MINISTRY OF EDUCATION AND TRAINING
HANOI NATIONAL UNIVERSITY OF EDUCATION

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# DEVELOPING SCIENTIFIC LITERACY ASSESSMENT SKILLS FOR HIGH SCHOOL STUDENTS TOWARDS PISA PERSPECTIVES

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# INTRODUCTION

## 1. RATIONALES

1.1.Key solutions in order to make a basic marked improvement in education quality are mentioned in the "Strategy for development of education in Vietnam 2001 -2010" approved by the Government on 28th December, 2001 and 8th Central resolution term XI that: " basic innovation in forms and methods of testing and evaluating the results of education and training, ensuring truthfulness and objectivity".

1.2. PISA- a Program for International Student Assessment is at global-scale, organized every three years, to assess the knowledge and skills in three areas: reading comprehension, numeracy literacy and science at high school level. This exam will test the literacy to meet the needed knowledge and skills for later life according to international standards. Since 2012 Vietnam has participated in the PISA program in order that by 2020, Vietnam will have promptly formulated appropriate education strategies that meet international standards.

1.3. Educational practice shows that the assessment of learning outcomes of Ss (Ss) still focuses on evaluating the results of separate subjects without knowledge literacy assessment and applying knowledge in solving practical problems. Perception of teachers in Biology of scientific capacity assessment of students is limited, so entail limitations in assessing the scientific capacity of the students. At the same time, problems in students of Biology Teachers were too vague.

For above reasons, we find the urgency of providing guidance to students (Ss) with necessary knowledge and skills on literacy assessment towards PISA perspectives with the aim to help them in the process of future teaching. So I studied the topic **“Developing scientific literacy assessment skills for high school Ss towards PISA perspectives"**

## 2. STUDY PURPOSES

Identifying scientific literacy assessment (SLA) skills towards PISA perspectives and building - using procedures to establish for Ss SLA skills of teaching Biology

## 3. SCIENTIFIC ASSUMPTIONS

If SLA skills towards PISA perspectives in teaching biology at high schools are identified and we can build and use the process to help Ss develop appropriate literacy assessment skills.

## 4. STUDY OBJECTTIVES AND STUDY SUBJECTS

* Subjects: scientific literacy; SLA skills, the process/solution to help Ss develop appropriate literacy assessment skills towards PISA perspectives

* Objectives: The process of training Ss in the teacher training institutions

**5. RESEARCH TASKS**

5.1. Overviews on studies on assessment skills; training skills on literacy assessment for pedagogy Ss; PISA assessment

5.2. Theories of literacy; scientific literacy; evaluation on scientific literacy; literacy assessment skills and assessment perspectives of PISA.

5.3. Practical research on matters related to the topic:

+ Learn awareness situation and literacy assessment skills of high school teachers(Ts)

+ Learn awareness situation and SLA skills of Biology pedagogy Ss

+ Identify integration possibility of SLA towards PISA perspectives into Biology teaching method modules

5.4. Describe the SLA skills towards PISA perspectives of Ss with expression of the skills

5.5. Propose a process to develop questions SLA towards PISA perspectives into Biology teaching and literacy assessment processes in teaching towards PISA perspectives

5.6. Recommended process for developing Ss' literacy assessment skills towards PISA perspectives in teaching Biology

5.7. Develop criteria for evaluating the level of achievement of formed skills

5.8. Building the exercise system for Ss on SLA towards PISA perspectives in teaching Biology

5.9. Pedagogical experimentation to test the effectiveness of the process for forming Ss' skills on SLA towards PISA perspectives

**6. SCOPE OF THE STUDY**

The process training of SLA for Ss can be formed in many different modules. However, in this thesis we focused on developing the skills in the subject of teaching biology method (Theory and methods of teaching general biology; Teaching Biology 10; Teaching Biology 11; Teaching Biology 12; Check, evaluation of teaching biology ...).

**7. RESEARCH METHODOLOGY**

The methodologies used: theoretical studies; Survey methods; Professional solution; Pedagogical experimental methods; Processing data using Excel software.

## 8. THE CONTRIBUTIONS OF THE DISSERTATION

- Determine the structure of the needed SLA for high school student in teaching Biology and criteria for evaluating SLA
- Identify the structure of SLA skills required for pedagogy Ss of Biology and evaluation criteria system of student skills
- Recommended procedures to building questions literacy assessment of student science perspective in teaching Biology PISA
- Recommended procedures to establish for Ss skills literacy assessment of student science perspective in teaching Biology PISA
- Building the exercise system for Ss on SLA towards PISA perspectives in teaching Biology

## 9. STRUCTURE OF THE DISSERTATION

Besides the introduction, conclusion, recommendations, references, appendices, the study is divided into three chapters:

Chapter 1: Rationales and practice of the study

Chapter 2: Develop Ss' SLA towards PISA perspectives in teaching Biology

Chapter 3: Pedagogy experiment

# RESEARCH RESULTS

# CHAPTER 1. RATIONALES AND PRACTICE OF THE STUDY

## 1.1. LITERATURE REVIEWS ON LITERACY ASSESSMENT AND PISA ASSESSMENT

### 1.1.1. Research on literacy assessment skills

#### *1.1.1.1. International studies*

Literacy assessment skills are a very important factor in the pedagogical skills of Ts. The studies on literacy assessment skills of pedagogy Ss focus on the direction such as:

- Direction 1: Look at the obstacles in the application of literacy assessment
- Direction 2: Look at the training of literacy assessment skills for pedagogy Ss
- Direction 3: Research the training modern literacy assessment skills for high school Ts
- Direction 4: Study the relationship of assessment-evaluation skills and the pedagogy skills of Ss

From the 1980s there was "a revolution" on assessment. Instead focusing on knowledge assessment, it focused on the actual literacy. Therefore, there were forms of assessment such as formative assessment, actual assessment and creative assessment. To develop the use of the methods, techniques, tools for Ss' literacy assessment, there was a need to identify the barriers to these processes. Through research we found that there are two main barriers such as the literacy of Ts and national policies. Thus, in addition to training pedagogy Ss on assessment and evaluation, there is also a need to create flexibility, initiative for Ts in the process of evaluating Ss in high schools.

