only as facilitator, still not maximal as a motivator since they cannot motivate me in studying. When I had a question or problem that I and my friends did not understand, then I asked the lecturer. Facilitator means; lecturer advised me to find out in a reference or lent me their books.

2 MAISON 3/08/2011 9:21 AM

The assessment system of Physics lecturers is good. It motivated me to study harder when my mid semester score was bad. It also happened when they inform me next test schedule, it motivated me to prepare for the exam.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Motivation Component

No 0.0427 2

1 MAISON 4/08/2011 3:18 PM

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2 MAISON 4/08/2011 3:19 PM

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Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0395 1

1 MAISON 4/08/2011 3:15 PM

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Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.0698 3

1 MAISON 4/08/2011 11:20 AM

Laboratory facilities are also not enough, since in the group (consist of 6 people) there is only 3 of them can use the facilities.

2 MAISON 4/08/2011 11:25 AM

We sometimes could only learn the theories instead of doing the experiment because we do not have the tools. Most of the tools in the laboratory were broken, so that some students cannot use it at the same time. We took turn in doing the experiment. We hope that all the tools is completed and hope that the broken tools are repaired or renew.

3 MAISON 4/08/2011 11:27 AM

I have quite the same opinion, most of the tools are broken for being unused.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.0569 3

1 MAISON 4/08/2011 11:20 AM

I do not have enough books. I used to go to library, but now I don't because I rarely found the book I needed for example 'Fismat' book (L. Boas).

2 MAISON 4/08/2011 11:22 AM

The learning material refers to some books and the internet. Some books are bought by us and some are borrowed from the lecturers. Generally, the books are rarely available compare to the amount of the students.

3 MAISON 4/08/2011 11:23 AM

I share the same opinion with my friends; I think there are lack of sources and facilities.

Internals\\Pre-service teachers' and graduates' interviews\\Focus Group_3

Node

Nodes\\Assessment

No 0.0441 1

1 MAISON 26/07/2011 2:03 PM

There are some lecturers who give encouragement for us. But, there is a lecturer who gives the grade which is not the same as we expect to. We know our own study effort, but the result is disappointed. We cannot make complain because the test sheets are not given back for us.

Nodes\\Characteristics could be improved\\According to the students

No 0.0491 2

1 MAISON 4/08/2011 3:30 PM

The lecturers' competences in physics are qualified. But, there are some explanations from the lecturers are difficult to be understood and the interaction between the lecturers and the students are not good enough

2 MAISON 4/08/2011 11:41 AM

I suggest the faculty to provide more books, laboratory devices, and the number of lecturers.

Nodes\\Curriculum Document\Content

No 0.0425 2

1 MAISON 3/08/2011 1:17 PM

The teaching and learning physics materials given are good, but the educational materials are not. Those are about the requirements to be a physics student teacher.

2 MAISON 3/08/2011 1:17 PM

I wish to have the explanation about applied physics in relation to the development of modern science.

Nodes\\Interest in Physics\Student interest in physics

No 0.2169 5

1 MAISON 4/08/2011 10:17 AM

I like physics and I want to be a physics teacher since I have been in the third grade of Senior High School. I want to apply it in the real life.

2 MAISON 4/08/2011 10:17 AM

I like physics since I have been in Senior High School. I study it to make my parents are proud of me. I would like to master some patterns in physics and I want to be a teacher to transfer my knowledge.

3 MAISON 4/08/2011 10:17 AM

I chose physics as my major, but it is not my first option. I am more interested in the Department of Psychology at North Sumatera University, however, my parents did not allow me to study there and suggested me to choose physics. So, I try to follow my parents' suggestions and try to enjoy it.

4 MAISON 4/08/2011 10:17 AM

I like physics, especially doing experiment. The inspiration comes to me when I had a physics teacher who taught us in a good way. I want to master physics and change people's perceptions about the difficulties in learning physics.

5 MAISON 4/08/2011 10:17 AM

I want to be a master in physics. I like physics, especially about electricity because I often repair electronics at home. Actually I do not want to be a teacher, but the provision of my family's finance is limited, I have to consider the nearest place to study. To become a teacher is my last choice. I will continue my study in graduate school and become a leader in my city next time. It seems that my educational background and my career expectation are not related each other.

Nodes\\Learning Styles & Learning Experiences

No 0.2953 8

1 MAISON 3/08/2011 11:57 AM

Some students don't mind to find the books, they just want to access easily using google engine and find the materials.

2 MAISON 3/08/2011 11:57 AM

I prefer to find the materials from the books because they have complete information and clear. I have already had some books entitled Mekanika (1 edition) and Listrik Magnet dan Termodinamika (2 edition) by Sutrisno. I also have Fisika by Halliday. I often visit university library.

