FOREWORDS

1. Reasons for choosing the study

It derives from the task of innovation in teaching method for high schools, from characteristics of Genetics of Biology subject of grade 12, from the advantages of the concept map for positive acquisition and remembering profoundly knowledge of biology of students, we select the study "*Design and use of concept maps in teaching module of "Genetics " to contribute to improvement of the teaching quality of the biological subject of grade 12*".

2. The objectives of the study

To determine scientific foundation (theory and factual foundation) of the design and use of the concept map of Genetics teaching of in Biology of Grade 12.

To determine the design process and use process of the concept map in teaching genetics part of Biology of grade 12 in order to contribute to improvement of the efficiency of biological teaching in high schools.

3. Research object and subject

- The object of study: Biological teaching process at high schools, the part of genetics part of Biology of grade 12.

- The subject of research: Design process and use the concept maps in the genetics part of Biology of grade 12.

4. Scientific hypothesis

If the design process is determined and the concept maps in teaching Genetics part of Biology of grade 12 is used in a reasonable manner towards positive cognitive activities of students. It will contribute to improvement of teaching effectiveness of high schools of information.

5. Limitation of the study

Design and use of the concept map in chapter 1 and chapter 2, genetics part of grade 12

6. Research Tasks

* Overview study of the theoretical basis of the concept map to apply for design of the concept map, theoretical study on the process of

formation and development of concept to give use method of the concept maps oriented towards promotion of positive perception of students in biological teaching.

* Studying on the actual status of teaching and learning in general and the part of genetics of biology of grade 12 in particular at high schools as a practical basis for the study.

* Proposal of design process the concept maps and design of some genetics parts (biology of grade 12).

* Proposal the using process of the concept maps in teaching part of genetics of grade 12 towards promotion of positive cogitation of students.

* Experiment of pedagogy to confirm the correctness of the scientific hypothesis that the subject set forth.

7. Research Methodology

The research methods include: method (PP) of theoretical research, practical research method (method of investigate education, expert method, method of pedagogical experiments) and methods of mathematical statistics.

8. New contributions of the dissertation

* Identifying solid theoretical foundation (the foundation on philosophy, information theory, cognitive psychology) and practical foundation (survey results the actual status on teaching the genetics part at high schools) for the design and use of the concept maps in teaching the genetics part of Biology of grade 12.

* Proposing the design method of the concept map under a scientific process consisting of 6 tight steps.

* Recommending the use process of the concept map in teaching the genetics part of Biology of grade 12 towards promoting positive perceptions of students in all stages of the process DH (the stage on new knowledge teaching, knowledge comprehension and assessment checks) and towards increasing gradually the active level of students (from the level of the concept maps used as a tool for teachers to organize learning activities of students to a higher level: students themselves design and use of the concept maps. At this time, it is the product of thinking of students).

* Scientific product is 12 the concept maps of genetics part (Chapter 1, Chapter 2) and have been tested scientific valid by the experts. These concept maps are useful references for teachers and for students to design and use the concept maps. At the same time, it is considered as reference examples for the design of the concept maps of other parts of biological subject.

9. The structure of the dissertation

Besides the parts of introduction and conclusion, the main contents of the dissertation is presented in 3 chapters. Chapter 1: Theoretical and practical foundation of the design and use of the concept map in teaching the Genetics part (Biology of grade 12); Chapter 2: Design and use of the concept maps in teaching the genetic part to contribute to improvement of the teaching quality of Biological subject of grade 12; Chapter 3: the experiment of pedagogy.

Chapter 1. theoretical and practical foundation of the design and use of the concept map in teaching the Genetics part (Biology of grade 12)

1.1. Literature review on the design and use of the concept maps in teaching Biology

1.1.1. The formation and development of the concept in teaching Biology

1.1.1.1. The concept

* The definition of the concept: "Concept is a form of thinking, of which, it reflects different basic signs of a single object or class of homogeneous objects. The concept is the generalized knowledge about the most common signs of nature and attributes of each group of object and the same phenomenon, the relationships and inevitable correlations between things and objective phenomenon "(inevitable correlate, 1992).

* Analysis of issues related to concept such as the concept structure, concept characteristics, the relationship among concepts (dependent relations, peer relations, etc.), the concept classification (particular concept, abstract concept, etc.) is the basis for studying the forming and development process as well as the design and use of the concept map in teaching concept.

1.1.1.2. The concept formation

The forming process in general speaking includes the steps shown in Figure 1.1. In the practical teaching, it should apply flexible application of the order of steps how to achieve the highest efficiency.

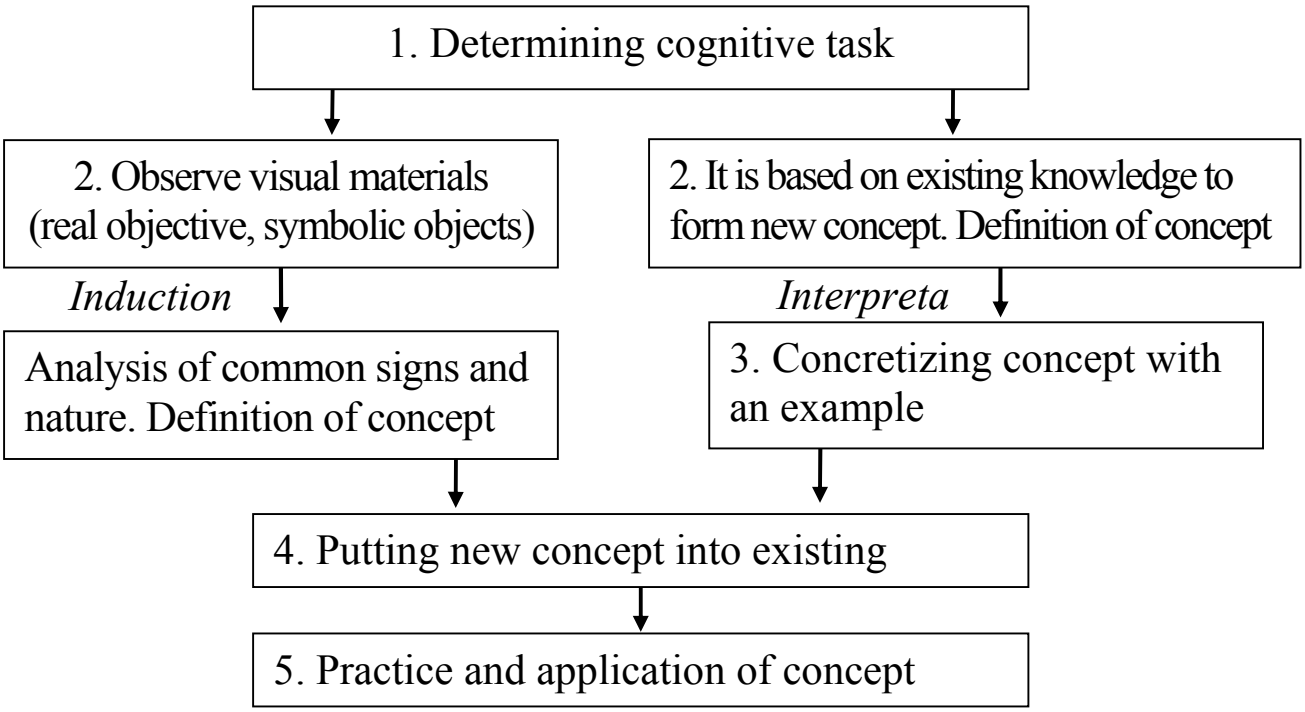


Figure 1.1. The concept forming steps

1.1.1.3. The development of concept: In teaching Biology, concepts are developed in forms of: the specific contents of concept, fulfillment of concept content and formation of new concept.

1.1.2. Concept maps

1.1.2.1. The definition of the concept maps

The concept maps are a schematic tool used to organize and present knowledge. They include concepts and linking words (or phrases) to indicate the relationships among concepts.

In terms of structure, each the concept map includes concepts, the seam between two concept, linking words and phrases (thesis in full text, page 27, 28).

1.1.2.2. The shapes of the concept maps

It is based on composition, the concept maps have shapes such as comprehensive the concept maps, the defect concept map and the dumb concept map. It is based on the shape, the concept map have shapes like the concept maps of spider shape, the concept map of process, the concept map of system.

