THAI NGUYEN UNIVERSITY
UNIVERSITY OF EDUCATION

TRAN QUANG HIEU

BUILDING AND USING LEARNING FILMS IN TEACHING MECHANICS - PHYSICS 10 TO FOSTER STUDENTS' PROBLEM-SOLVING ABILITY

Speciality: Theory and Methodology of Physics Teaching
Code: 9140111

DISSERTATION SUMMARY

THAI NGUYEN - 2022

The dissertation is completed at:

UNIVERSITY OF EDUCATION – THAI NGUYEN UNIVERSITY

Supervisors:

1. Prof. Dr. Do Huong Tra
2. Assoc. Prof. Dr. Vu Thi Kim Lien

Reviewer 1:……

Reviewer 2:……

Reviewer 3:…….

The dissertation will be defended in the university committee:
UNIVERSITY OF EDUCATION - THAI NGUYEN UNIVERSITY

At ……., 2022

The dissertation can be read at:

- National library of Vietnam;
- Digital Center - Thainguyen University;
- Library of University of Education.

LIST OF SCIENTIFIC WORKS OF THE AUTHOR

[1]. Do Huong Tra, **Tran Quang Hieu** (2015), "Using learning films in the teaching process to form problem-solving ability in students", *Journal of Education*, Special Issue March 2015, p.142-144.

[2]. Do Huong Tra, **Tran Quang Hieu** (2015), "Exploiting films in Physics class - A tool for forming and developing students' ability", *Journal of Educational Equipment*, Special Issue April 2015, p.20-22.

[3]. Do Huong Tra, **Tran Quang Hieu** (2020), "Promoting students' problem-solving ability in teaching knowledge about sliding friction (Physics 10) through learning films", *Journal of Education*, Special issue May 1, 2020, p.143-149.

[4]. Do Huong Tra, **Tran Quang Hieu** (2020), "Building and using learning films in teaching knowledge about gravitational force", *Scientific Journal of Hanoi National University of Education*, 65 (7), p.197-207.

[5]. **Tran Quang Hieu,** Vu Thi Kim Lien, Do Huong Tra (2020), STRENGTHENING PROBLEM-SOLVING COMPETENCE THROUGH THE USE OF LEARNING FILMS IN PHYSICS EDUCATION, Proceeding of the 3rd International Conference of Teacher Education Renovation (ICTER 2020): Teacher Competencies For Education 4.0, Thai Nguyen University Pulishing House, 572-586.

INTRODUCTION

1. Rationale for the study

Since the early years of the twentieth century, developing problem-solving ability has been one of the indispensable teaching requirements in countries with developed educational backgrounds. Developing problem-solving ability, especially for those subjects with knowledge of skills associated with reality, is not only following the right educational development orientation but also helping students to be more interested and active in learning, turning academic knowledge into the knowledge of life, strengthening students' confidence in science, making it easy for students to approach life...

In recent years, many studies have mentioned the use of visual aids in teaching physics to help bring the natural world into the classroom, including learning films.

Classical mechanics, stationary state and motion are common in all phenomena of life and have many practical applications. This allows teachers to build and use films in teaching, organize learning activities associated with the practice, and create opportunities to foster problem-solving skills for students.

With that idea, the author chose the topic: "***Building and using learning films in teaching Mechanics - Physics 10 to foster students' problem-solving ability".***

2. Research objectives

The thesis aims to propose the process of building, selecting and using learning films in teaching some knowledge of Mechanics - Physics 10 and designing the process of teaching problem-solving using learning films to foster students' problem-solving ability.

3. Research objects and scope

The thesis focuses on the following research objects: The knowledge content of Mechanics - Physics 10, learning films supporting the process of teaching Mechanics - Physics 10 and students's problem-solving ability.

The scope of research of teaching activities that use learning films in teaching Gravitational force, The laws of motion and universal gravitation, Centripetal force, Friction force and Throwing motion.

4. Research subjects

The research experimented with 10th-grade students in Thai Nguyen province.

5. Scientific hypothesis

If the proposed process of building, selecting and using learning films suitable for the process of teaching problem-solving, students' problem-solving ability will be fostered and developed.