3 MAISON 3/08/2011 11:57 AM

The effective study time for me is when I have a good mood to study. If I do not want to study even though I get some task to be presented, I will present it just the way it is and I will copy from my friend to the same assignments given. If I am interested in studying, I could study in any condition.

4 MAISON 3/08/2011 11:57 AM

I will study in a relaxing way because it is helpful for me. So, I try to be relaxed to study. My study time is from 8 to 9 pm. I would like to study in a good lighting and not so noisy. I think I have not studied as well as I could.

5 MAISON 3/08/2011 11:57 AM

I will study whenever I have my spare time. I use to study in the evening. When I want to study, I will find the place which is not so crowded. It is the same way if I study at night, I do not like to have friend to talk to while studying. Sometimes I study in the morning.

6 MAISON 3/08/2011 11:57 AM

If I have my spare time, I will study in my university library. I study in my room in order not to be disturbed by my brother in the evening or at night after performing sholat maghrib. I think my study effort is still not enough.

7 MAISON 3/08/2011 11:57 AM

If I have some tasks to do, I would like to study with my best friends who could train me to do the tasks. I like to study in the midnight (about 11 pm to 3 am) in my bedroom. I do not like to study in the afternoon because it is crowded.

8 MAISON 3/08/2011 11:57 AM

I do not like a kind of lecturers who just assign me to write a paper. I prefer to have a lecturer who explain the materials and give some examples and then assign me.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0179 1

1 MAISON 4/08/2011 3:35 PM

The lecturers assist me to study. If we do not have the books, some lecturers do not mind to lend us some books.

Nodes\\Teaching Resources & Facilities

No 0.1128 5

1 MAISON 15/06/2011 12:07 PM

There is a lack of laboratory facilities, consequently not all of the students can do the experiment. The classrooms are not comfortable, because of the number of students (more than 60 in one class) and hot.

2 MAISON 15/06/2011 12:08 PM

The provision of the books for the beginning materials of physics could be found. But the provision of the books for applied physics such Modern Physics and Mathematics Physics are rather difficult to be found. There is only one book for Modern Physics, that is the Concept of Modern Physics by Beiser.

3 MAISON 26/07/2011 2:01 PM

There are few lecturers.

4 MAISON 26/07/2011 2:02 PM

If we do not have the books, some lecturers do not mind to lend us some books.

5 MAISON 15/06/2011 12:15 PM

I suggest the faculty to provide more books, laboratory devices, and the number of lecturers.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.0371 2

1 MAISON 4/08/2011 11:38 AM

There is a lack of laboratory facilities, consequently not all of the students can do the experiment. The classrooms are not comfortable, because of the number of students (more than 60 in one class) and hot.

2 MAISON 4/08/2011 11:40 AM

There are few lecturers.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.0608 2

1 MAISON 4/08/2011 11:40 AM

The provision of the books for the beginning materials of physics could be found. But the provision of the books for applied physics such Modern Physics and Mathematics Physics are rather difficult to be found. There is only one book for Modern Physics, that is the Concept of Modern Physics by Beiser.

2 MAISON 4/08/2011 11:41 AM

If we do not have the books, some lecturers do not mind to lend us some books.

Internals\\Pre-service teachers' and graduates' interviews\\Focus Group_4

Node

Nodes\\Assessment

No 0.0514 3

1 MAISON 26/07/2011 2:06 PM

I also answer previous test since lecturers usually gave similar questions with different numerals.

2 MAISON 4/08/2011 3:48 PM

In giving assessment, some lecturers explained some assessment components. But, there are few lecturers did not want to explain it.

3 MAISON 4/08/2011 3:50 PM

In assessment, some lecturers assess very objective, but some of them did not. We studied hard, but the result far away from our expectation.

Nodes\\Characteristics could be improved\\According to the students

No 0.0355 2

1 MAISON 4/08/2011 3:52 PM

I suggested not using lecture method as much as possible. For particular subjects as I said before were not taught by using discuss method because we did not know what materials must be discussed.

2 MAISON 4/08/2011 12:03 PM

Furthermore, number of book collection had to be completed.

Nodes\\Curriculum Document\Content

No 0.1666 7

1 MAISON 4/08/2011 11:43 AM

We were learning based on the subject every semester.

2 MAISON 3/08/2011 1:17 PM

In my opinion, when we conducted with formula and we get the result, we did not know what the function of the result was.

3 MAISON 3/08/2011 1:17 PM

we only focus on some formulas without know the application.