1.1.2.3. Comparing the concept maps with some other similar

organizations of diagram: Mind maps and Graphs.

In terms of essence, the concept maps, mind maps and Graphs also are effective thinking tools, stimulate brain of activity and link ideas together. All three types are indicative of thinking brain. It is based on the rule of thinking that all information exists in the human brain needing to have interconnections in order to find and use. However, comparing with mind maps and Graphs, *structures of the concepts map indicate clearly and coherent on hierarchy as well as explain clearly the relationship between the concepts (clause) that allow description of knowledge in the form of the logic system with more large complex structure* .

1.1.2.4. The role of the concept maps in teaching: The concept maps have an important role for the active acquisition and thorough remembering of biological knowledge of students. Therefore, the concept maps are used very effectively in the stages of the teaching process as teaching new knowledge, comprehension of knowledge and test assessment. The use of the concept maps in teaching has contributed to the development of theoretical teaching method towards promotion of active perceptions of students at high schools.

1.1.3. History of research on concept maps: The concept maps in the world have been studied and applied in many different areas and have a lot of utility. The authors have studied the basis of cognitive psychology of the concept maps, software for developing the concept map - Cnap Tools software; the concept map be used in management, scientific research and planning in teaching (teaching a topic, evaluation, etc). In Vietnam, the design and use of the concept maps are limited. Most authors have just been interested in the role of the concept map in teaching. So far, there is not any study to research systematically on the design and use of the concept map in teaching in general and the genetics part in particular.

1.2. Scientific basis of the design and use of the concept maps in teaching biology

1.2.1. Theoretical basis: Study based on the scientific foundations as the philosophical basis (*structured approach method - system*), the basis of information theory (*stages of cognitive process*), the basis of cognitive psychology (*the ability to memory formation*) shows that the design and use of

appropriate the concept maps in terms of theoretical methodology and cognitive psychology of human beings (*thesis in full text from page 45 to page 53*).

1.2.2. Practical basis

Contents of survey of the practical situation of teaching biological concepts and the genetics part at high schools are presented in the thesis in full text from page 54 to page 60.

The survey results the real situation have showed that teaching of biological subject in general and the genetics part in particular has some shortcomings : In the teaching process, teachers are primarily interested in teaching for all in all knowledge, not really care for the students to train learning skills such as knowledge systematized skills, skills taking notes and remembering knowledge, etc. In teaching the genetics part, the teachers are often interested in each concept and not really focused on the relevant concept system. This means mainly for students to see "tree" without seeing the "forest". Therefore, students are passive in the learning process. Students are also in difficult to compare concepts, apply concepts, etc. So, the quality of learning subjects of students is limited.

GENERAL DISCUSSION OF CHAPTER 1

For the Department of Biology, the most basic knowledge is the system of concepts, the processes, the biological rules closely related to each other, is formed and developed in a logical order. teaching concepts is not only for students to understand the inner meaning of concepts, but also to make them to learn how to streamline concepts in existing concept systems. This helps students get systemic thinking, understand easily and inculcate knowledge.

Through the study, it shows that the concept maps in the world have been studied and applied in many different areas and have provided a lot of utility. In Vietnam, the design and use of the concept map are interested in by few authors. There have been some authors initially studying the concept map in teaching. However, it is only to focus on the important role in using the concept maps. So far, there is not any research paper to study systematically on the design and use of the concept maps in general and in teaching the genetics part of Biology of grade 12 in particular. So, it is necessary to continue for clarifying the theoretical basis of

the concept maps well as determination of the design process, the use process of the concept maps in the teaching of biological process discipline.

Through study on the actual teaching status of the Department of Biology in general and that of the genetics part of Biology of grade 12 in particular, we see there are still some shortcomings that limits teaching quality of the Department. Therefore, it is necessary to renovate teaching methods and facilities to further enhance the teaching quality of biology at high schools.

Thus, studies on the theory and practice have confirmed that the design and use of the concept maps in general and the genetics part of Biology of grade 12 in particular are based on solid scientific base and very necessary to meet the renewal current requirements of teaching method.

Chapter 2: Design and use of the concept maps in teaching the "genetic" part TO contribute to improvement of the teaching quality of Biological subject of grade 12

2.1. Analysis of the structure and contents of the part of Genetics (Biology 12)

The analysis of contents and structure of the part of Genetics indicated that characteristics of the part of Genetics such as difficult levels, the inheritance, etc. from that it can see that the design and use of the concept maps in teaching the part of Genetics is appropriate and necessary.

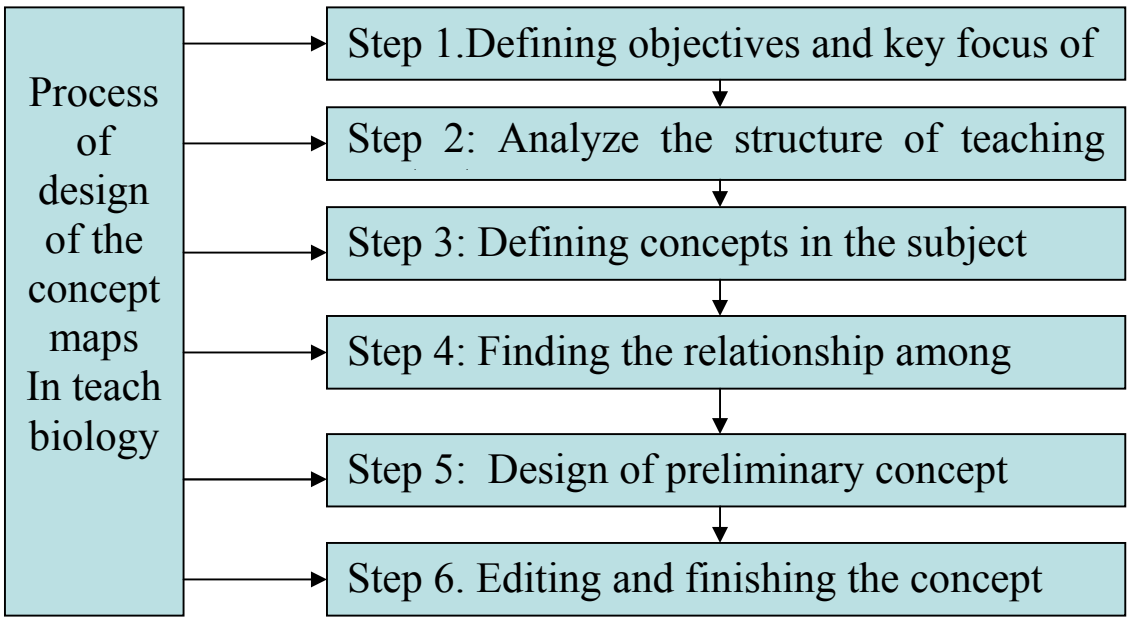
2.2. Principles of design of the concept maps

To design the quality of concept maps, principles should be adhered rigorously. Those are the principle of application of approach of the system structure, the principle of unity among teaching objectives - contents - methods - facilities principles consistent with the level of awareness of students. Besides, use of the concept map in teaching should comply with the principles such as principles of promotion of positive creative initiative of students and ensuring principle of evaluation and self-assessment, etc. (*the full text thesis, from the page 67 to page 73*).

2.3. Design of the concept maps on the part of Genetics (Biology of grade 12)

2.3.1. General process of design of the concept maps

General process of design of the concept maps consists of the following steps:



Example: Design of the concept map "the genetic rules through nuclear gene" (Figure 2.1).

