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INTERNATIONAL CONFERENCE ON
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EDUCATION OF MATHEMATICS AND
SCIENCES 2014



ICRIEMS
2014

Yogyakarta, 18-20 May 2014

*Global Trends and Issues
on Mathematics and Sciences
and the Education*

PROCEEDING

ISBN. 978-979-99314-8-1

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Global Trends and Issues
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Faculty of Mathematics and Natural Sciences
Yogyakarta State University

ICRIEMS 2014 : Global Trends and Issues on Mathematics and Science and The Education

- Mathematics & Mathematics Education
- Physics & Physics Education
- Chemistry & Chemistry Education
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- Science Education

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Preface

Bless upon God Almighty such that this proceeding on International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) 2014 may be compiled according to the schedule provided by the organizing committee. All of the articles in this proceeding are obtained by selection process by the reviewer team and already been presented in the Conference on 18 – 20 May 2014 in the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. This proceeding consists of 344 parallel papers, and comprises 9 fields, that is mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of ICRIEMS 2014 is ‘Global Trends and Issues of Mathematics and Science and the Education’. The main articles in this conference are given by five keynote speakers, which are Prof. Dean Zollman (Physics Department, Kansas State University), Prof. David F. Treagust (Center of Education, Curtin University), Prof. Dr. Amy Cutter-Mackenzie (School of Education, Southern Cross University, Australia), Prof. Tran Vui (Hue University, Vietnam), and Asst. Prof. Dr. Duangjai Nacapricha (Faculty of Science, Mahidol University). The conference is also supported by the LPTK (Lembaga Pendidikan Tenaga Kependidikan) Forum from Faculty of Mathematics and Sciences that consists of 12 universities all over Indonesia. Each member of the Forum contributed one invited speakers, such that there are an additional 10 invited speakers presenting in the forum. Besides the keynote and invited speakers, there are also 344 parallel articles that presented the latest research results in the field of mathematics and sciences, and the education. These parallel session speakers come from researchers from Indonesia and abroad, including Malaysia and Australia.

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

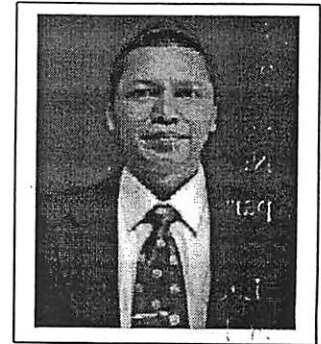
Yogyakarta, June 2014

The Editor Team

Forewords from The Head of Committee

Assalamu'alaikum wa Rahmatullahi wa Barakatuh
May God bless upon us.

Your excellency The president of UNY Prof. Dr. Rochmat Wahab, M. Pd., M.A., ladies and gentlemen, good morning and welcome to State University Yogyakarta. This seminar entitled International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS): global trends and issues on mathematics and science and the education is organized by the Faculty of Mathematics and Science, State University of Yogyakarta working together with 12 members of the Association of the Faculty of Math and Sciences from Teacher Education Program (LPTK). This seminar is also dedicated to the golden anniversary of UNY; 1 among 90 academic activities dedicated to the anniversary.



Ladies and gentlemen, on behalf of the committee of this conference, I would like to express highest appreciation and gratitudes to the keynote speakers, including:

1. Prof. David F. Treagust (Center of Science Education Curtin University)
2. Prof. Dean Zollman (Physics Dept, Kansas University, US)
3. Dr. Amy Cutter-Mackenzie (School of Education, Southern Cross University, Australia)
4. Asst. Prof. Dr. Duangjai Nacapricha (Faculty of Science , Mahidol University)
5. Prof. Tran Vui (College of Education, Hue University, Hue City, Vietnam)

Secondly, I would like also to give sincere thanks and gratitudes to the speakers from 10 College of Educations, including:

1. Universitas Negeri Surabaya (UNESA): Prof. Dr. Muchlas Samani, and 33 speakers
2. Universitas Negeri Jakarta (UNJ): Prof. Dr. Gerardus Pola, and 7 speaker
3. Universitas Pendidikan Indonesia (UPI): Dr. Hary Firman, and
4. Universitas Negeri Malang (UM): Prof. Effendi, Ph.D
5. Universitas Negeri Padang (UNP): Prof. Tjeerd Plomp
6. Universitas Negeri Semarang (UNNES): Prof. Dr. Supriyadi Rustad