4 MAISON 3/08/2011 1:17 PM

In my opinion, curriculum in this program was focused on advanced materials not only for materials that were needed to teach in school. There are still some students misunderstanding about the concept of Physics; meanwhile we were studying how to use formula and the theories of Physics. So, we did not get what we need as a Junior or Senior High school teacher. We expected that Physics Program provides what we do really need as a Junior or Senior High School teacher.

5 MAISON 3/08/2011 1:17 PM

When we did teaching practice, we needed simple concept of Physics, unfortunately we did not mastered it. Maybe, this science was be able to use in everyday, but we did not understand the concept well.

6 MAISON 3/08/2011 1:17 PM

Only little Physics science that was used in our life, specifically I only used Electronics and Radiance.

7 MAISON 3/08/2011 1:17 PM

Pre-service teacher program must be appropriate with the necessity when we did teaching practice such as making lesson plan. So, it was suitable with school curriculum which always changed.

Nodes\\Curriculum Document\Legitimacy

No 0.0097 1

1 MAISON 3/08/2011 1:24 PM

There were close relationship between one subject and another subject.

Nodes\\Interest in Physics

No 0.1546 4

1 MAISON 3/08/2011 1:19 PM

I was studying in Physics Education Program in Jambi University, because I did not success for the two choices in National University Admission – they were Andalas University and Sriwijaya University. I never thought be a teacher, because my background education was Vocational High School so I thought to continue in Engineering Faculty. At the first time when I entered, I felt disappointed, later I do really enjoy. Now, I love physics much.

2 MAISON 3/08/2011 1:19 PM

My background program in Senior High School was Science, but I did not know what program that I would take to continue my study. After senior high school graduation, I choose Physics as the first choice and Biology as the second. I want to be a Science teacher, not specific in Physics.

3 MAISON 3/08/2011 1:19 PM

When I was in Senior High School, I got low score in Physics. I felt curious. I had very strict teacher, and I thought one day I will not be a strict teacher as my teacher.

4 MAISON 3/08/2011 1:19 PM

I chose Medical Faculty but I did not pass. Second choice – it was Physics in Jambi University – was successful. If it was linked with my career as Physics teacher, so by studying in this program will be helpful.

Nodes\\Interest in Physics\Student interest in physics

No 0.1546 4

1 MAISON 4/08/2011 10:17 AM

I was studying in Physics Education Program in Jambi University, because I did not success for the two choices in National University Admission – they were Andalas University and Sriwijaya University. I never thought be a teacher, because my background education was Vocational High School so I thought to continue in Engineering Faculty. At the first time when I entered, I felt disappointed, later I do really enjoy. Now, I love physics much.

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3 MAISON 4/08/2011 10:17 AM

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4 MAISON 4/08/2011 10:17 AM

I chose Medical Faculty but I did not pass. Second choice – it was Physics in Jambi University – was successful. If it was linked with my career as Physics teacher, so by studying in this program will be helpful.

Nodes\\Learning Styles & Learning Experiences

No 0.1149 5

1 MAISON 4/08/2011 11:45 AM

There were some references but they were written in English. So, we were difficult to comprehend them. We were lazy to read those references even though they were available in library.

2 MAISON 3/08/2011 11:57 AM

We ever created some tools based on the assignment of the subject such as creating electronic sequence for Basic Electronic.

3 MAISON 3/08/2011 11:57 AM

I used to study when I only had a test and assignment.

4 MAISON 3/08/2011 11:57 AM

I did answer some questions which always came out in the test. Furthermore, I also did mapping concept in order to help me to comprehend Physics subject well. I prefer to learn in my bedroom.

5 MAISON 3/08/2011 11:57 AM

I studied one day before the test since I only study when I had a test. I never took note so to prepare the examination, I borrow friend’s note. I also answer previous test since lecturers usually gave similar questions with different numerals. I could study in everywhere.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No 0.1478 7

1 MAISON 3/08/2011 9:21 AM

Our lecturers often lend books and also their handout if we only had a few minutes to take a note.

2 MAISON 3/08/2011 9:21 AM

We also did not understand for specifics subject because the teaching method was discussion in which the lecturer did not explain materials.

3 MAISON 3/08/2011 9:21 AM

I also answer previous test since lecturers usually gave similar questions with different numerals.

4 MAISON 3/08/2011 9:21 AM

In giving assessment, some lecturers explained some assessment components. But, there are few lecturers did not want to explain it.

5 MAISON 3/08/2011 9:21 AM

When the lecturer came in to the class, she/he explained materials by writing on the whiteboard. If subject had correlation with mathematics, the lecturer wrote and explained the formulas. The students were then asked to answer question in front of the class.