6. Research tasks

- Investigate the theoretical basis for fostering ability, in which special attention is paid to the problem-solving ability of students in teaching Physics.
- Investigate the role of learning films with the development of students' problem-solving ability.
- Investigate the process of organizing teaching and developing problem-solving ability of students.
- Build and use learning films in the process of teaching problem-solving.
- Survey the current situation of teaching with the use of films in teaching as well as with fostering problem-solving ability of students.
- Propose measures to organize teaching problem-solving ability of students.
- Propose the process of building and using learning films.
- Analyze some knowledge of Mechanics - Physics 10 and the ability to use learning films in teaching.
- Build some learning films to use in teaching.
- Design teaching process using learning films to foster problem-solving ability of students.
- Build a tool for assessing problem-solving ability in teaching some knowledge of Mechanics - Physics 10.
- Pedagogical experiment.

- Collect experimental data, and compare problem-solving ability to analyze the behavioral manifestations of students.

- Evaluate the feasibility and effectiveness of using learning films according to the proposed process to the fostering of problem-solving ability of students.

7. Research methods

7.1. Theoretical research method

7.2. Practical research method

7.3. Professional method

7.4. Experimental method

7.5. Mathematical statistical method

8. New contributions of the thesis

Theoretically:

- Proposing the process of building and using learning films.

- Proposing teaching process using learning films to foster students' problem-solving ability.

Practically:

- Building and selecting 70 learning films in teaching Mechanics - Physics 10;

- Designing 4 teaching processes using 31 learning films to foster problem-solving ability of students.

- Building a tool for assessing problem-solving ability in teaching some knowledge of Mechanics - Physics 10.

The research results provide data and scientific information to enrich the reference materials for teaching with the use of learning films to foster problem-solving ability of students.

9. Structure of the thesis

In addition to the introduction, conclusion, references and appendices, the thesis consists of 26 tables, 58 figures and the content is presented in 4 chapters:

Chapter 1: Overview of the research issues

Chapter 2: Theoretical and practical basis of using learning films to foster students' problem-solving ability

Chapter 3: Designing a teaching process using learning films in teaching some knowledge of Mechanics - Physics 10

Chapter 4: Pedagogical experiment

Chapter 1. OVERVIEW OF RESEARCH ISSUES

1.1. Studies on building ability and problem-solving ability for students

One of the important goals of the teaching process is to foster learners' ability, in which problem-solving ability plays an important role and is necessarily formed for students in the learning process.

In the US, educators promote active teaching methods, in which learning is derived from problems and problematic situations. Since the early years of the twentieth century, studies of this type of teaching have been carried out by Kilpatrick (1918) and Dewey (1938). In Canada, a nearly 30-year project (since 1960) research on effective methods to develop problem-solving ability for students was carried out. The results of the project are described in the work of Donald R. Woods et al.

In the last years of the twentieth century, research turned to the direction of building and using case studies in training in many professions, in the fields of management, production activities, scientific research activities, and vocational training. .... Typically researchers in the US and the Netherlands such as Van De L.F.A., Barendse G.W.J. (1993), Dolman D. (1994), Woods D.R. (1994), Gilbert A. and Foster S.F. (1997), Ooms Ir.G.G.H. (2000) and many others. These are research papers on the construction and use of situations in teaching.

In Vietnam, when two books "Basics of problem-raising teaching" by V. Okon (1976) and "Problem-raising teaching" by I.Ia. Lecne (1977) were translated into Vietnamese and popularized in Vietnam, studies on using case studies in teaching began to appear more and more.

Since 2000, OECD has started researching to develop criteria for a common competence framework. In October 2001, OECD published a competence framework for students in three ability groups. A number of other international educational organizations such as ACARA or ATC21S have also studied and developed theories and frameworks on problem-solving ability, as a basis for the application of ability-oriented education.

In Vietnam, the 11th Party Central Committee issued a Resolution (2013) on Fundamental and Comprehensive Innovation in Education and Training. On this basis, the Ministry of Education and Training has implemented the project of Renovating the General Education Program, approved by the Prime Minister. Most recently, the Resolution of the 13th National Party Congress on Education and Training continued to emphasize: "Strongly shifting the educational process from mainly equipping knowledge to comprehensively developing human ability and quality".

Regarding the proposed research on the structure of problem-solving ability, the development of assessment tools, rating scales and the process of assessing students' problem-solving ability, there are works by Nguyen Thi Lan Phuong and Dang Xuan Chuong, by Tran Minh Man…. With reference to the competence framework proposed by international organizations such as OECD or PISA, the authors have developed a structure of problem-solving ability, based on which the authors have developed tools and procedures to assess problem-solving ability of students.