***1.1.1.2. Studies in Vietnam***

After 1945, the educational evaluation based on educational goals and made certain changes to the objectives in terms of education such as moral, culture, employment, protection and physical exercise. The highlights are the studies of the authors: Dang Ba Lam, Phan Thanh Long, Nguyen Cong Khanh, Tran Thi Bich Lieu, TranThi Tuyet Oanh, Nguyen Thi Lan Phuong, Do Thi Thuy Hang, Nguyen Thi Hong Van, Phan Thi Hong Xuan Tho Chu Cam, Nguyen Van Bien, Trinh Thi Lan ....

About assessment in teaching Biology there are studies of the authors Tran Ba Hoanh, Nguyen Duc Thanh, Le Dinh Trung, Phan Thi Thanh Hoi, Khanh Ngoc Tran. However, there are no studies regarding training the SLA skills in teaching Biology.

**1.1.2. Research on the PISA assessment**

***1.1.2.1. International studies***

The content of the PISA assessment is based entirely on the knowledge and skills necessary for future life. The common literacy sector was assessed in PISA: The literacy of numeracy; reading comprehension; scientific literacy; Problem-solving skills. Each term, the focus was on a specific literacy (in the focused literacy focus 2/3 of questions will be about that). In 2012 the content focus was on math capabilities, in 2015 it was scientific literacy. Test cycle: the survey was every three years: the first time in 2000, with 43 participating countries; The second time in 2003, with 41 participating countries; The third time in 2006 with 57 participating countries; The fourth in 2009, with 67 participating countries

***1.1.2.2. Studies in Vietnam***

In 2010 Educational Science Institute of Vietnam decided to establish the Office of Vietnam PISA. PISA Vietnam office conducted the necessary procedures to plan the deployment, testing survey in May 2011 and had a lot of workshops, studies on PISA. These studies have pointed out the basic content of the PISA assessment, built a question system towards PISA perspectives. At the same time, there are researchers

analyzed the results of PISA exam in Vietnam as well as in other countries around the world to experience indicates, causes and solutions in education.

## 1.2. LITERATURE REVIEWS

### 1.2.1. Scientific literacy

#### *1.2.1.1. Literacy*

Literacy is a broad term and very complicated, in this research, to serve for the assessment of Ss' learning outcomes, we approached literacy under the following signs:

- Nature: literacy is the psychological attributes of individuals

- Structure: literacy includes components: knowledge (intellectual literacy and knowledge), skills, attitude (emotions, willpower, motivation...) expressed in a specific context.

- On the results: literacy can help individuals make good actions and cope flexibly and efficiently in new, unfamiliar conditions.

- On the formation and development: literacy is formed by a genetic origin and practice

#### *1.2.1.2. Scientific literacy*

PISA uses the term scientific literacy instead of the term science to emphasize the importance of science in the PISA assessment in applying scientific knowledge to specific contexts. Scientific literacy according to PISA is expressed through the fact that Ss have scientific knowledge and use the knowledge to recognize the scientific issues, explain scientific phenomena and draw conclusions on the basis of evidence on related science issues; Understanding the characteristics of science as a form of human knowledge and a activity is to explore and discover; Recognizing the role of science; willing to participate as active citizens, to apply scientific knowledge to solve related problems.

#### *1.2.1.3. Structure of scientific literacy towards PISA perspectives in teaching Biology*

Scientific literacy is described with four interrelated factors:

➢ Background: The scientific assessment concerning individual, family, friends (individual); community (local, national) and life around the world (global).

➢ Attitude: attitudes used in PISA are: Interested in science and technology; Ready to meet the requirements of science; Responsibility for sustainable development

➢ Knowledge: Scientific knowledge consists of the following elements: content knowledge, procedural knowledge, epistemic knowledge

➢ Literacy: Scientific knowledge includes 3 components: Explaining phenomena scientifically; Evaluation and planning of scientific research; Interpretation of data and scientific evidence. The relationship among the three components of scientific knowledge according to PISA are shown in Table 1.1:

*Table 1.1. Structure of component literacy towards PISA perspectives*

| | | **Literacy** | | |
|---|---|---|---|---|
| | | Explain phenomena Scientifically (1) | Evaluate and design scientific enquiry (2) | Interpret data and evidence scientifically (3) |
| **Knowledge** | Scientific content knowledge (A) | A1 | A2 | A3 |
| | Scientific procedural knowledge (B) | B1 | B2 | B3 |
| | Epistemic knowledge (C) | C1 | C2 | C3 |

In details:

A1: Recall and apply appropriate scientific knowledge

A2: + Identify the question explored in a given scientific study;

+ Distinguish questions that are possible to investigate scientifically;

+ Propose a way of exploring a given question scientifically;

A3: + Transform data

+ Analyze and interpret data and draw appropriate conclusions;

B1: Identify, use and generate explanatory models and representations;

B2: Evaluate ways of exploring a given question scientifically

B3: Identify the assumptions, evidence and reasoning in science-related texts;

C1: + Offer explanatory hypotheses

+ Explain the potential implications of scientific knowledge for society.

C2: Describe and evaluate a range of ways that scientists use to ensure the reliability

of data and the objectivity and generalizability of explanations.

C3: + Distinguish between arguments which are based on scientific evidence and theory and those based on other considerations;

+ Evaluate scientific arguments and evidence from different sources (e.g. newspaper, internet, journals).

### 1.2.2. Scientific literacy assessment

#### *1.2.2.1. Literacy assessment*

According Leenpil (2011), literacy assessment is to assess the knowledge, skills and attitudes of Ss in a meaningful context. In the literacy assessment of the high

school Ss, literacy assessment tool is usually a system of tasks from easy to difficult, from simple to complex areas to ensure the measurement of literacy development of any subjects. The task for the learners needs to be tied to the practical context.

In essence, there is no contradiction between literacy assessment, knowledge and skill assessment. Literacy assessment is considered development higher than knowledge and skill assessment. Knowledge and skill assessment is usually in a specific subject which is anonymous and specific. Meanwhile, literacy assessments can synthesis knowledge and skills in many disciplines, through which we can have the general evaluation of the personality structure of the Ss.

***1.2.2.2. Scientific literacy assessment towards PISA perspectives***

PISA assessment is different from other current assessments in the following points:

- PISA assessment is concerned with the development of learners thus creating incentives for Ss, help them be more responsible for their learning, allowing Ts to identify and stimulate the creativity of Ss.