6 MAISON 3/08/2011 9:21 AM

In assessment, some lecturers assess very objective, but some of them did not. We studied hard, but the result far away from our expectation.

7 MAISON 3/08/2011 9:21 AM

I suggested not using lecture method as much as possible. For particular subjects as I said before were not taught by using discuss method because we did not know what materials must be discussed.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No 0.0514 3

1 MAISON 4/08/2011 3:47 PM

I also answer previous test since lecturers usually gave similar questions with different numerals.

2 MAISON 4/08/2011 3:48 PM

In giving assessment, some lecturers explained some assessment components. But, there are few lecturers did not want to explain it.

3 MAISON 4/08/2011 3:50 PM

In assessment, some lecturers assess very objective, but some of them did not. We studied hard, but the result far away from our expectation.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0496 2

1 MAISON 4/08/2011 3:42 PM

Our lecturers often lend books and also their handout if we only had a few minutes to take a note.

2 MAISON 4/08/2011 3:49 PM

When the lecturer came in to the class, she/he explained materials by writing on the whiteboard. If subject had correlation with mathematics, the lecturer wrote and explained the formulas. The students were then asked to answer question in front of the class.

Nodes\\Teaching Methods

No 0.0984 4

1 MAISON 4/08/2011 3:45 PM

We also did not understand for specifics subject because the teaching method was discussion in which the lecturer did not explain materials.

2 MAISON 4/08/2011 3:49 PM

When the lecturer came in to the class, she/he explained materials by writing on the whiteboard. If subject had correlation with mathematics, the lecturer wrote and explained the formulas. The students were then asked to answer question in front of the class.

3 MAISON 4/08/2011 3:50 PM

We used to be taught by using old method, but now some lecturers apply e-learning, so we had to become accustomed.

4 MAISON 4/08/2011 3:53 PM

I suggested not using lecture method as much as possible. For particular subjects as I said before were not taught by using discuss method because we did not know what materials must be discussed.

Nodes\\Teaching Resources & Facilities

No 0.1676 8

1 MAISON 15/06/2011 1:26 PM

We were learning based on the subject every semester. It was very difficult to find references. There were some references but they were written in English. So, we were difficult to comprehend them. We were lazy to read those references even though they were available in library.

2 MAISON 15/06/2011 1:30 PM

It was quite difficult to get the books since there were a few references. To solve this problem, we ordered the books from our friends whom study in another province such as in Jogjakarta. There were some books which were ordered such as Physics book written by Halliday.

3 MAISON 4/08/2011 11:54 AM

Experimental tools were available actually, but we never used some of them. Now, the tools do not work anymore.

4 MAISON 15/06/2011 1:39 PM

About the references, it was very difficult to get Mathematics Physics books.

5 MAISON 26/07/2011 2:05 PM

Our lecturers often lend books and also their handout if we only had a few minutes to take a note.

6 MAISON 15/06/2011 1:41 PM

Until now, we have about ten books such as mathematics physics, modern physics, electronics, magnet electricity, Halliday Physics and so on.

7 MAISON 15/06/2011 1:43 PM

There were some experimental subjects such as Basic Physics, Electronic, Physics Experimental, Alat-alat Ukur, Computer Practice, but we only have few experimental tools.

8 MAISON 15/06/2011 2:01 PM

Furthermore, number of book collection had to be completed.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.0390 2

1 MAISON 4/08/2011 11:54 AM

Experimental tools were available actually, but we never used some of them. Now, the tools do not work anymore.

2 MAISON 4/08/2011 12:02 PM

There were some experimental subjects such as Basic Physics, Electronic, Physics Experimental, Alat-alat Ukur, Computer Practice, but we only have few experimental tools.

Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.1015 5

1 MAISON 4/08/2011 11:42 AM

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2 MAISON 4/08/2011 11:50 AM

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3 MAISON 4/08/2011 12:00 PM

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4 MAISON 4/08/2011 12:01 PM

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5 MAISON 4/08/2011 12:02 PM

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Internals\\Pre-service teachers' and graduates' interviews\\Focus_Group_5

Node

Nodes\\Characteristics could be improved\\According to the students

No 0.0439 3

1 MAISON 1/09/2011 1:30 PM

I think the interaction between lecturers and students needs to be improved in order for all students – not only the smart students – to have good progress in their studies.

2 MAISON 1/09/2011 1:31 PM

I think that students who are experiencing difficulties should be given the problem solutions in order to motivate them to finish their study.

3 MAISON 1/09/2011 1:31 PM

I think that some lecturers never improved and updated on their teaching resources from year to year. I would like to suggest that the number of physics lecturers need to be increased. Physics pre-service teachers' program has the fewest number of lecturers among all study programs.