In teaching Physics, recent studies can include the works of Le Thi Thu Hien, Vu The Anh (2016); Tran Thi Ngoc Anh, Nguyen Thi Kim Hue (2020). The book "Teaching and developing the ability of high school Physics" by Do Huong Tra (2019) is a good reference for teachers who are oriented toward ability development.

Both domestic and foreign studies show that fostering and developing problem-solving ability for students must be through

problem-solving activities, which are performed when problematic situations arise. A problematic situation can be an exercise, a story, an image or a video…. Films create learning situations that are easy to attract learners to participate in solving problems due to the advantages of sound, animation, etc. Films also have many advantages in teaching problem-solving, especially for Physics. Therefore, there have been a number of studies on the use of video or film in different stages of the lesson, with different purposes, including the purpose of fostering problem-solving ability for students.

1.2. Research on the use of films in teaching and in teaching to develop problem-solving ability for students

The use of film in teaching has been interested in many countries around the world, especially since video technology appeared in the 1970s of the twentieth century.

With Physics, videos and learning films have been around since at least the early 1950s with a series of films sponsored by the American Association of Physics Teachers. Physics in Film is a Physics teaching program using films, deployed at the University of Florida (USA). However, at this stage, there are few theories on the method of building and using films in teaching. Regarding the method of using films in teaching in schools, two books with the same name by two former Soviet educators M.B.Vextiski and L.P.Precxmana "*Technical development of teaching in high school*" have generally mentioned the techniques in teaching science subjects at high schools, in which the importance of film and television is mentioned. However, the method of using films in teaching according to two books only for the purpose of illustrating the teacher's teaching in the class. Some authors theoretically assert more clearly the role of using videos in the classroom, such as Jean-Michel Ducrot (2005). Thierry Verstraete, Florence Krémer and Gérard Néraudau outlined the stages of using films. Bettine Hamille,

Peter Schott and Alain Pontes emphasized that the film acts as a warm-up for interactive activities in the classroom. Studies have all emphasized the role of film in the classroom.

In our country, the construction and use of video in teaching is at the initial stage of research and application. In the research and development of teaching videotapes, first of all, the Learning Resource Center of the Ministry of Education and Training, the Center of Audiovisual Education of the Department of Education and Training of Ho Chi Minh City must be mentioned. Besides, there have also been some domestic studies mentioning the use of video clips, computer connection software, specialized software such as Powerpoint, video analysis such as those of Phan Gia Anh Vu, Mai Van Trinh and some other projects. These studies all focus on the use and exploitation of software and experiments with the support of computers to organize learning activities in teaching Physics but have not yet gone deep into the construction and use of films in teaching.

There are a number of studies that have mentioned the history of film in teaching in the subjects of History, Geography and Chemistry. These studies have mentioned the use of images, experimental films and proposed measures to promote students' ability to explore, discover and practice. However, those studies have not established effective and feasible methods of using films, and the relationship between using films and fostering problem-solving ability has not been properly researched.

Thus, the use of films in teaching has been studied by a number of authors. However, the studies on the use of films with attention to learning films in teaching Physics knowledge in order to foster problem-solving ability for students, are still lacking.

From the above studies, the author identifies the research issues of the topic:

- How can we suggest the process of building and using films in learning?

- From the structure of the identified problem-solving ability, how can a teaching process be designed with the use of learning films to meet the goal of ability development?

- How can we build a tool to assess students' problem-solving ability?

From the above research problems, the author determined the title of the topic: **Building and using learning films in teaching Mechanics - Physics 10 to foster students' problem-solving ability.**

Chapter 2. THEORETICAL AND PRACTICAL BASIS OF BUILDING AND USING LEARNING FILMS TO FOSTER STUDENTS' PROBLEM-SOLVING ABILITY

2.1. Problem-solving ability

2.1.1. The concept of problem-solving ability

According to Vo Bich Ngan (2018), Student's problem-solving ability is the ability of students to coordinate and apply their own experiences, knowledge and skills of subjects in the curriculum to solve problems in school and their lives with a positive attitude.

2.1.2. Manifestations of problem-solving ability

The ability to solve problems is expressed specifically in:

- Detecting the problem.
- Collecting and clarifying information related to the problem.
- Proposing different scientific hypotheses.
- Creating a plan to solve the problem.
- Implementing and evaluating problem-solving solutions.

2.1.3. The structure of problem-solving ability

In this study, we agree and use the problem-solving ability structure of Do Huong Tra et al. The structure of problem-solving ability to develop in students includes four components: Understanding and identifying problems, Proposing solutions, Implementing solutions, Assessing the task of problem-solving and Discovering new problems.