- PISA Assessment will assess the level of mastery of scientific knowledge of Ss at level of integration, while knowledge and skill assessment only assess literacy of scientific knowledge at the level of individual student.

- PISA Assessment is capable of assessing levels of applying scientific knowledge into practice of Ss.

❖ Criteria for scientific competency in Biology

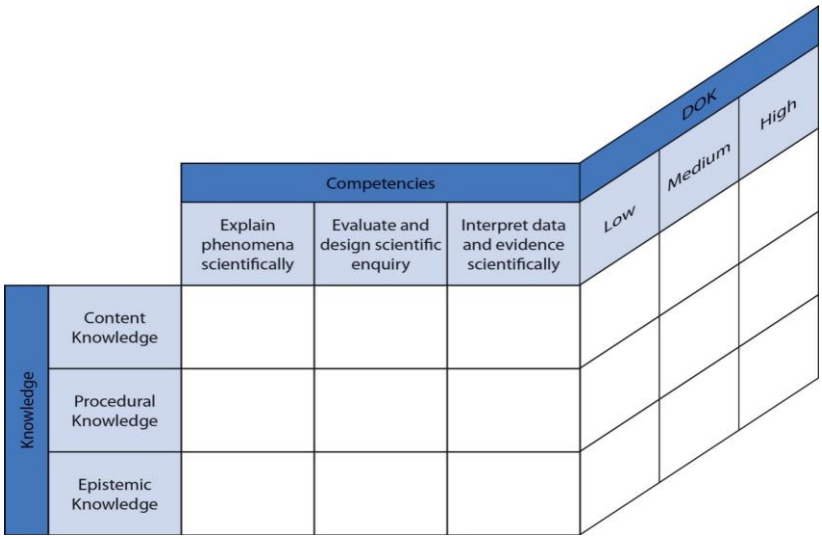


*Figure 1.2. . PISA 2015 Framework for Cognitive Demand*

❖ *Scientific scale of PISA*: To develop the goals of PISA, and based on the theory of capacity development, PISA 2015 proposed a more detailed description about scientific literacy with 7 levels.

❖ *PISA Questions*

* The types of PISA questions

The questions in the PISA tests are in 2 types: multiple choice questions and written questions. PISA structured questions (Units) consist of two parts: Part one: contents of the situations including title and references; Part two: The items

* Analysis of the questions of the PISA SLA

The questions of the PISA SLA are at different degrees according to the scale of scientific literacy. The contexts of PISA are real. In addition, to determine the level of awareness of Ss, PISA also gives the questions in order to determine if the level of awareness is low, medium and high.

**1.2.3. SLA skills towards PISA perspectives**

Our thesis focuses on the following four groups of skills:

➢ Skills for preparation of the assessment activities:

*Table 1.3. Structure of the skills for preparation of the assessment activities*

| **Component skills** | **Behaviors** |
|---|---|
| Assessment planning skills | - Identify the objective of the evaluation<br>- Design evaluation procedures (the content, objects, the information to be collected and processed, time, number and condition assessment)<br>- Identify opportunities for Ss' learning |
| Skill determines the behavior index to be evaluated | - Write behavior index (through the process of the implementation of skills)<br>- Identify the most important behavior index |
| Skills in building evaluation criteria rubric for scientific literacy | - Select and use available scales or integrate multiple scales, or design new scale consistent with the evaluation objective<br>- Design evaluation criteria table |

➢ Skills in building tests:

*Table 1.4. Structure of skills in building tests*

| **Component skills** | **Behaviors** |
|---|---|
| Develop | - Draw matrix details (form of exam, test form and needed awareness |

| | |
|---|---|
| test matrix | levels)<br>- Determination of the proportion corresponding to the content and level of Ss' awareness |
| Build SLA questions according PISA perspectives | - Determination of content, target of SLA in Biology suitable to assessed objects<br>- Compiling leading information segments and the focus of assessment<br>- Based on the target verb to determine the extent necessary to achieve<br>- Question assessment levels should be achieved and code answers<br>- Check the value of targeted questions to edit |
| Testing and finalizing the test | -Prospect the difficulty of the questions in the test<br>- Evaluate the quality of test and improve |

➢ Analytical, processing and interpretation skills of data:

*Table 1.5. Structure of analytical, processing and interpretation skills of data*

| **Component skills** | **Behaviors** |
|---|---|
| Using the method of processing information | - Use qualitative information criteria table<br>- Using mathematical formulas or quantitative processing software to evaluate the quantitative information |
| Interpretation of obtained data | - From the obtained data, give the assessment results of the Ss<br>- Identify the impacts and causes of results<br>- Interpretation of the Ss' level of development |

➢ Skills of feedback on the results:

*Table 1.6. Structure of the skills of feedback on the results*

| **Component skills** | **Behaviors** |
|---|---|
| Transfer assessment results information to related objects | - Identify the purpose and time of reporting<br>- Interpretation of report content<br>- Presentation of report language |
| Use the evaluation results to adjust the teaching process | - Planning of pedagogical intervention of the teacher<br>- Guiding Ss how to plan to improve their achievement<br>- Make recommendations for parents |

### 1.2.4. General process of skill formation

Skill formation processes include the following stages:

- Stage 1: Forming skills

- Stage 2: Consolidate and enhance skills: Process of skill formation is an important basis for the formulation of skill formation for Ss in the study.