Nodes\\Curriculum Document

No 0.1845 9

1 MAISON 31/08/2011 7:45 PM

Studying in the Physics Education program helped to develop my career as a Physics teacher. Now, I've begun my career as a Physics teacher at the Secondary School and a Physics tutor at a tutoring institution. I have gained a significant amount of knowledge and skills whilst studying at the Physics Education Study Program.

2 MAISON 1/09/2011 9:53 AM

I am satisfied from my experiences over the four years which I undertook studying physics education. However, there are several matters which, in my opinion need to be improved. For example, there were several subjects that should be conducted using experiments and needed to be explained more clearly.

3 MAISON 1/09/2011 10:02 AM

Basic concepts of physics in several subjects (like General Physics, Thermodynamic or Mathematical Physics) were good enough, but I felt the need for more in-depth explanations.

4 MAISON 1/09/2011 10:08 AM

Physics subjects which covered both theory and experiments were (1) General Physics 1, (2) General Physics 2, (3) Instruments of Measurement, (4) Basic Electronic 1, (5) Basic Electronic 2, and (6) Experiments of Physics.

5 MAISON 1/09/2011 10:09 AM

During the course of my study I often found it difficult to grasp concepts of physics in the pursuit to further my knowledge. Some subjects consisted of many theories and difficult concepts. Hence we didn't have enough knowledge in the basic concepts which was needed to teach physics at secondary schools.

6 MAISON 12/10/2011 1:40 PM

I think physics education curriculum provides knowledge and skills for our career and I have obtained the basic competences required in teaching physics. However, I think that I still need to acquire a deeper level of knowledge and understanding to further develop my skills.

7 MAISON 1/09/2011 10:45 AM

I think my capabilities as a new teacher especially in managing the classrooms are insufficient. In my opinion, there was up to 50% of my peers who experienced learning difficulties– for example, with mathematical methods in physics or quantum physics. I think that students who are experiencing difficulties should be given the problem solutions in order to motivate them to finish their study.

8 MAISON 1/09/2011 10:47 AM

Not all lecturers would give detailed information or specific syllabus about the subjects that they taught. Therefore, I didn't know exactly what materials would be taught. Nevertheless, I still maintained good progress during my time of study. Until that time, I could not solve and understand many problems in physics but I can solve it now.

9 MAISON 1/09/2011 10:51 AM

I have obtained a great deal of my competencies during my study, i.e. physics knowledge and teaching skills, especially when I was trained as a pre-service teacher.

Nodes\\Curriculum Document\Aims & Objectives

No 0.1104 5

1 MAISON 31/08/2011 7:44 PM

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Nodes\\Curriculum Document\Content

No 0.1422 7

1 MAISON 1/09/2011 9:53 AM

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2 MAISON 1/09/2011 10:02 AM

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4 MAISON 1/09/2011 10:09 AM

During the course of my study I often found it difficult to grasp concepts of physics in the pursuit to further my knowledge. Some subjects consisted of many theories and difficult concepts. Hence we didn't have enough knowledge in the basic concepts which was needed to teach physics at secondary schools.

5 MAISON 1/09/2011 10:42 AM

I have obtained the basic competences required in teaching physics. However, I think that I still need to acquire a deeper level of knowledge and understanding to further develop my skills.

6 MAISON 1/09/2011 10:45 AM

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Nodes\\Curriculum Document\Content\Difficulty of Physics

No 0.0225 1

1 MAISON 1/09/2011 10:09 AM

During the course of my study I often found it difficult to grasp concepts of physics in the pursuit to further my knowledge. Some subjects consisted of many theories and difficult concepts. Hence we didn't have enough knowledge in the basic concepts which was needed to teach physics at secondary schools.

Nodes\\Interest in Physics

No 0.1258 7

1 MAISON 31/08/2011 7:45 PM

I like physics and I have participated in several physics competitions since I was a student in Senior High School/Secondary School. After graduating from Senior High School, I decided to apply for the Physics Education program for my university degree. I am particularly interested in physics theories and physics computations.

2 MAISON 31/08/2011 7:51 PM

My learning objectives were to pass the exams.

3 MAISON 31/08/2011 7:49 PM

I chose physics education because I enjoy studying Physics, and also because in secondary school I had a very good Physics teacher who inspired me to take further interest in Physics. Just like Farida, I also prefer theoretical Physics rather than practice. I have always aspired to become a Physics teacher since I was a child.

4 MAISON 1/09/2011 9:05 AM

I've always wanted to become a teacher; therefore, I chose to enrol in the Physics Education program. Jambi University was my first choice, because the place was close by to where I lived, and the tuition fee was very cheap. I became more motivated to be a Physics teacher after graduating. I like calculations in physics.