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7. Universitas Pendidikan Singaraja (UNDIKSA): Prof. Dr. I Nengah Suparta, M.Si
8. Universitas Negeri Makasar (UNM): Oslan Junaidi, Ph.D
9. Universitas Negeri Gorontalo (UNG): Prof. Dr. Sarson Pomalto, M.Pd
10. Universitas Negeri Yogyakarta (UNY): Dr. Jaslin Ikhsan

Next, I also would like to thanks to our special guests and speakers from:

1. Universitas Pendidikan Sultan Indris (UPSI), Malaysia
2. University of Mahidol, Thailand
3. University of Malaysia in Trengganu

Next, I would like to thanks and welcome to 379 speakers from the entire Indonesia and all participants registered in this seminar.

Ladies and gentlemen, recently the number of research and publication on mathematics and science and the education is vulnarable. It is nescessary for us to organise, to share, and to publish the results of the research in this conference. I hope the conference will bear fruitful results and promote networking and future collaborations for all participants from diverse background of expertise, intitutions, and countries to promote science, mathematics, and the education.

Finally, I am delighted to thank the committee members who have been working very hard to ensure the succes of the conference.

Please enjoy the conference and enjoy Yogyakarta, the city of education, tourism, and culture. Thank you very much.

Assalamu'alaikum wa rahmatullahi wa barrakatuh

Dr. Slamet Suyanto, M. Ed.

**Forewords from The Dean of Faculty of Mathematics and Natural Sciences,
Yogyakarta State University**

Assalamu'alaikum warahmatullahi wabarakatuh

May peace and God's blessings be upon us all.

On behalf of the Organizing Committee, first of all allow me to extend my warmest greeting and welcome to the International Conference on Research, Implementation, and Education of Mathematics and Sciences 2014, held in Yogyakarta State University, one of the qualified education universities in Indonesia.

To celebrate the 50th Commemoration of Yogyakarta State University, our faculty, in collaboration with Forum of MIPA LPTK, has the opportunity to conduct International Conference on Research, Implementation, and Education of Mathematics and Sciences 2014. This conference proudly presents five keynote speeches by five fabulous speakers: Prof. Dean Zollman, Prof. David F. Treagust, Prof. Dr. Amy Cutter-Mackenzie, Prof. Tran Vui, and Asst. Prof. Dr. Duangjai Nacapricha, around 380 parallel speakers with 344 orally presented articles.

Distinguished guest, ladies and gentlemen,

The independence of a country is impossible to gain if the education does not become the priority and it is not supported with the development of technology. We all know that the technology development could be achieved if it is supported by the improvement of firm fundamental knowledge. The empowerment of fundamental knowledge could not be separated from research which is related to the development of technology and the learning process in school and universities.

This conference is aimed to pull together researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Therefore, we are able to understand and examine the development of fundamental principle, knowledge, and technology. By perceiving the matters and condition in research and education field of mathematics and sciences, we could take a part in conducting qualified education to reach out the real independence of our nation.

Distinguished guest, ladies, and gentlemen

This conference will be far from success and we could not accomplish what we do without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members. I would also like to thank each of participants for

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attending our conference and bringing your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept my sincere apologies.

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

Wa'alaikumsalam warahmatullahi wabarakatuh

Dr. Hartono

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INDONESIAN QUALIFICATION FRAMEWORK (IQF) LEVEL 6 FOR BIOLOGICAL SCIENCE EDUCATION

Zuhdan Kun Prasetyo, Slamet Suyanto, Senam

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Abstract

Indonesian government released Presidential decree number 8 year 2012 on Indonesian Qualification Framework (IQF). The IQF will have impacts on several areas in educational system, including curriculum in higher education, standard of competences of workers, and wages system in Indonesia. The curriculum of higher education must adopt this IQF as a framework, in which the undergraduate students must achieve level 6 of the IQF, level 7 for professions like teachers, level 8 and 9 for graduate and postgraduate. The level 6 of the IQF consists of five generic competence, one of them is about character and the other four are related to the field of study. The IQF's generic competences must be describe more detail as learning outcomes (LO) to guide universities to redevelop their curriculum. The problem is, the decription of the IQF level 6 not available yet. This research aims to develop LO derived from the IQF level 6 for biology education, chemistry education, and physic education. The respondent consists of 87 science teachers, 54 lecturers, and 180 undergraduate students from five higher education institutions in Indonesia. The results of the research is the accepted LO.