**1.3. PRACTICAL BASIS**

**1.3.1. Awareness situation about evaluation- assessment science of teacher in high school Ts**

**1.3.2. Awareness about evaluation- assessment of Ss of pedagogical schools**

**1.3.3. Situation about training of SLA skills in training program of Biology teacher**

## CHAPTER 2. DEVELOP SS' SLA TOWARDS PISA PERSPECTIVES IN TEACHING BIOLOGY

**2.1. The formation process of SLA skills towards PISA perspectives in teaching biology**

**2.1.1. Principles to build process**

* Principle suitable to specialized content of Biology

* Principle suitable to trained objects

* Principles in accordance with the laws of psychology and pedagogy

**2.1.2. The process for forming Ss' skills towards PISA perspectives**

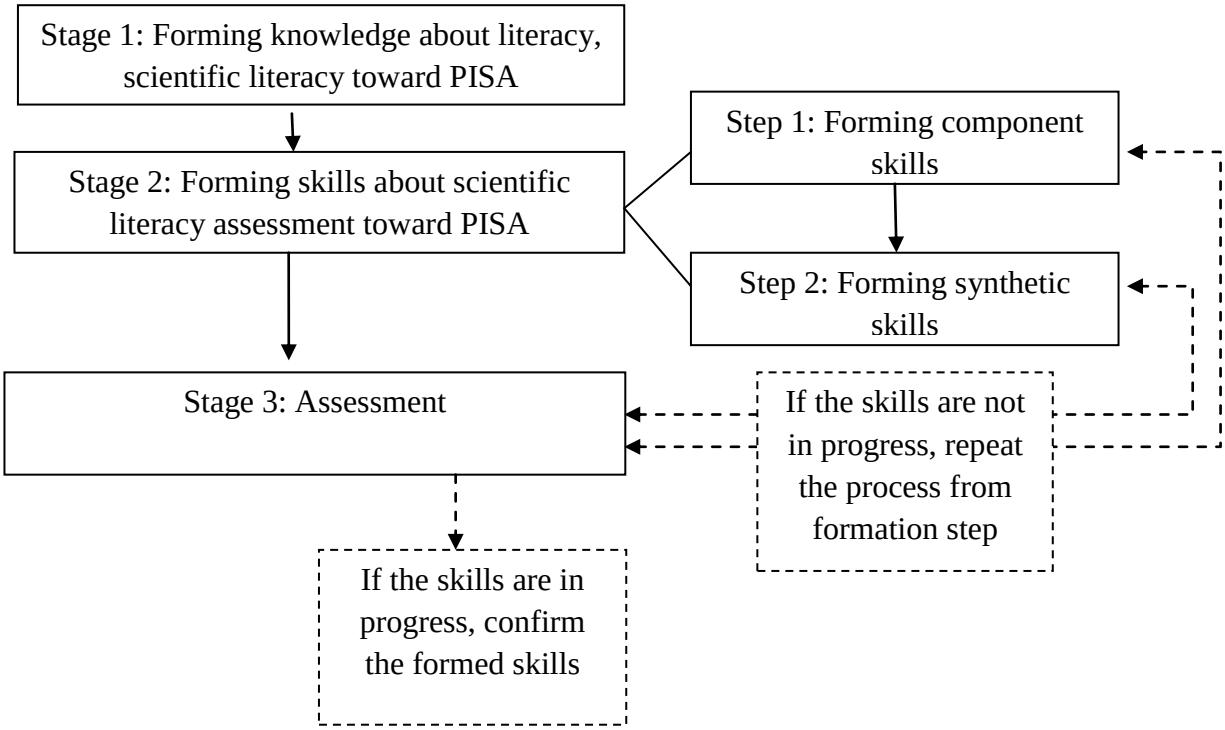


*Figure 2.1. Process of training for Ss skills in SLA skills towards PISA perspectives in teaching biology*

**** Stage 1: Forming knowledge about literacy scientific towards PISA perspectives.***

*Step 1: Acquire knowledge about literacy, and scientific literacy towards PISA perspectives and SLA towards PISA perspectives This knowledge includes:* The concept of literacy, scientific literacy, structure of scientific literacy according to PISA; concept of literacy assessment, SLA, SLA towards PISA perspectives; questions building process towards PISA perspectives; Process of SLA skills towards PISA perspectives in teaching biology

- *Step 2: Take the illustrated examples about SLA skills towards PISA perspectives:* This step may both be performed alternately with the activities of step 1 and can be done after the end of step 1.

**** Stage 2: Forming skills about SLA towards PISA***

- *Step 1: Forming component skills:* SLA skills towards PISA perspectives include 10 component skills. To perform this step, Ts conduct the following activities:

+ Ts introduce SLA skills towards PISA perspectives

+ Ts give training assignments on component skills for Ss

+ Ss do the assignments thereby forming the component skills

+ Ts give comments and correct trained skills

+ Ts organize for Ss to do the same exercises to reinforce skills

- *Step 2: Forming synthetic skills:* conduct similar to step 1. However, in this step Ts provide exercises requiring Ss to form synthesis skills in step 1.

* ***Stage 3: Assessment***

After forming SLA skills towards PISA perspectives for Ss , Ts examine Ss' skills through the system of assignments. Stage 3 was conducted together with activities in stage 2 to increase the efficiency of the process of forming SLA skills towards PISA perspectives.

### *2.1.3. Processes of SLA towards PISA*

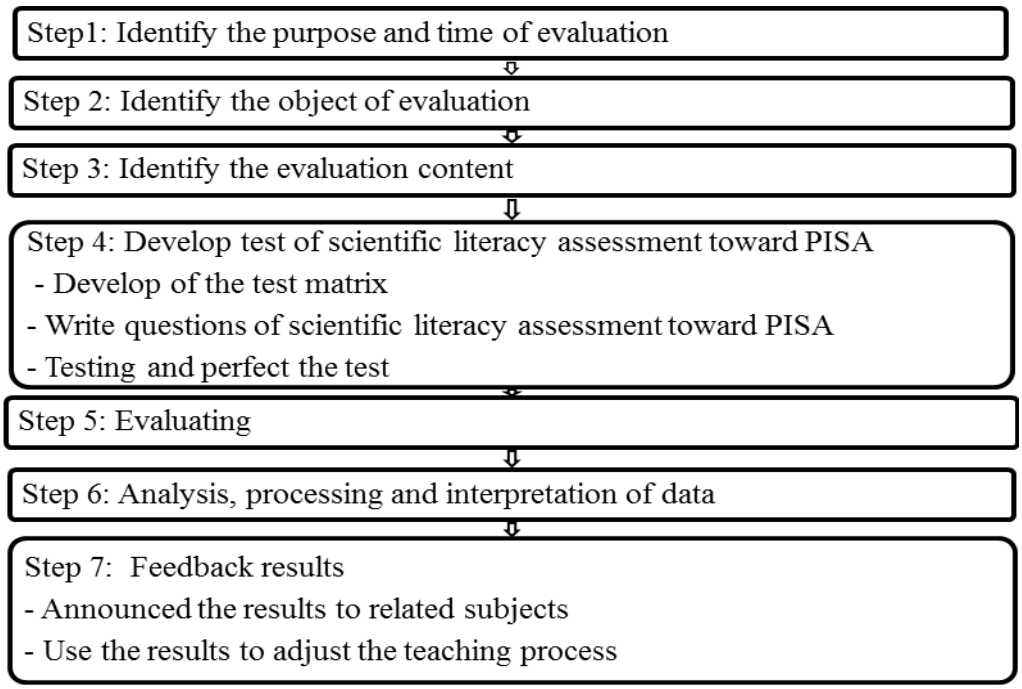


*Figure 2.2. Processes of SLA towards PISA*

* *Step 1: Identify the purpose and time of evaluation*: The purpose of the assessment to develop or evaluate to explain and thereby determining what is the goal of literacy assessment and to what extent. Also according to the purpose of evaluation, Ts will provide appropriate evaluation time.