5 MAISON 1/09/2011 9:06 AM

I chose physics because enjoyed studying this subject and my secondary school teachers encouraged me to study physics education so that I could become a physics teacher. I became more inspired to be a physics teacher knowing that the employment opportunities were greater than other subject areas. I also favoured doing physics experiments rather than physics theories.

6 MAISON 1/09/2011 10:10 AM

Of all subjects in Physics, I particularly liked modern physics and mathematical physics subjects. However, I didn't like the electronics subject.

7 MAISON 1/09/2011 10:12 AM

Even though I prefer doing physics experiments, I have also learnt a quite a lot about physics theories and physics formulas. I have gained new knowledge in these areas.

Nodes\\Interest in Physics\Student interest in physics

No 0.1258 7

1 MAISON 31/08/2011 7:41 PM

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7 MAISON 1/09/2011 10:12 AM

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Nodes\\Learning Styles & Learning Experiences

No 0.1434 6

1 MAISON 31/08/2011 7:51 PM

My learning objectives were to pass the exams.

2 MAISON 1/09/2011 10:17 AM

I realise now that I did not practice good enough learning techniques during my time of study at university. I only studied during exam periods and when the lecturers gave homework that we had to complete. I preferred studying with my friends at home, because we had the opportunity to discuss the difficult problems and issues amongst one another and exchange ideas at the same time.

3 MAISON 1/09/2011 10:18 AM

I preferred to do my study routine early in the mornings as I could never sleep too late at night. I would go to bed at around 9pm and begin studying at 3am or 4am through until 7am. My main target was to pass my exams. I liked to study with quiet surroundings.

4 MAISON 1/09/2011 10:20 AM

I used to study when I had exams and assignments. There were many assignments, because we had too many subjects – around seven or eight subjects each semester. I liked to study by myself. I felt that studying in groups was not effective because the students did more talking than learning. I also preferred to study at night rather than daytime hours. Previously, when I was a student, I feel that I did put enough effort into studying. Now, I realize that it is also important to study with enthusiasm in order to accomplish an excellent achievement.

5 MAISON 1/09/2011 10:21 AM

I never used to study regularly. I would only study for exams and assignments. Sometimes, when I was bored of studying, I would go and find interesting places that I could venture out to. I enjoyed studying alone, although I would still discuss matters with a friend if I had any difficulties. I would usually study late at night, when people were asleep and my surroundings were quiet. I believe that I did put a sufficient amount of effort into my study.

6 MAISON 1/09/2011 10:36 AM

Lecturers' assessment components included quizzes, assignments, mid semester test, and final test. Our lecturers' announcements about exam schedules were very helpful. I could study for the exam and look at previous exam papers given by that lecturer.

Nodes\\Teaching Approaches (Content-centered or Learning centered)

No 0.2362 13

1 MAISON 1/09/2011 10:00 AM

Some lecturers conducted their lessons using only an Over Head Projector (OHP) and by oral presentation, so it was uninteresting and I didn't gain in-depth knowledge from these lectures.

2 MAISON 1/09/2011 10:24 AM

I think that each of my lecturers had very different characteristics and teaching styles. Therefore I do not feel I am able to give a generalisation about my lecturers' teaching approaches. Some lecturers showed great efforts in teaching their students. Others seemed to have only delivered the subject material and did not care whether the students understood it or not. In my opinion, the lecturers who taught physics subjects are better than the lecturers who taught us education subjects (the external lecturers). The external lecturers would often use a boring method of discussion and would then request that the students write a summary of the subject.

3 MAISON 1/09/2011 10:26 AM

Many students studied because they were motivated to study. I think that the lecturers did not put enough effort into helping students who had difficulties with their learning process. I felt sympathetic towards the students who experienced learning difficulties.

4 MAISON 1/09/2011 10:27 AM

Lecturers were good enough in assessing my learning however, as they had notes in every lesson and would promptly return my assessment results. I would study more if my scores were low.

5 MAISON 1/09/2011 10:29 AM

Lecturers would also lend books to students which were not available in the library. Each lecturer had different strengths and weaknesses.

6 MAISON 1/09/2011 10:33 AM

Lecturers should find ways of delivering the subject topics more interestingly.

7 MAISON 1/09/2011 10:35 AM

The assessment should be clear and coherent; if it is an important assessment, each of the students' scores is shown on the announcement board.

8 MAISON 1/09/2011 10:36 AM

Lecturers' assessment components included quizzes, assignments, mid semester test, and final test. Our lecturers' announcements about exam schedules were very helpful. I could study for the exam and look at previous exam papers given by that lecturer.