2.2. Teaching to foster students' problem-solving ability

2.2.1. Measures to foster problem-solving ability

a. Fostering the ability to understand and define problems

b. Fostering the ability to propose solutions

c. Fostering the ability to implement problem-solving solutions

d. Fostering the ability to evaluate the task of problem-solving and discover new problems

2.2.2. Teaching problem-solving in the direction of fostering students' problem-solving skills

a. The concept of teaching problem-solving

According to V. Okon, teaching problem-solving in the most general form is all activities such as organizing problematic situations, detecting and stating problems, guiding students to find the necessary information to solve given problems, then examining ways of solving and finally systematizing and consolidating the acquired techniques. Teaching problem-solving is a teaching strategy to form for students the habit of exploring problem-solving in the way of scientists. Thereby, it not only creates demand and interest in learning, helps students to dominate knowledge, but also contributes to the development of problem-solving and creativity ability of students.

b. Stages of teaching problem-solving in teaching Physics

- *Stage 1: Create a problem that needs to be solved*
- *Stage 2: State the problem to be solved*
- *Stage 3: Solve the problem*
- *Stage 4: Draw a conclusion*
- *Stage 5: Apply new knowledge to solve the next tasks*

2.2.3. The scientific process of building and applying knowledge in teaching Physics

In the research, the author used the proposed process diagram of problem-solving by Pham Huu Tong. Specifically, the path of

forming knowledge follows the stages of the teaching process to solve problems. Depending on the content of the lesson, the cognitive level of the students and the teaching goals, the problem-solving process can follow a branch (or a *theoretical* route (theoretical inference) or an *experimental* route (Observation, conducting experiments) or both.

2.3. Building and using films in the teaching process

2.3.1. The concept of film

2.3.1.1. Film

A film is a cinematographic work that is recorded and played on a screen through electronic signals.

2.3.1.2. Learning film

Learning films are understood as films that are built for the purpose of teaching. They contain images and sounds related to the lessons and concepts of teaching activities. The structure of the film is suitable for the learning activities, teaching methods and it ensures the teaching environment as well as the pedagogical requirements. The thesis uses the term *learning film* with the above meaning.

2.3.2. The role of learning films in teaching Physics

The effect of learning films is great since students come to knowledge through attractive and vivid images and sounds. Learning film is a tool for teachers to exploit and use for teaching purposes.

2.3.3. Classification of learning films

a. Films for the purpose of creating situations

b. Films for the purpose of supporting the process of proposing solutions to problems

c. Films for the purpose of supporting the problem-solving process

d. Films requiring applying knowledge and skills to explain the phenomenon

2.3.4. Building and selecting learning films

2.3.4.1. Principles of building and selecting learning films

Based on the teaching to develop ability, the characteristics of cognitive activities, the knowledge that needs to be taught and the

role of learning films, the author proposes principles of building the learning films:

Principle 1: Learning films must reflect real-life events and phenomena in the most realistic and natural way. It can be processed or unprocessed.

Principle 2: The layout of the learning films should be tight, clear, bright, and friendly to learners.

Principle 3: The content of the learning films must be appropriate to the curriculum and the psychological characteristics of the students' ages.

Principle 4: The content of the learning films must ensure convenient use for teachers and students.

Principle 5: The content of the learning films must orient to develop and foster students' problem-solving ability.

Principle 6: The content of the learning films must be evaluated and edited during use.

2.3.4.2. Steps of building a learning film

From the principles of building learning films, the process of building learning films is described in Figure 2.4.

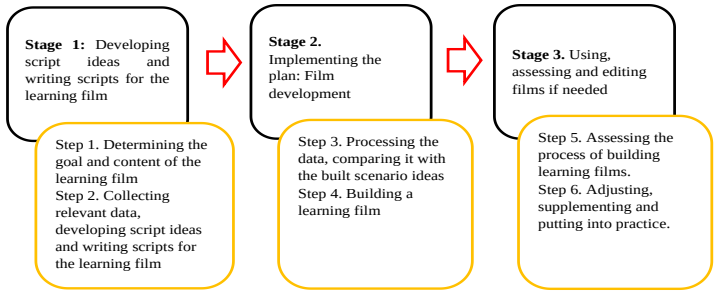


Figure 2.4. Steps of building a learning film

2.3.5. Using learning films to develop students' problem-solving ability

2.3.5.1. Teaching and learning strategies in exploiting films in class

The exploitation of film is divided into three stages: Before screening, during screening and after screening. It is during that

process that students' problem-solving ability are fostered and developed.