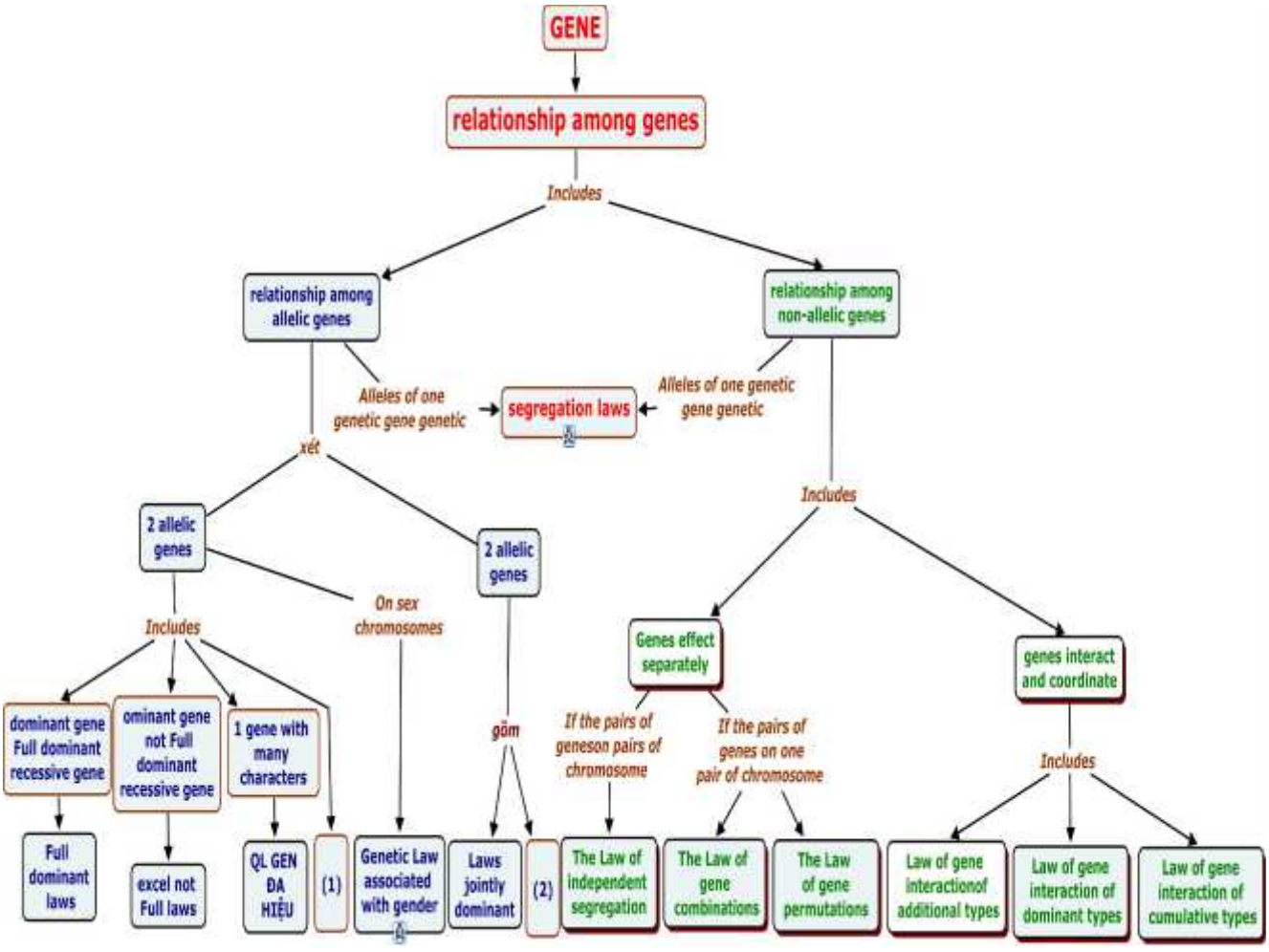
Step 1: Defining objectives and key focus of the concept maps: Objective is systematized the genetic law via nuclear genes (gene in nuclear - gene belongs to the chromosome). The genetic laws include law of segregation, law of independent segregation, law of gene interaction, law of entire gene linkage, law of gene permutation, etc. Key focus of the concept maps is to answer the question "what laws do genes on chromosome comply with? " or the central topic is "the laws of genetics via nuclear genes".

Step 2: Analyze the structure of teaching contents: First of all, it is necessary to identify the logic circuits of content knowledge. *Logic circuits of* "the laws of genetics through nuclear genes" is determined according to *nature* of laws. The essence of laws is that *the relationship among genes* (the relationship between the allele).

After defining the logic circuit of knowledge contents, that is the relationship among genes, contents should be analyzed to determine the system of concepts in a logical relationship: from concept of "gene" (The gene is a segment of AND molecule carrying coded information for a defined product, etc.), genes in nuclear are analyzed to see how they are in relation to each other (in fact the relationship among genes are the relationship among products of the gene synthesis). This will determine two systems that is the relationship between allelic genes and non-

allelic genes. Similarly, when analyzing the relationship between allelic genes, there will be two main relationships. *The dominant genes are completely expressed over the recessive genes and the dominant genes are not completely expressed over the recessive genes, etc*. By such analysis, logical relations between later concepts with previous concepts as well as the relationships among concepts in the system.

Figure 2.1. the concept map of "The laws of genetics through nuclear genes"



Step 3: Defining concepts in the subject: General concept: the relationship among genes, the concepts in the system: the relationship among allelic genes, non- allelic genes, dominant genes completely expressed over recessive genes, dominant genes incompletely expressed over recessive genes, etc.

Step 4: Finding the relationship among concepts. Determining the relationship among concepts such as a dependent relations, peer relations; finding suitable linking words, etc.

Step 5: Design of preliminary concept maps (Figure 2.1).

Step 6: Editing and finalizing the concept maps.

When reviewing the concept maps, it is necessary to check the following key issues:

- Checking the level of complexity of the concept map. If it is too complexity, the concept map needs to simplify for ease of use. With concept maps have not many concepts, at the end of each concept, it can add contents to clarify those concepts.

- Check out the full and accurate levels of concepts, location of concepts. Check the appropriate level of linking words between two concepts. Linking words have to ensure that the relationship between two concepts forming clauses.

2.3.2. The system of the concept map designed the part of Genetics (Biology of grade 12): Scientific products are 12 the concept map of Chapter 1 of 2 parts of genetics. The concept map has been tested scientific valid by the experts.

2.3.3. Design tool of the concept maps - CMAP Tools Program

Cmap Tools is a modern tool of design of the concept maps and computer and Internet based program- an integration of knowledge and visual information. This software helps users to easily create and modify the concept map well as facilitate the link with natural resources. In addition, the software allows users to exchange with each other (cooperative learning) when designing and using concept maps on computer available the Internet connection.

2.4. Use of the concept maps in teaching the part of genetics (Biology of grade 12)

In teaching the part of genetics of Biology of grade 12, the concept maps are used in the stages of the teaching process as teaching of new knowledge, perfect of knowledge and examination and evaluation. The concept maps are used towards increase gradually the active level of students in participating in designing the concept map, namely:

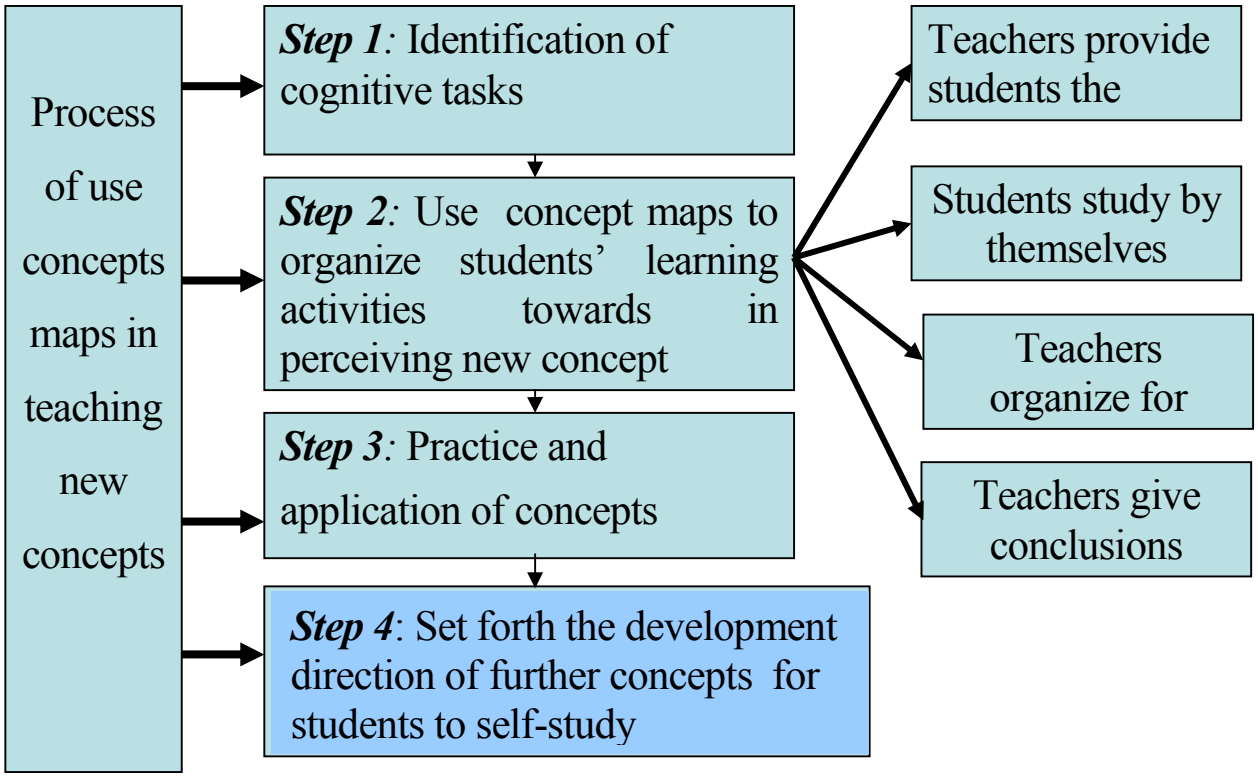
The level 1: Teachers use fulfilled concept maps to provide students to study.