9 MAISON 1/09/2011 10:38 AM

Some lecturers only focused on their lectures and didn't know whether their students understood the material or not. Students would write about topics from their books even though they couldn't fully comprehend the information.

10 MAISON 1/09/2011 10:41 AM

I think the interaction between lecturers and students needs to be improved in order for all students – not only the smart students – to have good progress in their studies.

11 MAISON 1/09/2011 10:45 AM

I think my capabilities as a new teacher especially in managing the classrooms are insufficient. In my opinion, there was up to 50% of my peers who experienced learning difficulties– for example, with mathematical methods in physics or quantum physics. I think that students who are experiencing difficulties should be given the problem solutions in order to motivate them to finish their study.

12 MAISON 1/09/2011 10:47 AM

Not all lecturers would give detailed information or specific syllabus about the subjects that they taught. Therefore, I didn't know exactly what materials would be taught. Nevertheless, I still maintained good progress during my time of study. Until that time, I could not solve and understand many problems in physics but I can solve it now.

13 MAISON 1/09/2011 10:49 AM

Although the lecturers didn't pay enough attention to all students in their learning, they generally had good social skills with all students which should be maintained.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Motivation Component

No 0.0524 4

1 MAISON 1/09/2011 10:00 AM

Some lecturers conducted their lessons using only an Over Head Projector (OHP) and by oral presentation, so it was uninteresting and I didn't gain in-depth knowledge from these lectures.

2 MAISON 1/09/2011 10:26 AM

Many students studied because they were motivated to study. I think that the lecturers did not put enough effort into helping students who had difficulties with their learning process. I felt sympathetic towards the students who experienced learning difficulties.

3 MAISON 1/09/2011 10:27 AM

Lecturers were good enough in assessing my learning however, as they had notes in every lesson and would promptly return my assessment results. I would study more if my scores were low.

4 MAISON 1/09/2011 10:33 AM

Lecturers should find ways of delivering the subject topics more interestingly.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components

No 0.2031 10

1 MAISON 1/09/2011 10:24 AM

I think that each of my lecturers had very different characteristics and teaching styles. Therefore I do not feel I am able to give a generalisation about my lecturers' teaching approaches. Some lecturers showed great efforts in teaching their students. Others seemed to have only delivered the subject material and did not care whether the students understood it or not. In my opinion, the lecturers who taught physics subjects are better than the lecturers who taught us education subjects (the external lecturers). The external lecturers would often use a boring method of discussion and would then request that the students write a summary of the subject.

2 MAISON 1/09/2011 10:26 AM

Many students studied because they were motivated to study. I think that the lecturers did not put enough effort into helping students who had difficulties with their learning process. I felt sympathetic towards the students who experienced learning difficulties.

3 MAISON 1/09/2011 10:29 AM

Lecturers would also lend books to students which were not available in the library. Each lecturer had different strengths and weaknesses.

4 MAISON 1/09/2011 10:35 AM

The assessment should be clear and coherent; if it is an important assessment, each of the students' scores is shown on the announcement board.

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10 MAISON 1/09/2011 10:49 AM

Although the lecturers didn't pay enough attention to all students in their learning, they generally had good social skills with all students which should be maintained.

Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Accommodation for student characteristics

No 0.1221 5

1 MAISON 1/09/2011 10:24 AM

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Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Assessment

No 0.0425 3

1 MAISON 1/09/2011 10:27 AM

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2 MAISON 1/09/2011 10:35 AM

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3 MAISON 1/09/2011 10:36 AM

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Nodes\\Teaching Approaches (Content-centered or Learning centered)\Strategy Components\Instruction

No 0.0419 2

1 MAISON 1/09/2011 10:38 AM

Some lecturers only focused on their lectures and didn't know whether their students understood the material or not. Students would write about topics from their books even though they couldn't fully comprehend the information.

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Nodes\\Teaching Methods

No 0.0136 1

1 MAISON 1/09/2011 10:00 AM

Some lecturers conducted their lessons using only an Over Head Projector (OHP) and by oral presentation, so it was uninteresting and I didn't gain in-depth knowledge from these lectures.

Nodes\\Teaching Resources & Facilities

No 0.2247 11

1 MAISON 1/09/2011 10:03 AM

The supporting text books, however, were sufficient, as some lecturers advised me to purchase some important books, for example 'Physics' by Halliday, 'Fundamentals of Physics' by Gian Coli, 'University Physics' by Sears & Zemansky, and 'Wave' by Tjia.