2.3.5.2. Teaching process with the use of learning films

The author proposes the teaching process with the use of learning films described in Figure 2.5.

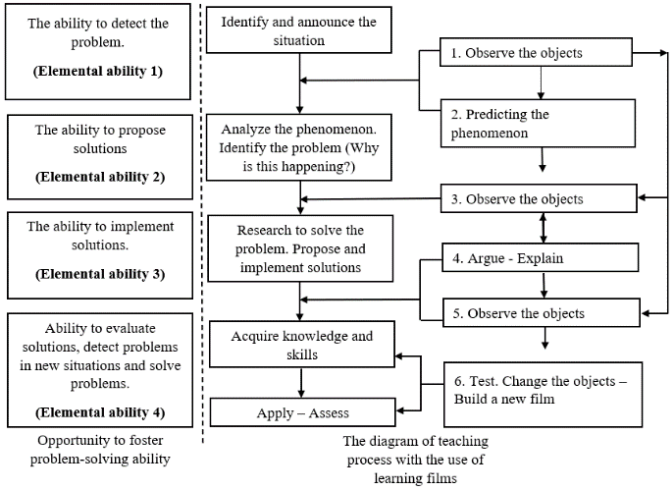


Figure 2.5. Teaching process with the use of learning films to foster students' problem-solving ability

2.4. Assessment of problem-solving ability in teaching with the use of learning films

2.4.1. The concept of ability assessment

According to Eric Witty's approach, it can be generalized that ability assessment is the process of interacting with the assessee to collect evidence about ability, using existing assessment standards to draw conclusions about the level of success or failure of a person's ability.

2.4.2. Principles of ability assessment

Principle 1. Ensure validity.

Principle 2. Ensure comprehensiveness and flexibility.

Principle 3. Ensure fairness and trustworthiness.

Principle 4. Evaluation requires consideration of both outcomes and the experiences that lead to them.

Principle 5. Evaluation in a practical context and for the development of the person being assessed.

2.4.3. The tool for assessing problem-solving ability

2.4.3.1. Checklist for observing the behavior of problem-solving ability in teaching using learning films

2.4.3.2. Assessment by Academic Profile

2.4.3.3. Assessed by Competence Assessment Test

2.5. Practical investigation

A practical investigation shows that the actual situation of building and using learning films has many shortcomings, such as lack of theoretical basis, lack of learning film resources, teachers are still afraid to innovate, and afraid to invest in building learning films. While in the opposite direction, students are more interested in learning films compared to other teaching media.

CONCLUSION OF CHAPTER 2

Problem-solving ability is one of the important human abilities that many advanced education systems in the world pay attention to fostering for students in teaching. This is one of three groups of common abilities that need to be formed and developed for students that the Ministry of Education and Training of our country identifies in the new general education program.

For the fostering of problem-solving ability for students, problem-solving teaching is the predominant type of teaching organization in the methods and types of active teaching organizations. In teaching problem-solving, giving rise to a problem to be solved, or creating a problematic situation in learning, is considered the starting point, an important step in motivating learners, attracting learners to participate in knowledge-building activities. From there, learners actively participate in the next steps of problem-solving activities, helping to

improve their problem-solving ability in learning.

One of the effective tools that can create interactive situations for students to detect problems that need to be solved is the use of learning films. Learning films are used throughout the problem-solving process to assist in proposing solutions, implementing problem-solving solutions or describing phenomena that require the application of knowledge to explain. The effect of teaching with films is great. However, through practical investigation, it shows that the building and use of learning films in schools are still inadequate. While in the opposite direction, students are more interested in learning films compared to other teaching practices. Therefore, the proposal of principles and processes for the building and use of learning films will help teachers clearly shape the path to building and using learning films appropriately, helping to support the teaching problem-solving ability for students effectively.

Chapter 3. BUILDING AND USING LEARNING FILMS IN TEACHING THE KNOWLEDGE OF MECHANICS

3.1. Analysis of the content characteristics of Mechanics - Physics 10

3.1.1. The logical structure of knowledge of Mechanics - Physics 10

The part Mechanics in the 10th-grade Physics program is divided into chapters: Kinematics, Dynamics, Equilibrium and motion of solids and Conservation laws. Thus, it can be seen that the part Mechanics in the 10th grade Physics program includes 4 groups of content about Motion of objects, Forces in mechanics and Newton's Laws, Equilibrium of objects and forms of equilibrium and Conservation laws.