* *Step 2: Identify the object of evaluation*: Learn scientific literacy in Biology program to determine the achieved level of Ss in scientific literacy.

* *Step 3: Identify the evaluation content*: identifying Biology content corresponding to components of scientific literacy to be evaluated and determining the level of scientific literacy to be evaluated.

* *Step 4: Develop test of SLA towards PISA*: go through the steps: Develop a matrix of test subject; Write questions of SLA towards PISA; Test and perfect test subject

* *Step 5: Evaluating:* Ts organize for Ss to do exams, collect tests or let Ss evaluate themselves or do peer feedback under the guidance of Ts

* *Step 6: Analysis, processing and interpretation of data*: Ts analyze process and interpret results from the collected information based on the reference criteria have been developed for scientific literacy in Biology. The attainment of the criteria can be converted into the corresponding scores. Through the collection and processing of data, Ts can assess Ss' scientific literacy.

* *Step 7: Feedback Results*: Report results to the related subjects: Report on the results need to make the score, give comments on sides of scientific literacy.

### 2.1.4. Process of building questions on SLA skills towards PISA perspectives

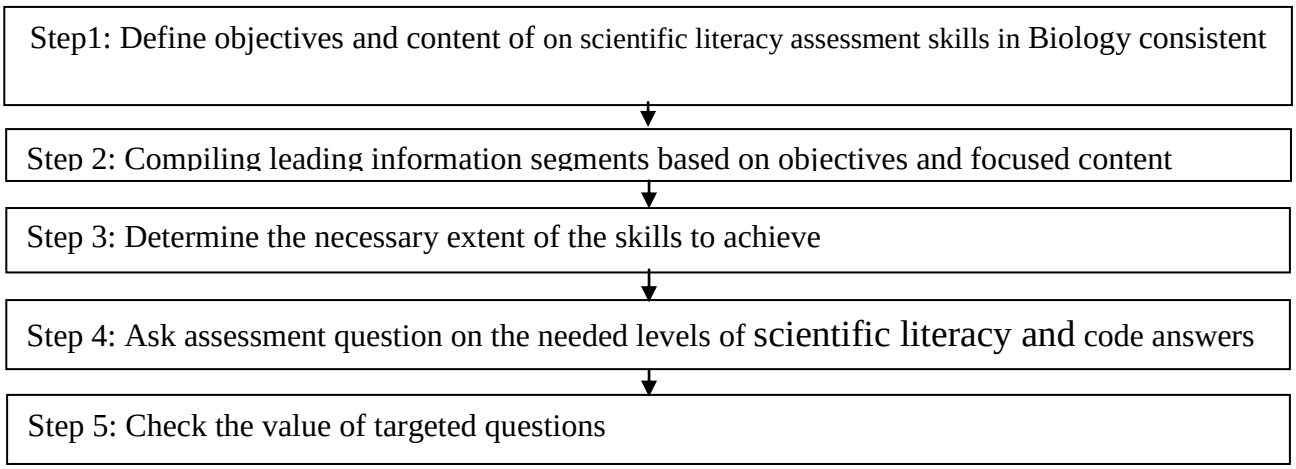


*Figure 2.3. Process to develop evaluation questions according to PISA*

* *Step 1: Define objectives and content of on SLA skills in Biology consistent*: Base on the Biology program of the Ss to find the focused content of the questions. Then determine the objectives to be evaluated in 9 expressions of scientific literacy in the structure of scientific literacy.

* *Step 2: Compiling leading information segments based on objectives and focused content:* When determining the content, the main objective should be assessed, Ts list the “required material", then bring the "material" into the context of the leading information. Ts need to search for the information in the textbook, Biology magazine, internet ... to make it appropriate leading information.

* *Step 3: Determine the necessary extent of the skills to achieve:* From the set assessment targets at the beginning and the leading information, Ts need to find out the verb determining the necessary extent to achieve of literacy and rewrite in details each target corresponding to the Biology content. It aims to create a framework for questions.

* *Step 4: Ask assessment question on the needed levels of scientific literacy and code answers*: Based on the verbs and the expression levels of scientific literacy. Question 1: Usually, they are the questions for the central objective assessment. It is also the objective to determine the content of the piece of leading information. The next questions: expand to other objectives that Ts have identified in step 1. The label indicates the answered extent including: pass level or the maximum level, the incomplete level and fail level.

* *Step 5: Check the value of targeted questions*

## 2.2. Formation of SLA towards PISA perspectives in curriculum of training Biology Ts

To have SLA towards PISA, Ss must first have scientific literacy. Ss should learn essential basic science disciplines. Nest, Ss must have the capacity for SLA

(pedagogical literacy). In training programs, pedagogical literacy is formed mainly through the discipline modules of Teaching Biology. Thus, to form SLA towards PISA perspectives in teaching Biology, we offer two solutions:

First: Integration the skill formation of SLA in teaching modules of Biology: The modules will help Ss with specialized knowledge of Biology and knowledge of the research process. However, within the scope of the study this solution has not been conducted.

Second: formation of skill of SLA in teaching methodology modules of Biology. In the study, we implemented this solution. However, in most of the universities training Biology Ts, there are elective courses named "Examination and evaluation of teaching biology" or "Assessment in Education". Thus, during the experiment, we built a theme to integrate into these modules.