2 MAISON 1/09/2011 10:04 AM

I also think that the laboratory facilities were insufficient, although I didn't know the overall condition in detail, but based on my experiences, we were only able to conduct a few experiments throughout the course.

3 MAISON 1/09/2011 10:06 AM

I would occasionally purchase books, and I often used text books that were available in the university library. There weren't very many physics books in our library. Sometimes I couldn't find the book which I needed in the library, as they had already been borrowed out by my peers. In these situations I would ask my friends if they could lend the book to me before he/she returned them to the library.

4 MAISON 1/09/2011 10:08 AM

In general, equipment available in the laboratories was not sufficient and their maintenance was also limited. Damaged laboratory kits were not repaired.

5 MAISON 1/09/2011 10:11 AM

Classroom numbers were also unaccommodating, we had large number of students, but the classroom capacity was limited as the number of lecturers who taught physics were low.

6 MAISON 1/09/2011 10:13 AM

It was not easy to find the text books and related sources that I needed to support my study. Alternative books that can be borrowed were also of limited availability. Therefore, I would just use the books that were recommended by the lecturers.

7 MAISON 1/09/2011 10:14 AM

We have had awful experiences during experiments that took place in the laboratory, as some laboratory equipment has been unsuitable and we have not been able to conduct numerous experiments.

8 MAISON 1/09/2011 10:19 AM

Sometimes, there would be up to sixty or seventy students attending a single lecture in a classroom. In these situations, the lectures were not very effective, and only the students sitting in the first and second rows could listen well and participate. Students who were sitting in the back rows could not listen and take part in the lecture as much. The classroom was not a very suitable learning environment as it was also uncomfortable and very hot considering there was no air conditioning and the room was densely occupied by students.

9 MAISON 1/09/2011 10:29 AM

Lecturers would also lend books to students which were not available in the library. Each lecturer had different strengths and weaknesses.

10 MAISON 1/09/2011 10:34 AM

Student numbers per classroom should also be reduced so that all students, rather than just the ones sitting in the front rows, can focus well on their lectures. I could not get a grasp on what the lecturer was discussing when I sat towards the back of the classroom.

11 MAISON 1/09/2011 10:50 AM

Another comment I have is about the lecturers' materials. I think that some lecturers never improved and updated on their teaching resources from year to year. I would like to suggest that the number of physics lecturers need to be increased. Physics pre-service teachers' program has the fewest number of lecturers among all study programs. This can be seen that the physics lecturer didn't have enough time to supervise his or her students in the final research project.

Nodes\\Teaching Resources & Facilities\Facilities and Institution Supports

No 0.1483 7

1 MAISON 1/09/2011 10:04 AM

I also think that the laboratory facilities were insufficient, although I didn't know the overall condition in detail, but based on my experiences, we were only able to conduct a few experiments throughout the course.

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Nodes\\Teaching Resources & Facilities\Teaching resources

No 0.1110 5

1 MAISON 1/09/2011 10:03 AM

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Appendix 9 the Classroom observations' calendar

Date and Time	Subject	Topic	Lecturer
30 September 2010 (09.50 – 13.10)	Mechanics	Kinematic of particles, one- dimensional motion (motion along a straight line), freely falling objects, general problem-solving strategy	Lecturer C
7 October 2010 (09.50 – 13.10)		Some applications of kinematics of particles, general problem-solving strategy	
21 October 2010 (09.50 – 13.10)		Two-dimensional motion with constant acceleration, uniform circular motion, projectile motion, general problem-solving strategy	
4 November 2010 (09.50 – 13.10)		Force and motion (dynamic of particles): Newtonian mechanics, applying Newton's Laws, friction, general problem-solving strategy	
1 October 2010 (08.00 – 10.30)	General Physics I	Vector and scalar quantities; some properties of vector; component of a vector and unit vector; differential and integral.	Lecturer B
8 October 2010 (08.00 – 10.30)		Motion in one dimension (position, velocity, speed, instantaneous velocity and speed, acceleration, one-dimensional motion with constant acceleration). Motion in two dimensions.	
15 October 2010 (08.00 – 10.30)		The laws of motion, circular motion	
22 October 2010 (08.00 – 10.30)		Some applications of Newton's Laws	
9 October 2010 (08.00 – 09.40)	Laboratory Management	The meaning and function of a physics laboratory; the minimum standards of facilities, infrastructure, laboratory equipment, and standard operational procedures.	Lecturer A
23 October 2010 (08.00 – 09.40)		Arrangement, maintenance, and repair of laboratory equipment, administration of the laboratory	
30 October 2010 (08.00 – 09.40)		The administration of the laboratory (continued)	
6 November 2010 (08.00 – 09.40)		Work safety and laboratory safety	