3.1.2. Teaching goals

According to the standard of knowledge and skills in Physics 10, the teaching objectives are about Motion of objects, Forces in mechanics and Newton's laws.

3.2. Designing a teaching process using learning films

According to the stages of film building/use described in section 2.4.5.2 and the teaching process using learning films in section 2.4.6.2, the researcher has built/selected films for 4 lessons and designed the process of teaching problem-solving using those films. In each lesson, along with the Scientific Process Diagram to solve the problem, the researcher has built a learning film and designed a teaching process. Based on the goal of fostering problem-solving ability, the researcher has designed a checklist of problem-solving ability for 4 lessons.

3.2.1. The lesson "Gravitational force"

3.2.1.1. The scientific process of problem-solving

3.2.1.2. Building a learning film

Stage 1: Developing script ideas and writing scripts for the learning film

Step 1: Determining the goal and content of the learning film

a. Difficulties in teaching the lesson "Gravitational force"

Identifying difficulties in teaching and ways to overcome them through learning films in the process of teaching the lesson "Gravitational force".

Step 2. Collecting relevant data, developing script ideas and writing scripts for the learning film

- Collecting relevant data to script ideas:

+ The attractive force between two objects with mass.

+ Determining Cavendish's gravitational constant.

+ The Moon's orbit around the Earth, the Earth's orbit around the Sun.

+ Causes of tides.

+ The phenomena of using gravitational force and Newton's II law.

- Write scripts for each film.

Stage 2. Implementing the plan: Film development

Step 3: Processing the data, comparing it with the built scenario ideas

Step 4. Building a learning film

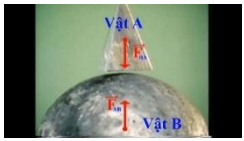
From the above analysis, the author has built/selected learning films and used them in teaching the lesson of Gravitational force.

Film 1: The film is used in creating situations where Gravitational force appears.

- A tennis ball spinning around a point requires a force (e.g. string tension) to hold the ball. The question arises: is there a force that keeps the Moon around the Earth and the Earth around the Sun? Students discuss and give explanations.

Link: https://youtu.be/5pvXRlDlAfs

Movie 2: Visualizing Gravitational force that is always the force of attraction between objects with mass.



Observe the film about weighing a heavy object and read the scale's index: 152.166g. Put under the weight a lead ball with a large mass, and ask students to predict if the weight will change and why?

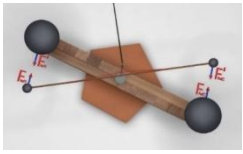
Link: https://youtu.be/nMDM3HSBtJ4

From the results of the experiment: the index of the scale increases, the student must make a prediction and explain the increase in the index of the scale because there is an attractive force between the ball and the object.

Through the film, students will clearly recognize the attractive force between two objects with mass.

Link: https://youtu.be/-UUsRtce65E

Film 3: Introduction to determining the gravitational constant G

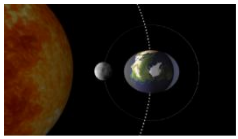


How can the mass of the planets in the solar system be determined, for example the mass of the Earth? To do this, it is necessary to know how to determine the constant G. The film introduces how to measure Cavendish's

gravitation constant. Students watch a film on how to measure the gravitational constant to explain the experimental solution, predict the results, and then make comments.

Link: https://youtu.be/AykqRs-7Yq0

Film 4: Describe and explain the phenomenon of tides



The film describes the phenomenon of tides: the water rises and falls at fixed times of the day.

The film simulates the cause of tides due to the movement of the Moon around the Earth.

Link: https://youtu.be/UBWcAIh4IEQ

Film 5: Life on a space station orbiting the Earth

The film shows images of the space station orbiting the Earth, where the gravitational force is almost eliminated. Questions arose about what phenomena in life would be like without gravitational force such as: What would it be like to move? Would the way of eating change? How can objects be moved?

Link: https://youtu.be/0BJXaJLH93s

Stage 3. Using films and editing films if needed

Through the process of teaching with the use of films, the teacher can evaluate the effectiveness of the film (in particular, fostering problem-solving ability). From there, film corrections can be made if needed.

3.2.1.3. Designing a teaching process using learning films

3.2.2. The lesson "Friction"

3.2.3. The lesson "Centripetal force"

3.2.4. The lesson "Throwing motion"

Similar to the above lesson, along with the Scientific Problem Solving Process Diagram, the author has built a learning film and

designed the teaching process of the lessons “Friction”, “Centripetal force” and “Throwing motion”.