Keywords: IQF, Level 6, biology, chemistry, and physics education

INTRODUCTION

Rationale

IQF (Indonesian qualification Framework) is a grading system of competences in such a way for bechmarking, leveling, and waging of workers in Indonesia. It is also integrating education and training and usefull to certify working competences of the workers. The IQF also has consequence on the workers appraisal or salary. The workers who will work in Indonesia must undergo such a measurement based on the IQF to know the level of competence of the workers. This will also affect the worker's salary relating to level of the competence in the IQF. In the long run, the IQF will also usefull for transfer of credit system of education.

Many countries has a qualification framework. Such qualification frameworks are AQF (Australia), Europass (Europeans), NQF (England), NCP (France), NLQF (Natherland), and WSQ (Singapore). Every qualification framework has different levels. However, by using IQF, the qualification levels can be compared from country to country. For example, the National Qualifications Authority of Ireland completed its amalgamation with HETAC, FETAC and the IUQB and a new integrated agency, Quality and Qualifications Ireland (QQI) in November 2012.

Currently many foreigners workers come to work in Indonesia, and this trend will likely increase in the future. In order to know their competences and to pay for their appropriate

salary, the IQF will be used to judge their competences. On the contrary, some Indonesians may go abroad to work in other countries. The IQF level of competence of them will be assigned to compare to the qualification of the destination countries to judge their competences and their salary (Perpres, 2012).

IQF also integrates educational and training system to the workplace interm of the standard of competences. People may get their competences from education or from training; and their is no guarantee that education is better than training and conversely. In the job market, thou, the IQF can be assigned to judge their competence and to rate the their wages (Perpres No 8, 2012). Tis happens because the IQF is developed based on the Government decree number 31 year 2006 on the National Job Training system, and government act number 23 year 2004 on the National Certification System and The law of worker system number 30 (Dirjen Dikti, 2010).

The European Qualification Framework (EQF) is one of the main references to develop the IQF. In the EQF there are eight levels qualification (Cedefop, 2010), whiles IQF has nine levels of qualification. Level 1 is the lowest level and level 9 is the highest level. Level 1-4 is considered as an operator level, level 5-6 is a technician/analitical level, 6-7 is a profession level, and 8-9 is an expertise level (Perpers Republik Indonesia Nomor 8 Tahun 2012).

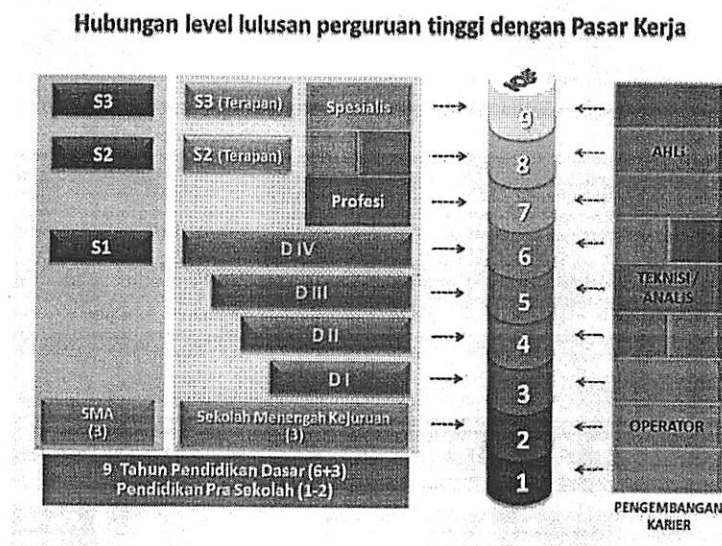


Figure 1. Level of qualification of the IQF and educational system (Endrotomo, 2012)

The qualifications, from level 1 to 9 can be achieved by both education and training. Therefore there are four pathways to get the nine qualifications: (1) formal education, (2) professional training, (3) careers in workplace, and (4) individual experiences (Dirjen Dikti, 2010) (Figure 1).