The level 2: Teachers use concept maps to organize students' learning activities towards positive cognitive promotion of students.

The level 3: Instruction of students to learn designs by themselves and use of the concept maps. At this level, teachers guide students to design themselves the concept maps in teaching process with the final goal towards to let student capable of designing and exploiting the concept maps. When students themselves design the concept maps, the concept maps are *the product is thinking process of students*.

2.4.1. Use the concept maps in teaching new knowledge

General process consists of following steps:



***For example**, use of the concept maps in teaching the section "Duplicate of DNA in prokaryotes"* (Biology of grade 12). On the basis of determination on teaching methods and facilities, teachers can organize students to acquire new knowledge by following these steps:

***Step 1**: Identification of cognitive tasks*.

***Step 2**: Use concept maps available gaps to organize learning activities towards promotion of positive cognition of students.*

- Teachers provide students the concept map available gaps "Duplication of DNA" learned at Biology of grade 9 (Figure 2.5) with the missions to organize for students to implement:

Task 1: Studying on the concept map available gaps (Figure 2.5). Please, review knowledge by answering questions and filling concepts available gaps on the map. (Figure 2.5 and the contents of questions available in full text thesis at page 89).

Task 2: studying on contends of textbook of Biology of grade 12, observing the diagram on process of duplication of ADN and answering questions through that identifying new concepts and fulfilling the concept map available gaps on "duplication of ADN" of grade 12 (Figure 2.6).

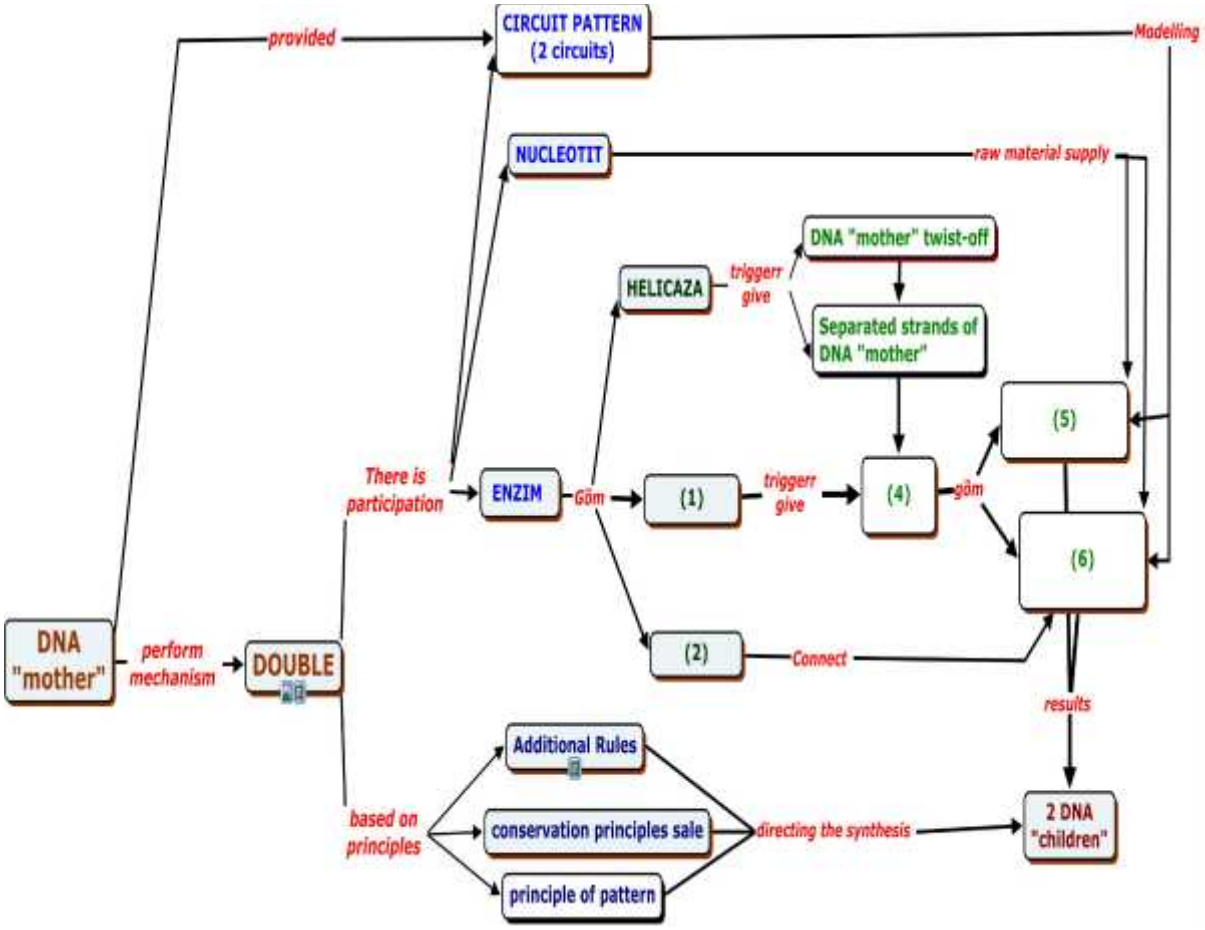


Figure 2.6. the concept map on "Duplication of DNA" of grade 12

- Students with activities of individuals or group to perform tasks such as analysis, synthesis of knowledge, completion of the concept maps available gaps, answer to questions, etc. Through the implementation of learning activities, students will define concepts and take new concepts into the system of existing concepts.

- Teachers organize for students to report and discuss.

- Teachers adjust and make conclusions and provide completed the cmaps

Step 3*: Practice and application of concepts:* Using exercise: Giving one segment of DNA (containing one structural gene). Please specify the structure of 2 DNA "child" formed.

5 'ATGGXTAAA ... GGXTTATAG 3'

3 'TAXXGATTT ... XGGAATATX 5'