CONCLUSION OF CHAPTER 3

1) Teaching problem-solving in which the use of films is the foundation to foster problem-solving ability for students.

2) It is especially important to identify the knowledge of each lesson and base it on the data (movies, pictures, experiments, historical stories, etc.) From there, teachers can have enough ground and combine their own skills to build and select learning films to meet the requirements of fostering and developing students’ ability.

3) Learning films can be used in many different stages of problem-solving teaching process.

4) Teachers need to exploit each learning film into many stages: before watching the film, while watching the film and after watching the film. From there, it is possible to gain the highest efficiency when using learning films.

5) In the process of teaching with the use of learning films, it is always necessary to evaluate and innovate on teaching methods as well as film content to match the psychology of students and the content of the lesson.

CHAPTER 4. PEDAGOGICAL EXPERIMENT

4.1. Purposes and tasks of pedagogical experiment

4.1.1. Purposes of pedagogical experiment

Pedagogical experiment is conducted for the purpose of checking the correctness of the scientific hypothesis that the topic has set,. At the same time, it assesses the feasibility and effectiveness of the teaching processes designed in chapter 3 with the use of learning films in teaching to foster problem-solving ability of students. From there, based on the results of pedagogical experiments, it is possible to make appropriate adjustments on how to organize teaching as well as the content of the teaching films and their use in different stages of the teaching process in order to foster problem-solving ability of students.

4.1.2. Tasks of pedagogical experiment

To achieve the goals, when conducting pedagogical experiments, the author performed the following tasks:

- Preparing adequate facilities.

- Organizing teaching lessons designed in chapter 3 with the support of learning films.

- Collecting information about problem-solving ability of students in the process of organizing teaching. To assess students' progress through lessons, the study focused on monitoring the behavior of problem-solving ability in 8 students.

- Analyzing, processing and evaluating the results of the pedagogical experiment.

4.2. Objects and content of pedagogical experiment

4.2.1. Objects of pedagogical experiment

The pedagogical experiment is conducted in 2 rounds with 10th-grade students of Bac Son high school and Luu Nhan Chu high school - Thai Nguyen province in the lessons designed in chapter 3.

4.2.2. Time and content of pedagogical experiment

The time to conduct the first round of the pedagogical experiment was from September 25, 2019 to November 31, 2019. The second round was conducted from March 16, 2019 to May 10, 2020.

4.3. Methods of pedagogical experiment and design selection

4.3.1. Methods of pedagogical experiment

4.3.1.1. Observation method

4.3.1.2. Mathematical statistical method

4.3.2. Design selection

As presented, the study selected a design with a control group.

4.4. Process and results of pedagogical experiment

4.4.1. Results of the first round of the pedagogical experiment

4.4.1.1. Evaluation criteria: Determine the criteria for evaluation of measures to foster problem-solving ability for students through the use of learning films and the process of building and using films.

4.4.1.2. Evaluation of the results of the first round of the pedagogical experiment

- The learning films proved to be effective in fostering problem-solving ability for students.

- The steps to build learning films initially show the suitability when experimenting with film building.

- The process of using learning films has met the criteria of fostering problem-solving ability of students.

4.4.1.3. Necessary adjustments to prepare for the second round of the pedagogical experiment

From the results of the first round of pedagogical experiment, it shows that the process of building and using films is quite suitable for fostering problem-solving ability. However, there are also some film content and activities using films that need to be adjusted to bring about higher efficiency.

4.4.2. Progress and results obtained in the second round of the pedagogical experiment

4.4.2.1. The lesson "Gravitational force"

4.4.2.2. The lesson "Friction"

4.4.2.3. The lesson "Centripetal Force"

4.4.2.4. The lesson "Throwing motion"

4.5. Evaluation of pedagogical experimental results

4.5.1. Developing criteria to evaluate the achieved levels of problem-solving ability

In order to facilitate the assessment of the level of achievement of problem-solving ability, the quality criteria of behavior should be scored.