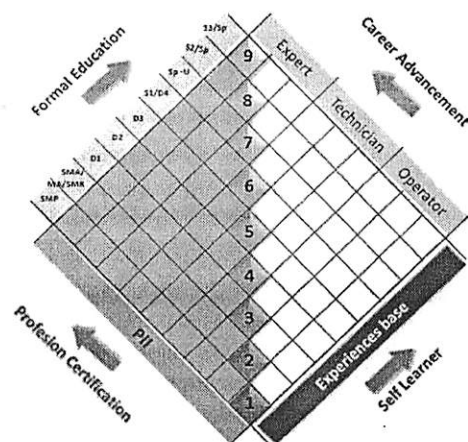


Figure 2. Nine levels of IQF and four pathways (Megawati Santoso, 2013)

Every levels of IQF consists of four major competency, those are (a) knowledge, (b) skills, (c) research, and (d) managerial (Dikti, 2010:18). The four competences are considered as generic competences. Beside the four competences, every worker must also possess a certain moral and ethics.

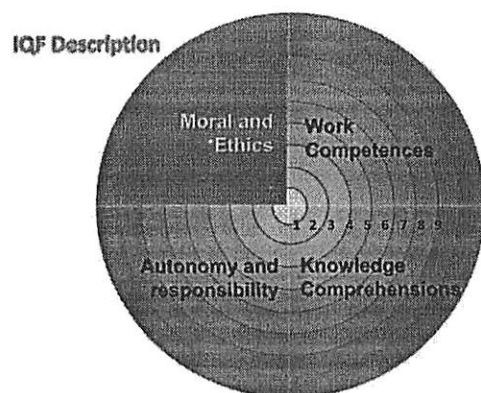


Figure 3. IQF description: (a) Moral and Ethics, (b) Work competences, (c) Knowledge comprehensions, and (d) Autonomy and responsibility (Megawati Santoso, 2013)

IQF formulate the moral, ethics and the other domain of competence into four generic descriptors. The first descriptor is about moral and ethics. It is similar for all levels (Figure 3).

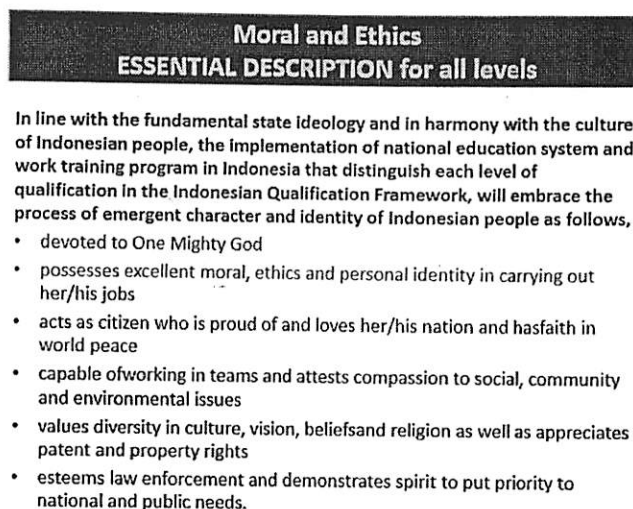


Figure 4. Generic descriptors of the IQF for Moral and Ethics (Megawati Santoso, 2013).

The descriptors for the other domain (work competences, knowledge comprehensions, and autonomy and responsibility) are variable for every level of the IQF. Every level has different descriptors of the competence. Here the example of descriptors for the IQF level 6 (Figure 4). This research aims to describe learning outcomes (LO) from the level six and to get agreement from the respondent concerning the LO.