*Table 2.2. Specialized content frame "formation of skills of SLA towards PISA perspectives in teaching Biology"*

| **Content** | | **Time** |
|---|---|---|
| Theory (5 periods) | - Overview of PISA assessment<br>- scientific literacy and SLA towards PISA perspectives<br>- The process of developing questions about SLA towards PISA perspectives<br>- The process of SLA towards PISA perspectives in teaching Biology | } 3 periods<br>1 period<br>1 period |
| Practice (5 times) | - Practical skills in preparation for the evaluation activities<br>- Practice on developing and choosing evaluation tools<br>- Practice on skills of using assessment supporting software<br>- Practical skills in data interpretation in assessment and feedback results<br>- Practical skills in SLA towards PISA perspectives in teaching Biology | 5 times (1.5 hours/each time on a specific issue) |

**2.3. Criteria for evaluating the attainment of skills**

We build a criteria table 2.2 which will be the basis for us to build evaluation criteria table for attainment level of scientific literacy

*Table 2.2. Scale level of development in the scoring guidance*

| **Scale (10 score scale)** | | **Indicators** |
|---|---|---|
| 1 | Poor | Do not know to perform manipulation or incorrectly |

| | | |
|---|---|---|
| | (0 - 2,5 mark) | implement actions |
| 2 | Significant below average (2,6 – 5 mark) | Perform the operation under the guidance of Ts, but also the lack or excess multiple tasks or confused among operation |
| 3 | Significant above average (5,1 – 7,5 mark) | Perform tasks competently, with more precise guidance but also make a few small errors. |
| 4 | Very good (7,6 - 10 mark) | Coordinate harmoniously the operation with unity of the different conditions and circumstances |

**2.3.1. Evaluation criteria of evaluation planning skills**

| **Behavioral indicators** | **Scale** | **indicators** |
|---|---|---|
| Show the objectives of the assessment (2 points) | 1 | Not know how to determine the assessment objectives or identify inaccurately |
| | 2 | Known the objectives of the assessment but there are some of the inaccuracies |
| | 3 | Identifying and presenting the evaluation objectives, but sometimes they are misidentified or presented unclearly |
| | 4 | Identifying and presenting the objectives adequately without confusion |
| Design assessment procedures (5 points) | 1 | Not fully aware of the assessment procedures or know with incompletion |
| | 2 | Has known the necessary procedures in the competency assessment include time, content, objects, and methods of assessment, the information to be collected and processed. But the arrangement of work is not in order or assessment procedures are not consistent with each other or the wrong procedure but consistent content |
| | 3 | Know the design of the evaluation procedures in accordance with the evaluation process; these procedures are consistent with each other. But sometimes there are small or incomplete mistakes |

| | | |
|---|---|---|
| | 4 | Design the procedure in the evaluation process carefully with clarity and consistency of the content |
| Identify learning opportunities for Ss (3 points) | 1 | Not know how to organize learning activities of Ss corresponds to evaluation objectives |
| | 2 | Knowing the needed activities to organize for the Ss, but they are not arranged in the order |
| | 3 | Determine the required learning activities for Ss under the suggestion of Ts |
| | 4 | Determine the required learning activities organized for Ss without Ts'help |

**2.3.2. Evaluation criteria skills identify behavioral indicators of SLA**

**2.3.3. Evaluation criteria of skills of developing evaluation criteria rubric for scientific literacy**

**2.3.4. Evaluation criteria of matrix building skills for test subjects**

**2.3.5. Evaluation criteria of question development according to PISA**

**2.3.6. Criteria for evaluating the skills of testing and perfecting test subjects**

**2.3.7. Criteria for evaluating the skills to use the information processing method**

**2.3.8. Criteria for evaluating the skills to interpret the collected data**

**2.3.9. Criteria for evaluating information transmission skills of assessment results to the related subjects**

**2.3.10. Criteria evaluation of the skill of using evaluation results to adjust the teaching process**

**2.4. Develop exercises of SLA formation in teaching Biology towards PISA perspectives**

***2.4.1. Exercises of evaluation plan formation skills***

*2.4.1.1. Requires skills*

Planning for evaluation is important work before the assessment. This skill requires Ss to identify evaluation goals. Derived from evaluation purposes, determining the content, evaluation objects, the information should be collected and processed, thereby, determining when, how long, how and in what order to evaluate. Which conditions to evaluate? At the same time Ss can make plans to organize learning activities to collect information. Such requirements for Ss include:

- Point out the objectives of the assessment

- Defining the time, duration, content, objects, methods of assessment, the information to be collected and processed, and conditions to evaluate.

- Identify scientific learning opportunities need to be evaluated

*2.4.1.2. Example of exercises*

* Exercise: Prepare the end of the academic year 1 semester , teachers in academic subjects must be examined - assessment of student learning outcomes . I make a plan for the semester exams of class 11A1 including HS DGNLKH standpoint of PISA .

* Exercise: Before the end of the 1 semester of the academic year, must examine - assess Ss' learning outcomes. You make plan for semester exams of class 11A1 including evaluate scientific literacy towards PISA perspectives.

**2.4.2. Exercise to build skills of identifying behavioral indicators of scientific literacy**

**2.4.3. Exercise to build skills of building evaluation criteria rubric of scientific literacy**

**2.4.4. Exercise to build skills of building matrix for tests**

**2.4.5. Exercise to build skills of developing questions towards PISA perspectives**

**2.4.6. Exercise to build skills of testing and perfecting test subjects**

**2.4.7. Exercise to build skills of using the information processing method**

**2.4.8. Exercise to build skills of explaining the collected data**

**2.4.9. Exercise to build skills of transmitting evaluated results to related subjects**

**4.2.10. Exercise to build skills of adjusting the teaching process**

**2.4.11. Exercise to build skills of forming synthetic exercises in teaching towards PISA perspectives**

## CHAPTER 3. PEDAGOGY EXPERIMENT

### 3.1. Experimental purposes

In order to test the feasibility and effectiveness of the scientific hypothesis that the subject was raised: If the skills of SLA towards PISA perspectives in teaching high school Biology are identified and used, they will help Ss develop the skills of literacy assessment.

### 3.2. Experimental content

- Before experiment: Learn the skills of the Ss through the test No. 1 (Appendix 5).

- In the experimental stage: We evaluated the effectiveness of the established procedures of SLA towards PISA perspectives in teaching Biology in high schools through exercises Ts give to Ss (Appendix 4 )

- The period after experiment: We evaluated the effectiveness of the process to form SLA towards PISA perspectives in teaching Biology in high school for Ss through exercises to assess changes in the level gain of the component skills (appendix 4) and synthesis skills before experimental through test No. 2 (appendix 5).