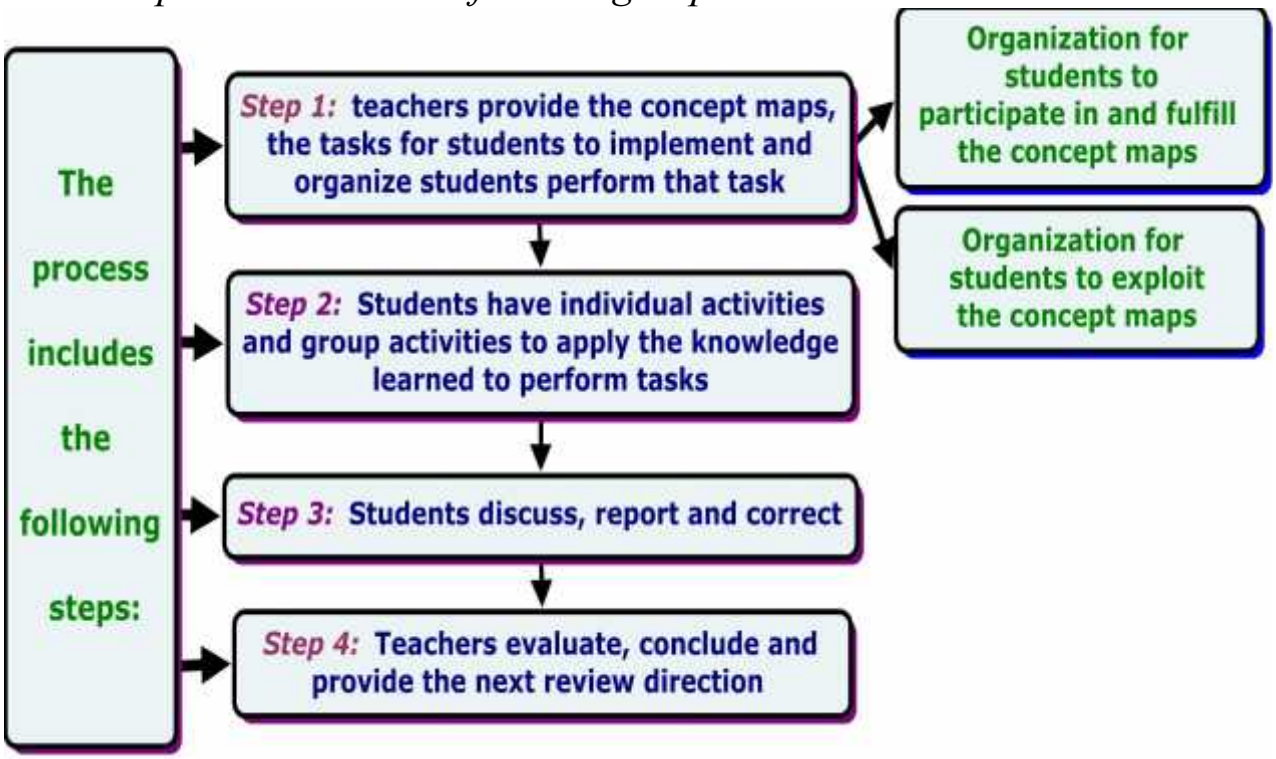
Step 4*: Set forth the development direction of further concepts for students to self-study* as: "Duplication of DNA" in eukaryotic organisms have different characteristics with "Double DNA" in prokaryotes. So, what are traits and why characteristics have or if in the process of DNA replication, the additional

principle is violated, how are consequences ? what is meaning that?

2.4.2. Use of the concept maps to complete knowledge

2.4.2.1. Use of the concept maps to organize the review activities and strength students' knowledge

General process considers following steps:



For example: Use of the concept map available gaps on mechanism of "translation of genetic code" in consolidating activities after teaching the lesson 2 (Biology of grade 12).

Step 1: teachers provide the concept maps available gaps (Figure 2.7), the tasks (in learning sheets) for students to implement and organize for students to perform that task. At this step, teachers should perform two main tasks: the firstly, organization for students to consolidate knowledge through participation of design and completion of the concept map of "Translation to code"; secondly, organization for students to exploit the concept maps (actually, it is to guide students to change from map language into the language of "semantics" in apply in learning duration).

Study Sheets

Use knowledge learned in the "translation of code" to complete the following tasks during the 7 minutes:

Task 1: Studying the concept map available gaps on translation of code. From their knowledge, they check the accuracy of the existing concepts and supply missing concepts from 1-6 to complete the concept map.

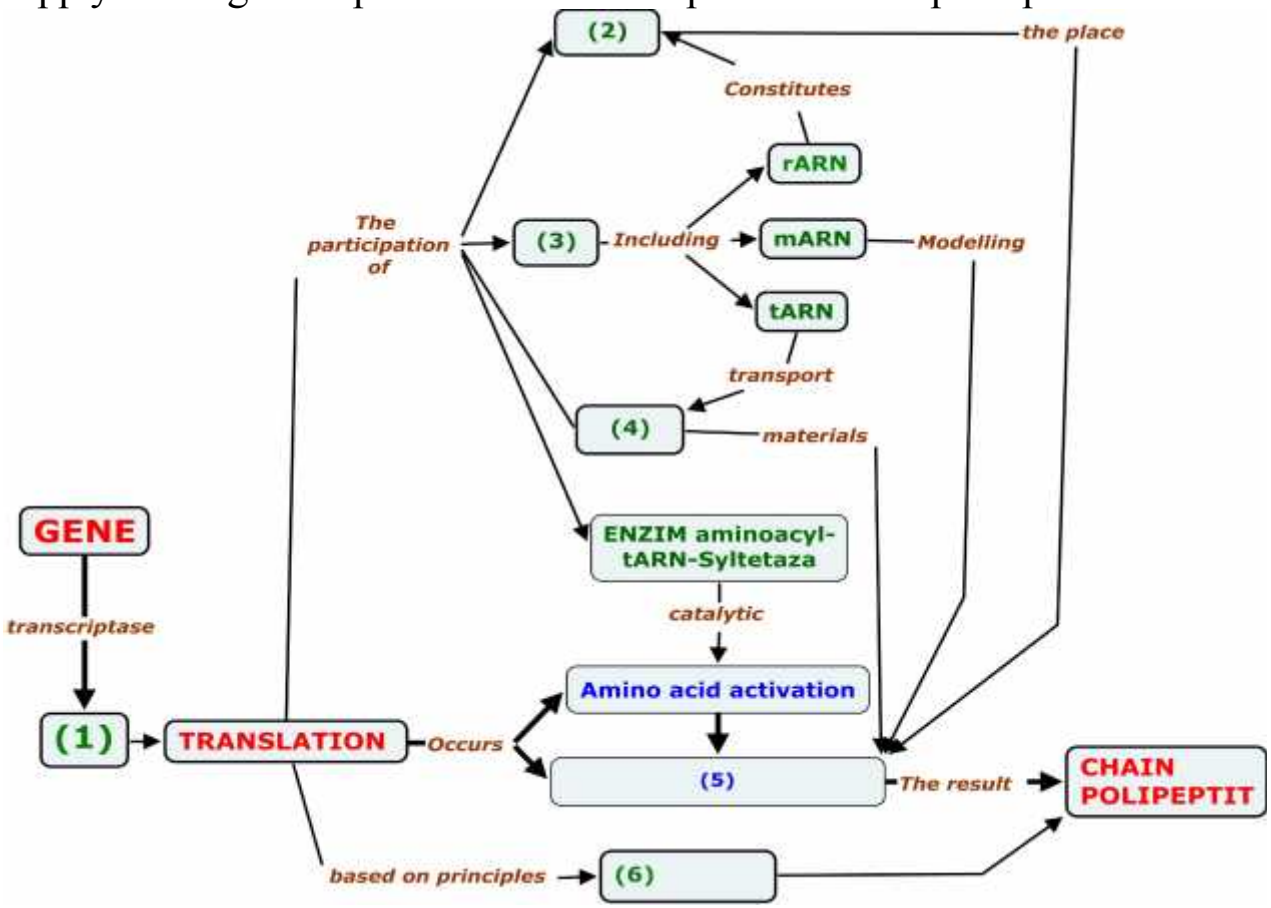


Figure 2.7. the concept map available gaps on the mechanism of "translation of code"

Task 2: From completed the concept map, *find contents for answering* and for the following questions:

Question 1. What is *translation of code*? List the role of the basic elements participating in *translation of code.*

Question 2. What are results of the process of *translation of code*? Explain why polypeptide chain synthesized is the accurate translation from mRNA ?