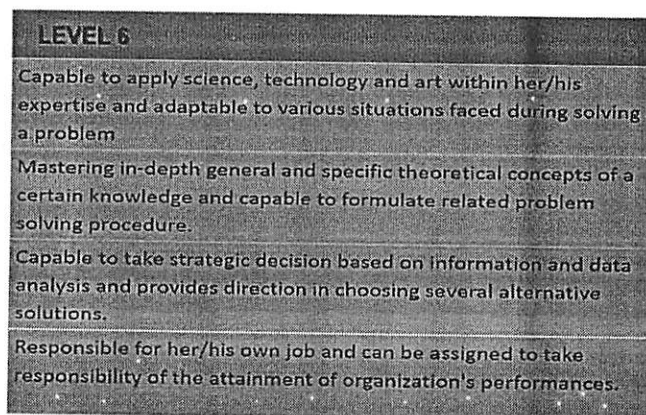


Figure 5. The descriptors of the IQF level 6 (Megawati Santoso, 2013)

Statement of the Problem

The problems to study of this research is what are the descriptors of learning outcomes (LO) for biology education based on the IQF level six agreed by the respondents? In this research the generic descriptors of level six of the IQF are describe more specifically related to biology education by lectures and graduate students of Yogyakarta State University. The descriptions are sent to respondents to get the agreement index. The level of agreement analysed by using the Kappa Cohen's inter-rater agreement index to know the accepted LO.

Objective

The research objective is to describe learning outcomes (LO) for biology education based on the IQF level six agreed by the respondents.

RESEARCH METHOD

The research is R & D (Research and Development) follows the Borg & Gall's model (1983), modified into four steps (1) primary study, (2) development, (3) field test and validation, and (4) dissemination. The first step is research and information collecting, including needs assessment of teacher competences, literature study, and studying on governmental regulations related to teaching competency. The second step is planning and developing of the preliminary product, in this case is learning outcomes. The formulation of LO then validate by using expert judgment. The LO then undergo field test. Respondent includes teacher (87 people), lecturers (54 people), and university students (180 people) from five Universitas Negeri Yogyakarta (UNY), Universitas Pendidikan Indonesia (UPI), Universitas Sriwijaya (UNSRI), Universitas Lambung Mangkurat (UNLAM), Universitas Patimura (UNPATI), dan Universitas Nusa Cendana (UNDANA). Data collection was mainly by using a questionnaire, followed by observation and an interview. The data were analyzed by using descriptive statistics of interclass correlation from Fernandez to know the agreement and reliability of the respondents to the item.

RESULT AND DISCUSSION

The data shows that they are 45 items of LO having a high percentage of agreement among respondents.

Table 1. The description of the IQF level six for biology teacher

IQF level 6	Specific Descriptor (LO)	r
1. Mastering in-depth general and specific theoretical concepts of a certain knowledge and capable to formulate related problem solving procedure.	1.1. Biology teacher candidates understand basic concepts of biology necessary to teaching in high schools, including:	
	a. understanding the structure of biological science,	0.872
	b. understanding the objects of biology,	0.872
	c. understanding the problems to study in biology,	0.872
	d. understanding the level of organization of living things,	0.872
	e. understanding basic concepts underlying biological phenomena,	0.872
	f. understanding inquiry approach to teaching biology.	
	1.2. Biology teacher candidates understand pedagogical theories of biology education, including:	0.872
	a. understanding the characteristics of the learners in physical, social, moral, emotional, intellectual development,	0.872
	b. understanding theories and principles of educative teaching and learning processess,	0.872
c. undertanding biology curriculum development in high school,	0.847	
d. understanding biology teaching materials for		