### 3.3. Experimental Methods

#### 3.3.1. Experimental objects

- Places: Hanoi Pedagogical University 2, Vinh University, Da Nang University of Education.

- Choose Ss: 3rd year and 4th year Ss of Biology

#### 3.3.2. Experimental procedure

*Table 3.1. Test time, testing instruments and testing methods*

| Test time | | Evaluated content | Testing instruments | Value of the instruments | Testing methods |
|---|---|---|---|---|---|
| Before experiment (1st time) | | - component skills<br>- synthetic skills | Test 1 | - Professional method<br>- Testing and adjusting instruments | Written test |
| During experiment | After finishing the theory (2nd time) | - component skills corresponding to each exercise | Exercises forming corresponding concepts | - Professional method<br>- Testing and adjusting instruments | Written test |
| | After finishing the exercises (3th time) | - component skills corresponding to each exercise | Exercises forming corresponding concepts | - Professional method<br>- Testing and adjusting instruments | Written test |
| After experiment – at the end of the program (4th time) | | - component skills<br>- synthetic skills | - test 2 | - Professional method<br>- Testing and adjusting | Written test |

| | | | | |
|---|---|---|---|---|
| | | | instruments | |

### 3.3.3. Experimental evaluation results

For 10 component skills of SLA skills we calculated the average of the corresponding behavior (with weighted). For synthetic skills we build the following rubric:

*Table 3.2. Evaluation rubric in SLA towards PISA perspectives in teaching Biology*

| ***Skills*** | ***Content for evaluation*** | ***Point*** |
|---|---|---|
| Plan for evaluation | - Determine the assessment objectives clearly, precisely<br>- Design procedures in the assessment process clearly and consistently with content.<br>- Identify the learning opportunities of Ss after assessment | 0,5 |
| Determination of behavior indicator of SLA | - Identify important behavioral indicators and write behavior of scientific literacy with accuracy and clarity | 0,5 |
| Develop criteria rubric for scientific literacy | - Develop criteria for evaluating the table fluently, accurately, clearly | 1 |
| Build matrix to evaluate | Design matrix test subject in detail, consistent with evaluated objectives | 2 |
| Develop questions according to PISA perspectives | Literacy evaluation questions of Ss towards PISA perspectives are consistent with the purpose, content, assessment methods | 3 |
| Assess the questions | Testing quality questions correctly | 2 |
| Use the information processing method | Fluency in using supporting evaluation tools (criteria table, supporting software) | 0,5 |
| Interpretation of obtained data | Explain exactly and clearly obtained assessment data | 1 |
| Transmission of information to related to subjects | Information about the evaluation results is transmitted timely with accurate, positive, understandable reporting content | 0,5 |
| Using the results to adjust the teaching process | Using assessment results to plan feasible instruction for Ts, self-study for Ss | 1 |

## 3.4. Experimental results

### *3.4.1. Quantitative analysis of experimental results*

*3.4.1.1. The experimental results help to form component skills of SLA skills towards PISA perspectives of Ss*

*a. Experimental results develop evaluation planning skill*

Statistical results compiled data of testing evaluation planning skill are shown in Figure 3.1

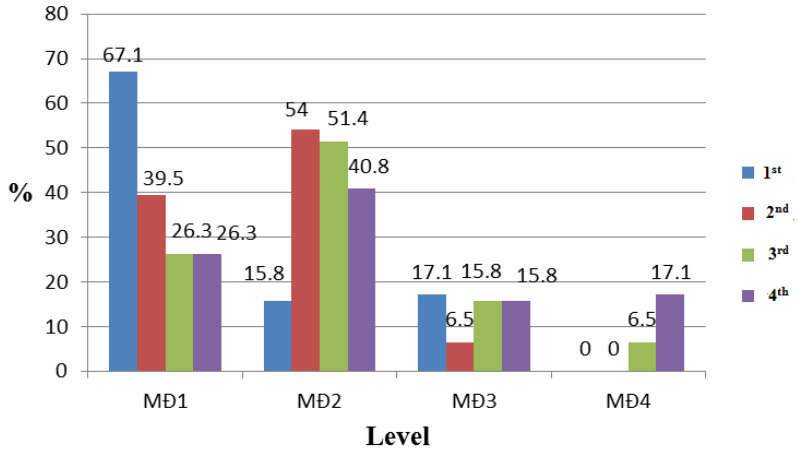


*Figure 3.1. The results of testing evaluation planning skill*

Figure 3.1 shows that: After 4 tests, the percentage of Ss does not have evaluation planning skill (level1) descending from 67.1% (1st), 39.5% (2nd), 26.3 % (3rd), 26.3% (4th). The proportion of Ss has evaluation planning skill at level 2 increases after the first training (from 15.8% to 54%), then decrease over the next training times. The proportion of Ss has evaluation planning skill at the level of 3 and 4 also increases over the check. To test whether the difference in the levels of achievement of Ss through tests at random or by the effectiveness of the training, we use Chi-square test through CHITEST function in excel. Results are presented in Table 3.4:

*Table 3.4. Test results of variables of mean from tests of evaluation planning skill*

| Comparison | $P(X > \chi^2)$ |
|---|---|
| Time 1 - Time 2 | $3{,}91116.10^{-41}$ |
| Time 2 - Time 3 | $7{,}6765.10^{-11}$ |
| Time 3 - Time 4 | $5{,}60966.10^{-38}$ |

Table 3.4 shows the value of P (X> χ2) to compare the proficiency level of skill from measurements is 3.91116.10-41; 7.6765.10-11; 5.60966.10-38 smaller than value α = 0.05. This shows that the difference in results of the tests of Ss is significant. In other words, the development of evaluation planning skill of Ss does not occur randomly, but actually because of the efficiency of Ts' training.