Question 3. State the relationship among DNA (gene) - mRNA - Proteins - status

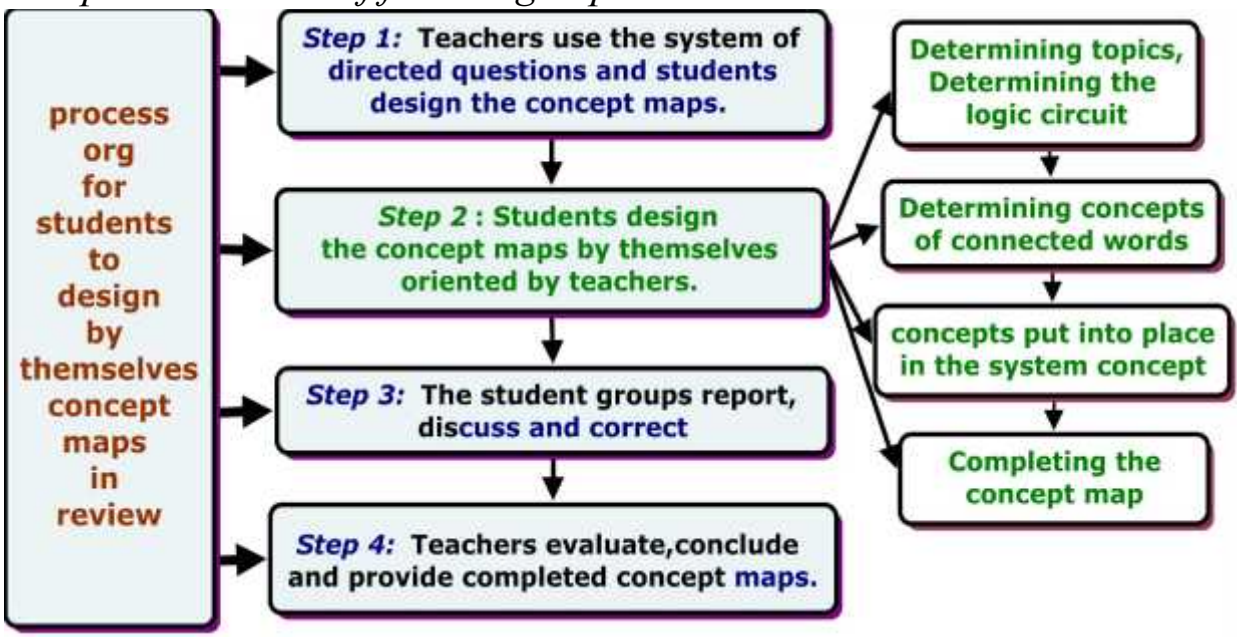
Step 2: Students have individual activities and group activities to apply the knowledge learned about the translation of code to perform tasks such as identifying missing concepts (concepts of mRNA, ribosome, amino acids, additional rules, etc.); completing maps, reading contents of map, correcting errors and answering relevant questions, etc. Through that students can thoroughly understand and mastery of mechanism of translation of code.

Step 3: Students discuss, report and correct.

***Step 4*:** Teachers evaluate, conclude and provide the next review direction for students self-study and complete knowledge.

2.4.2.2. Organizing for students to review and strengthening via self-design of the concept map

General process consist of following steps:



For example: Organizing for students to review on genetic mechanisms by self-design of the concept map "*The mechanism of genetic phenomen*" (Biology 12).

***Step 1*:** Teachers use the system of directed questions and students design the concept maps.

Teachers use questions to organize students to determine *topics and logic circuits*, of contents, to identify and to find the relationship among concepts (connected words).

Question 1: What are materials facilities of the genetic mechanism? What is the relationship between those organizations of materials ?

Question 2: What is the mechanism of genetic information in cells? Through what are generations of cells? Through what are the generation of the body?

Step 2: Students have group activities to design the concept maps oriented by teachers.

- Students study, analyze and determine the topic of review content is "*The mechanism of genetic phenomena"*.

- Students, through answering questions, figure out the logic circuit of contents of review, namely:

Question 1. Material facilities of genetic phenomena is ADN, gene,

chromosome. Relationship: ADN is *the main component to create* chromosomes, ADN has genes being as *functioning operated unit*.

Question 2.

+ The relationship of ADN → mARN → Protein→ status via mechanism of *transcription of code, translation of code* is the transmission mechanism of genetic information in cells.

+ Mechanism of self-replication of ADN and associated with *doubling* of chromosomes in *mitosis* is the transmission mechanism of genetic information through cell and body generations (in asexual species).

+ Combination of 3 mechanisms of *meiosis, fertilization and mitosis* is the mechanism of transmission of genetic information via the body generations in sexual reproduction species

Since then, students identify logic circuits of contents of knowledge: the structure of genetic materials - the movement of genetic materials.

- Students determine concepts in topics: concepts on structures such as concepts f genes in relation to concepts of ADN and chromosomes; concepts on the mechanism of genetic phenomena at the molecular level, such as self-replication, transcription in relation to the mechanism of translation of code, etc.

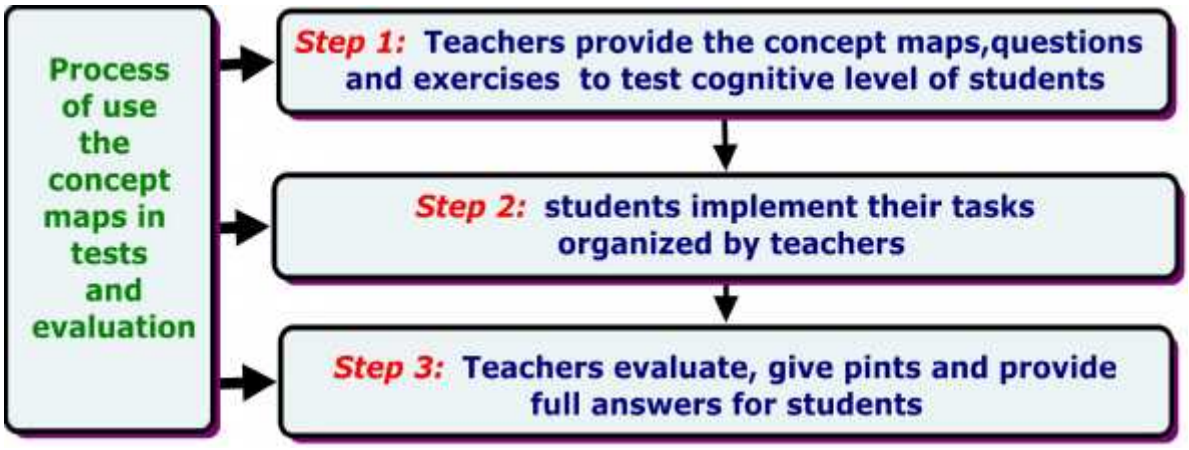
- Students arrange concepts in the concept maps to perfection.

Step 3: The student groups report, discuss and correct

Step 4: Teachers evaluate, conclude and provide completed concept maps.

2.4.3. Use of the concept maps in test and evaluation

The process include following steps:



GENERAL DISCUSSION OF CHAPTER 2

The design of the concept maps in teaching is based on the scientific

foundation. That includes 3 main principles: the principle of structural system approach, principles of unity among objectives - contents - methods - facilities in teaching process, the principles ensuring students' proficiency. The design is taking place under 6 strict steps.

The use of the concept maps in teaching the part f genetics of biology of grade 12 is to organize learning activities towards positive cognitive activity of students, in which there is close coordination between the teaching activities of teachers and students' activities. Thereby, it is not only help students to master knowledge, skills, personality development, but also train students learning method towards approach of systems theory

It can be used the concept maps in teaching process and includes: teaching new knowledge, perfecting knowledge of the test and evaluation. The use of the concept map towards positive direction of cognitive activities to improve teaching quality of the Department of Biology at high schools.

Chapter 3. THE EXPERIMENT OF PEDAGOGY

3.1. The purpose of experiment of pedagogy: Deployment of the design and use of the concept maps of the part of genetics of biology of grade 12 in practice to confirm the correctness of the scientific hypothesis that the research paper set forth.

3.2. Experimental contents: Experimental contents are taught most of all lessions in chapter 1, chapter 2 at the part f genetics, of which, 6 lessons are chosen to evaluate.

3.3. Criteria and methods to assess the experimental effects: It is based on the classified system of Benjamin Bloom to assess students' cognitive ability in teaching by the concept map (cognition, understanding and application) and evaluate the ability of knowledge systematization of students. In addition, it is also to evaluate educational psychology of students including attitude, excitement, emotion, etc.

3.4. The process of pedagogical experimentation

3.4.1. Organization of pedagogical experimentation: pedagogical experimentation was conducted in two periods: Period 1: School Year of 2010-2011; Period 2: School year of 2011-2012.

3**.4.2. Selection of samples**: Selecting experimental schools, teachers ad students participating in the experimentation.