	<p>high school and the development,</p> <p>e. understanding variety of effective and empathic techniques of communication,</p> <p>f. understanding the development and use of media in teaching biology,</p> <p>g. understanding the variety of strategy, approaches, and models of biology instruction,</p> <p>h. understanding the variety of strategy and techniques of assessing biology learning achievement,</p>	<p>0.847</p> <p>0.847</p> <p>0.872</p> <p>0.872</p>
<p>2. Capable to take strategic decision based on information and data analysis and provides direction in choosing several alternative solutions.</p>	<p>2.1. Biology teacher candidates are able to solve problems to improve students' and school performance , including:</p> <p>a. are able to solve classroom problems and perform effective educative biology instruction by using variety of learning strategies and methods, and media,</p> <p>b. are able to solve problems related to the development of potencies, gifts, and talents of the learners,</p> <p>c. are able to solve problems related to effectively and emphatically communication to the learners,</p> <p>d. are able to assess student achievement in lerning biology,</p> <p>e. are able to solve problems related to students' achievement.</p> <p>2.2. Biology teacher candidates understand research and classroom action research to improve teaching and learning biology, including:</p> <p>a. Planning,</p> <p>b. Acting and observing,</p> <p>c. Reflecting.</p>	<p>0.872</p> <p>0.847</p> <p>0.847</p> <p>0.872</p> <p>0.847</p> <p>0.910</p> <p>0.910</p> <p>0.910</p>
<p>3. Responsible for her/his own job and can be assigned to take responsibility of the attainment of organization's performances.</p>	<p>3.1. Biology teacher candidates are responsible to manage, and control and organize teaching and learning, including:</p> <p>a. are able to organize students,</p> <p>b. are able to organize clasroom,</p> <p>c. are able to organize teaching materials,</p> <p>d. are able to organize learning activities.</p> <p>3.2. Biology teacher candidates are able to work together with collegeus and school community to make better performance of the school, including:</p>	<p>0.910</p> <p>0.910</p> <p>0.910</p> <p>0.910</p>

	a. Are able to work collaboratively with other teachers,	0.773
	b. Are able to work collaboratively with parents,	0.847
	c. Are able to work collaboratively with school community.	0.899
	3.3. Biology teacher candidates have a good ethics and attitudes, and good social competences, including:	
	a. performing behaviors suitable to the norm of religions, law, and socio-cultural,	0.857
	b. performing behaviors as a honest, good manner and leader person,	0.857
	c. performing behaviors as a mature, stable, wise, and prudent person,	0.872
	d. performing good workhabit, responsibility, and proudness to be a teacher,	0.872
	e. performing high obediency on the ethical code of teachers.	0.872
	f. are inclusive, objective, and udiscriminative to gender, races, physical condition, SES, and religion of students,	0.872
	g. are able to communicate effectively to collegeus, parents, and society,	0.847
	h. are able to adapt to work in all areas in Indonesia.	0.601
	3.4. Biology teacher candidates are able to continously perform professional development, including:	
	a. are able to do a research approach for instructional development	0.854
	b. are able to write an academic paper,	0.872
	c. are able to present orally scientific presentation,	0.847
	d. are able to do a lesson study to improve his/her professional competences.	0.847

Table 1 shows that almost all of the descriptors of the IQF level six have high agreement from the respondets. It means that all descriptors are agreed to be the learning outcomes of the graduate program of bacheleor of biology teacher program. The highest agreement is on the competence of understanding research and classroom action research to improve teaching and learning biology, and responsible to manage, and control and organize teaching and learning.

CONCLUSION AND SUGGESTION

Based on the results of the survey, there several competences of bachelor graduate of teacher education program based on the IQF level six are:

Biology teacher candidates are able to develop longterm program, inquiry-based lesson plan, and teaching materials,

Biology teacher candidates are able to teach biology in high schools,

Biology teacher candidates are able to use ICT in instructiobnal process,

Biology teacher candidates are able to apply laboratory procedures, equipment, and devices,

Biology teacher candidates are able to evaluate and to improve teaching and learning by using various techniques and strategies.

Biology teacher candidates understand basic concepts of biology necessary to teaching in high schools,

Biology teacher candidates understand pedagogical theories of biology education,

Biology teacher candidates are able to solve problems to improve students' and school performance

Biology teacher candidates understand research and classroom action research to improve teaching and learning biology,

Biology teacher candidates are responsible to manage, control, and develop the classroom and lesson,

Biology teacher candidates are able to work together with collegeus and school community to make better performance of the school,

Biology teacher candidates have a good ethics and attitudes, and good social competences,

Biology teacher candidates are able to continously perform professional development.

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