*b. The experimental results build the skill of determining behavior indicator of SLA*

*C. The experimental results build the skill of building evaluation criteria rubric of SLA*

*d. The experimental results build the skill of developing matrix of SLA*

*e. The experimental results build the skill of developing questions towards PISA perspectives*

*f. The experimental results build the skill of testing and perfecting test subject*

*g. The experimental results build the skill of using information processing methods*

*H. The experimental results build the skill of explaining the collected data*

*i. The experimental results build the skill of transmitting evaluated information to different subjects*

*k. The experimental results build the skill of using the evaluated results to adjust the teaching process*

***3.4.1.2. The experimental results build for Ss' skill of SLA towards PISA perspectives (synthetic skills)***

*Table 3.24: Summary of percentage of student test scores*

| | Percentage of Ss' test gets score $x_i$ (%) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Before experiment | 0 | 6,58 | 3,95 | 13,19 | 30,19 | 26,32 | 13,19 | 3,95 | 2,63 | 0 |
| After experiment | 0 | 1,32 | 3,95 | 2,63 | 9,2 | 26,32 | 26,32 | 21,05 | 6,58 | 2,63 |

The results in the table above shows the percentage of Ss with test scores from 1 to 5 before experiment higher than after experiment, test scores from 6 to 10 after experiment higher before experiment.

Using Data Analysis / Descriptive Statistics in Excel to calculate the statistical parameters such as mean, mode, median, standard deviation. The results shown in Table 3:25:

*Table 3.25: The statistical parameters of test scores before and after experiment*

| **Test** | **Mean** | **Median** | **Mode** | **standard deviation** | **Variability** |
|---|---|---|---|---|---|
| **Before experiment** | 5,34 | 5 | 5 | 1,54 | 7 |
| **After experiment** | 6,67 | 7 | 7 | 1,57 | 8 |

The results in Table 3:25 show the mean after experiment (6.67) higher than before experiment (5.34). The standard deviation and variability across the tests were in the range of reliable oscillation. To test if this difference makes sense or not, we use T-test with Data Analysis / t-test: Paired Two Sample for Means in Excel. The results presented in Table 3:26:

*Table 3:26. Test results the difference in mean scores between the before and after experiment*

| **Mean difference before and after experiment** | **\| t \| (t Stat)** | **Degrees of freedom** (df) | p | **t Critical two tail** |
|---|---|---|---|---|
| 1,33 | 7,05 | 607 | $7{,}62.10^{-10}$ | 1,99 |

The results are shown in Table 3:26 shows the absolute value of t is greater than the value of 7.05 p (7,62.10-10) and t values are greater than the standard 2-D (1.99). Therefore, the difference in mean values before and after the experiment is statistically significant with α = 0.05 at significance level. So we can confirm the progress of SLA towards PISA perspectives after experiment better than before experiment is due to process of teacher training.

### 3.4.2. Qualitative analysis of experimental results

#### *3.4.2.1. Perceptions, attitudes in Ss' learning*

#### *3.4.2.2. Regarding the development of the trained skills of Ss*

It can be seen, prior to pedagogy experiment, SLA towards PISA perspectives of Ss is weak, usually at a poor or below average level. Skills such as identifying indicators of scientific literacy and skills to use information processing methods have not yet done by any Ss. However, after experiment, most Ss have achieved the level of above average or very good level in all SLA skills.

# CONCLUSIONS AND RECOMMENDATIONS

## I. CONCLUSION

After a period of research, the implementation of the research task, we have solved the problems of theory and practice of the followings:

1. The research were determined to evaluate SLA towards PISA perspectives, it is necessary to develop for Ss 4 group skills: ability to prepare for the evaluation activities, developing the test capacity, analysis- processing and interpreting data skills and result feedback skills. Four groups corresponding skills with 10 component skill, the component skills we describe the structure through behavioral indicators.

2. From the reality of the common perception of Ts and Biology teacher Ss of evaluation skills of Ss and the training program for Ss of pedagogical skills, it is necessary to train Ss and high school Ts the SLA towards PISA perspectives in teaching biology.

3. The research have given a process to develop evaluation questions of SLA towards PISA perspectives in teaching high school biology with 5 steps: *Define objectives and content of on SLA skills in Biology consistent, Compiling leading information segments based on objectives and focused content, Determine the necessary extent of the skills to achieve, Ask assessment question on the needed levels of scientific literacy and code answers, Check the value of targeted questions.*

4. The research have developed SLA towards PISA perspectives in teaching high school biology including7 steps to form the basis of assessment skills for Ss

5. The research have developed process of SLA towards PISA perspectives in teaching Biology for Ss and use this procedure in training Ss. This process consists of 3 phases: Stage 1 -knowledge formation of competence, scientific literacy towards PISA perspectives, SLA towards PISA perspectives (2 steps); Stage 2- Forming SLA towards PISA perspectives (including 2 steps); Stage 3 3. Evaluation-assessment

6. The research built 11 criteria tables for assessing the skill development of Ss (10 component skills and one synthesis skill)

7. The research have built 11 types of exercises in SLA towards PISA perspectives in teaching high school biology of Ss (10 component skills and one synthesis skill)

8. The experimental results confirmed the efficiency of the process and skill assessment exercises towards PISA perspectives that we have used

**II. RECOMMENDATIONS**

Over a period of research, we have some suggestions below:

1. Continue the experimental process of developing evaluation skill in teaching Biology in towards PISA perspectives in other Universities of Education in the country

2. It is necessary to integrate the content of "forming SLA towards PISA perspectives in teaching Biology" to the module of "Measurement and evaluation in education" for Bachelor of Biology Teacher program.

3. It is necessary to train biology lecturers of basic science content the SLA towards PISA perspectives from which to change their teaching methods to help Ss with career -oriented development.

# LIST OF PUBLICATIONS

## Scientific articles

1. Nguyen Thi Viet Nga (2013), "History of research evaluation in the world and in Vietnam", Journal of Education, special issue in September, pg.86-87.
2. Nguyen Thi Viet Nga (2014), "Assessing the capacity of Ss' thinking in Genetics - Biology 12", Journal of Science - School DHSPHN2, No. 31, pg.87-92.
3. Nguyen Thi Viet Nga (2015), "The study on theory evaluation and application in teacher education", Journal of Education, No. 357, 1, pg.25-27.
4. Nguyen Thi Viet Nga (2016), "Building capacity assessment questions in the teaching of science in high school biology towardss PISA", Journal of science education, special issue of January, pg.62 -63.
5. Nguyen Thi Viet Nga (2016), "Skill and competency assessment process in teaching Biology", 2nd National Conference on Research and Teaching of Biology in Vietnam , Da Nang.1