3.4.3. Testing and collecting data: Inspecting and colleting data of tests of

lessons (tests of MCQ and essay) during and after experimentation

3.5. Results and discussion

3.5.1. Results of quantity

3.5.1.1. Results of tests in the experimental period 1

The results of tests in the experimental period 1

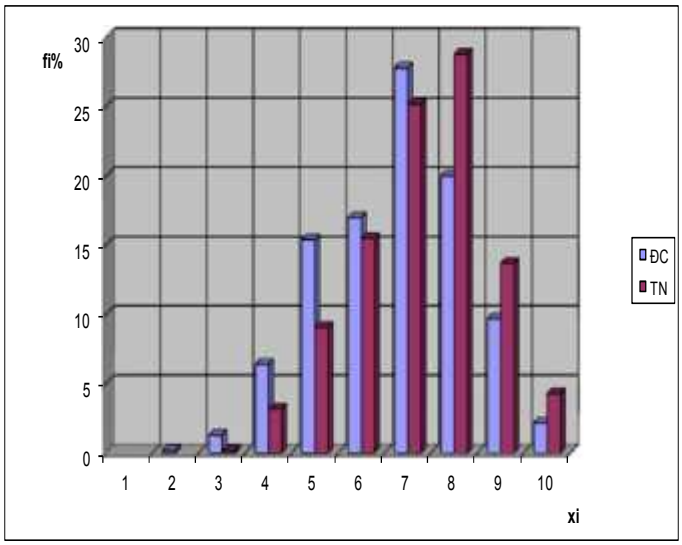


Figure 3.1. Diagram of frequency of test scores in the ex period 1

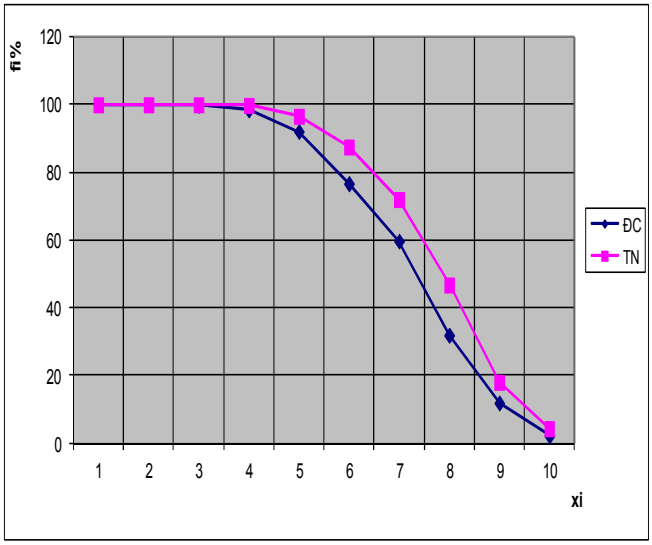


Figure 3.2. The graph of frequency of convergence of test scores in the Ex period 1

The results showed that the average score of groups of the experiment class (7.2) is higher than that of groups of the general class (6.7). In order to confirm this, it is necessary to compare *mean values and analysis of variance* (Table 3.3, 3.4 , the full-text thesis). Hypothesis H_0 set forth "There is no difference between the study results of groups of the experiment classes and those of the general classes" and the null hypothesis H_1: "*There is a difference between learning outcomes of groups of the experimental classes and those of general classes*". The test results showed the absolute value of U = 10.4> 1.96 (the standard numeric value of the z-score), with probability 1.64> 0:05, the hypothesis H_0 is rejected, the alternative hypothesis H_1 is accepted; this means that *study results of the experiment classes are better than those of the general classes.*

It is an analysis of variance. Hypothesis H_A set forth "*teaching the part of genetics of the concept maps and other different methods available similar effects to the level of comprehension of students in groups of the experimental and general classes*". Table of analysis of variance showed that the numeric value FA = 108.9> F crit (standard) = 3.84, hypothesis H_A is rejected and the

alternative hypothesis is accepted. This means that teaching by the concept maps help students to understand better lessons

**** The results of one hour tests in the experimental period 1***

The result comparing mean values and testing the hypothesis H_0 indicates $\overline{X}_{EX}(7.41) > \overline{X}_{GE}$ (6.81). *Comparison of average values* (Table 3.7, full text thesis): absolute value of U (6.46)> the standard numeric value of the z-score (1.96), hypothesis H_0 is rejected, the alternative hypothesis H_1 is accepted. This means that results of one hour tests of groups of the experimental classes are higher that those of general classes.

The analysis of variance (Table 3.8, the full text thesis) showed that the numeric value F_A= 41.66> F standard (3.84), hypothesis H_A is rejected. This means that two teaching methods in the experimental period 1 affect differently on the ability to systematize knowledge of students. The ability to codify the experimental groups and classes is better than that of general groups and classes.

3.5.1.2. Results of tests after the experimental period 1

Table 3.10. Comparison of characteristic parameters of 2 experiment and general groups

PA	**n_i**	$\overline{X}$	**S**	**Cv%**	**$d_{TN-ĐC}$**	**t_d**
ĐC	949	6.63	1.43	21.6	0.7	11.13
TN	947	7.33	1.33	18.1		

Comparison of characteristic parameters of results of test scores of 2 experiment and general groups shown: GPA of 2 times of tests after the experimentation of the experiment groups and classes are higher than that of the general groups and classes. GPA of the experimental groups and classes and the general groups and classes is significant difference (0.7). This means that points of students of the experimental groups and classes is relatively stable scores and points of the general groups and classes is much lower than that of the experimental groups and classes. Thus, the level of retention of knowledge learned in the experimental groups and classes is better than that of the general groups and classes.

The standard deviation and coefficient of variation of the experimental groups and classes were lower than those of the general groups and classes. This suggests that the experimental results are reliable.

3.5.1.3. Results of tests in the experiment period 2

Results of MCQ tests in the experiment period 2

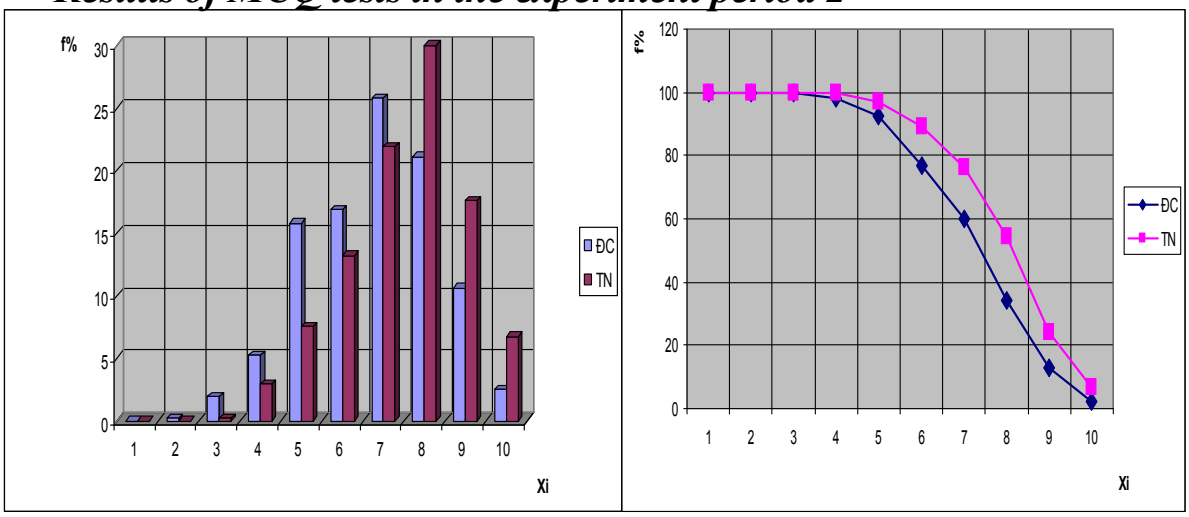


Figure 3.6. Diagram of frequency of test scores in the ex period 2

Figure 3.7. The graph of frequency of convergence of test scores in the Ex period 2

The result is $\overline{X}_{EX}$ (7.48) > $\overline{X}_{GE}$ (6.77). To confirm this matter, it is necessary to compare *mean values and analysis of variance* (Table 3.13, 3.14, the full text thesis). The analysis results show that the absolute value of U (14.42)> standard numeric value of the z-score (1.96). Hypothesis H_0 is rejected. This means that the learning outcomes of the experimental groups and classes is higher than these of the general groups and classes. This difference is statistically significant. *Results of variance analysis* showed that F_A = 207.88> F standard = 3.84. Therefore, hypothesis H_A is rejected. This suggests that sources affect students' academic performance is due teaching method.

*** Results of 1 hour tests in the experiment period 2**

Grade point average of the experimental groups and classes (7.68) is higher than that of the general groups and classes (6.87). Comparison of mean values and test of hypothesis H_0 (Table 3.17, the full-text thesis) has U numeric value = 9:24> Z standard numeric value of Z-score (1.96). Thus, the difference of GPA between the experimental groups and classes and the general groups and classes is with statistically significant.

Analysis of variance (Table 3.18, the full-text thesis) showed that FA numeric value (85.46)> F crit (3.84). So it can be concluded that sources led to difference in learning outcomes of two groups and classes is due to different teaching method and this difference is statistically significant.

3.5.1.4. Results of tests after the experimental period 2

Comparison of parameters such as mean value, variance, standard deviation, coefficient of variation of the point results of the experimental groups and classes and the general groups and classes (Table 3:20).

The result is $\overline{X}_{EX}$ (7.59) > $\overline{X}_{GE}$ (6.72). The difference on $\overline{X}$ between the experimental groups and classes and the general groups and classes is significant (0.87). This means that points of students of the experimental groups and classes are more stable than those of the general groups and classes. This proves that the retention level of learnt knowledge of the experimental groups and classes is better than that of the general groups and classes.

Table 3.20 . Comparison of characteristic parameter of ex and ge groups after ex

PA	$\mathbf{n_i}$	$\overline{X}$	**S**	**Cv%**	$\mathbf{d_{EX-GE}}$	$\mathbf{t_d}$
General	946	6.72	1.46	21.7	0.87	13.43
Experiment	940	7.59	1.35	17.8		

The standard deviation and coefficient of variation of the experimental groups and classes are lower than those of the general groups and classes. This suggests that perceived knowledge of students of the experimental groups and classes is fairly even and efficiency of use of the concept maps in teaching the module of genetics of biology of grade 12 is reliable.

3.5.1.5. General comments in terms of quantity over 2 years of the experimentation

Analysis of the experimental results of 2 periods, we find that:

1. General point average of the experimental groups and classes is always higher than that of the general groups and classes. This demonstrates that the ability to understand and synthesize knowledge of students learning via the concept maps f the experimental groups and classes get better results than that of the general groups and classes .

2. Results of test scores between the experimental groups and classes and the general groups and classes compared by the average values and analysis of variances showed that results of the experimental groups and classes are more certain and more stable than that of the general groups and classes. By comparison of confidence that demonstrates results perceived knowledge of

the experimental groups and classes being higher than these of the general groups and classes is reliable.

3. When comparing the results of 10-minute tests with 45-minute tests, it shows that points of 45-minute tests are usually higher than these of 10 minutes and results of the experimental groups and classes are much higher these of the general groups and classes. This means that the ability to codify knowledge in the classes studying by the concept maps in accordance with process is higher than that of the groups and classes not taught by the concept maps.

4. Comparison of the results during and after experiment of each period found that the general average point between the experimental groups and classes and the general groups and classes has significant difference. Points of students of the experimental groups and classes is relatively stable. Points of students of the general groups and classes decreased relatively more than that of the experimental groups and classes. Thus, the level of retention of knowledge learned in the experimental groups and classes is higher than that of the general groups and classes. Since then, we can see level of impact of change of teaching method to outcomes of study as well as the durability of knowledge between the experimental groups and classes and the general groups and classes.

5. Average values and arithmetic mean offsets of the experimental groups and classes compared with those of the general groups and classes of the period 2 are higher than those of the period 1. This can be explained due to teacher at the period 1 are not really familiar and not really active and flexible in organizing for students to acquire knowledge by the concept maps. So, the difference of points is not significant (0.54). After 1 year of experimental teaching, teachers have accumulated much experience in the design and use of the concept map in teaching, the difference of points is pretty significant (0.76). Thereby, it can see the impact of changes f teaching method of teachers to students' learning outcomes in the presence or absence of use of the concept maps in accordance with the scientific process in teaching the part of genetics of biology of grade 12.

3.5.2. The qualitative results

Based on the ability of synthesis and of generalization of students on learned concepts as well as assessment of the students' excitement in learning, we found that the ability to synthesize and generalize of students of the

experimental classes is better than that of the general classes. This is expressed in tests of students (the full text thesis, page 129 - 133). Students of the experimental classes were very excitement and active in the implementation of learning activities.

GENERAL DISCUSSION OF CHAPTER 3

The concept maps can be used in all stages of the teaching process. However, the most efficient is use the concept maps in teaching new lessons, in strengthening the knowledge and self-study of students.

Use of the concept map to organize cognitive activities will help students more favorite the subject, more understanding lessons and better remembering and applying. Learning by the concept maps will train students' logical thinking ability, systematized skills of knowledge and the other self-study skills.

The result obtained from two experimental periods in terms of both quantitative and qualitative aspects. Although the experimental scope is not broad enough, it allow to have following conclusions: Design and use of the concept maps in teaching the part of genetics of bilgy of grade 12 in accordance with the scientific process has contributed to improve the teaching efficiency of the Department of Bilogy. This confirms the effectiveness and feasibility of use of the concept maps in teaching the module of genetics of biology of grade 12 at high schools.

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

From the results of theoretical and practical study on the design and use of the concept maps in teaching the part of genetics of biology of grade 12, we can draw the following conclusions:

1. The research and application of design process, use of the concept maps in teaching the module of genetics of biology of grade 12 is to have a solid theoretical basis (the basis of philosophy, the basis of information theory, cognitive psychology basis) and teaching practical basis (results of survey of real status in teaching the module of genetics at high schools) that have contributed to theoretical development of teaching method towards promotion of positive perceptions of students at high schools.

2. The design of the concept maps should be based on the system of design

principles. They are the principle of systemic structure, unified principles among objectives - contents - methods - teaching facilities, principles in accordance with the cognitive level of students; the concept maps can be designed in a scientific process with 6 steps closely. It is based on the foundations, 12 concept maps of Chapter 1 and 2, the module f genetics are designed. These the concept maps have confirmed by experts in terms of the quality and value in use.

3. The dissertation has identified the process of use of the concept maps in teaching the module of genetics of biology of grade 12 in all stages of the teaching process such as teaching new knowledge, fulfilling knowledge and testing and assessment. The use of the concept map at levels in the direction of gradual increase positive activities of students, from the level that the concept maps used as a tool for teachers to organize learning activities of students to a higher level that the concept maps designed self-students and use - the concept maps are thinking products of students. In addition, the method of organization of learning activities by the concept map for students is that teachers has taught both students the learning method, the way of scientific thinking and systemic thinking to ensure for students able to perform the learning process to achieve good results in identified learning situations .

4. Results of the investigation, field survey and pedagogical experimentation have showed that the use of the concept maps designed in teaching and learning processes for module of genetics is feasible and effective. The effectiveness of the design process and use of the concept maps in teaching the module of genetics of biology of grade has confirmed initially and proposed by the dissertation and is consistent with the scientific hypothesis that the research dissertation set forth from the beginning

B. RECOMMENDATIONS

1. It is to continue to deploy the pilot process of design and use in teaching the part of genetics of Biology of grade 12 at high schools.

2. It is to continue to study and apply the process of design and use the concept maps in teaching other modules of biological programs at high schools.

3. Contents of design and use in teaching the module of teaching method of Biology in bachelor program of pedagogy in major of biology should be contained in order to enrich the system of teaching method of Biology towards positive way of learning activities of students.

LIST OF RESEARCH PAPERS PUBLISHED BY THE AUTHOR

1. Nguyen Phuc Chinh, Pham Thi Hong Tu (2010), "*Design concept maps for the part of Genetics - Biology of grade 12*," Journal of Education (No. 265).
2. Pham Thi Hong Tu (2011), *"Using concept maps in self-study and collaborative study and learning via the Internet*", Journal of Education (No. 283).
3. Pham Thi Hong Tu (2011), "*the concept maps - Useful Tool in Biology Teaching and Learning*", Summery records of the scientific conference of fellows, Scientific and Educational Institute of Vietnam, page 270.
4. Nguyen Phuc Chinh, Pham Thi Hong Tu (2012), "*Design and use the concept map in self-teaching of the Chapter 1*" "*Mechanisms of genetics and genetic variation - Biology of grade 12* ", Journal of Science and Technology, Thai Nguyen University, No. 07, vol.: 95.
5. Pham Thi Hong Tu (2012), "Using concept maps in teaching the part of genetics of Biological Textbook of grade 12", Journal of Education (No. 295).