4.5.2 Case study: Assessing the development of problem-solving ability of students

4.5.2.1. Assessment according to each element of problem-solving ability

4.5.2.2. Overall assessment of the problem-solving ability

4.5.3. Evaluation by test after pedagogical experiment

School/Class		Average	Median	Standard deviation	T- Test
Bac Son	10A6 (TN)	6.88	7.0	1.48	p = 0.028 (p < 0.05)
	10A7 (ĐC)	6.19	6.0	1.30	
Luu Nhan Chu	10A6 (TN)	6.77	7.0	1.40	p = 0.029 (p < 0.05)
	10A8 (ĐC)	6,08	6.0	1.31	

Table 4.10: Summary of the results of the first ability assessment test

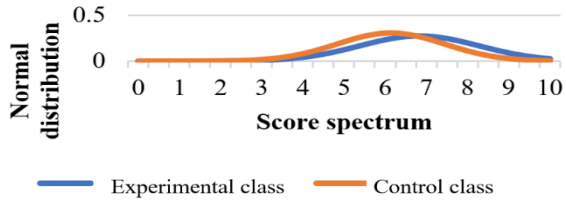


Figure 4.40. The normal distribution of the first test score results

Comparing the average scores of the first test shows that: In both schools, the average score of the experimental class is higher than that of the control class. Using the T-test with 2 independent groups, the result is $p < 0.05$. Thus, it can be concluded that the difference between the mean value of the first test in the control and experimental classes in both schools is significant.

School/Class		Average	Median	Standard deviation	T- Test
Bac Son	10A6 (TN)	7.14	7.0	1.32	p = 0.004 (p < 0.05)
	10A7 (ĐC)	6.31	6.0	1.24	
Luu Nhan Chu	10A6 (TN)	6.92	7.0	1.35	p = 0.043 (p < 0.05)
	10A8 (ĐC)	6.31	6.0	1.26	

Table 4.11: Summary of the results of the second ability assessment test

From the results obtained in the second test, similar conclusions can be drawn: In both schools, the average score of the experimental class is higher than that of the control class. Using the T-test with 2 independent classes, the result is $p \leq 0.05$. Thus, it can be concluded

that the difference between the mean value of the second test in the control and experimental classes in both schools is significant.

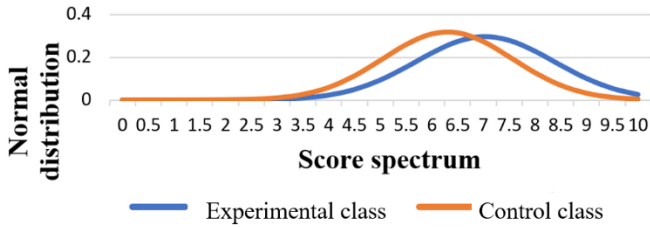


Figure 4.41. The normal distribution of the results of the second test

The above results show that the content of learning films and the teaching process using learning films have had the effect of fostering problem-solving ability of students.

CONCLUSION OF CHAPTER 4

The process of teaching problem-solving with the support of learning films is suitable to apply on 10th-grade students in order to foster their problem-solving ability.

The proposal of steps and stages to build learning films in Chapter 3 shows reasonableness after the first experiment, with the adjustment and addition of films for the second experiment in learning activities.

The set of tools is reliable in assessing the development of students' problem-solving ability and the level of behavioral indicators is suitable for 10th-grade students.

The obtained results of the pedagogical experiment also allow confirming the effectiveness and feasibility of dividing the level of assessment of problem-solving ability of students with both the process as well as with each component ability in the problem-solving process. At the same time, it allows assessing the progress of students' problem-solving ability through lessons.

CONCLUSION, PROPOSALS AND RECOMMENDATIONS

1. Conclusion

1.1. We have identified the concept of learning film and proposed the steps to build learning films based on the principles of building learning films.

1.2. We have proposed to bring the process of teaching problem-solving with the support of learning films.

1.3. We have identified the concept of problem-solving ability, its manifestations and components.

1.4. We have built a toolkit for assessing problem-solving ability and correspondingly, each component has 3 levels of behavioral indicators of students.

1.5. We have selected 4 lessons in the content of Mechanics - Physics 10 to build the process of teaching problem-solving with the support of learning films.

1.6. We have built new learning films, selecting existing videos and editing them into films to serve teaching activities. Besides, the content of the films is suitable for the lessons, making it easier for teachers to build teaching processes.

2. Proposals for the next research of the thesis

2.1. Researching to design a system of learning films on Thermography and Optics at secondary and high school levels to teach problem-solving with the support of learning films.

2.2. Building a system of questions and exercises to be a development tool for assessing students' problem-solving ability.

2.3. Researching to develop a set of criteria for assessing problemp-solving ability of students to detect and foster high-quality human resources.

2.4. Researching to design a website for a system of learning films, helping teachers have quality and effective teaching and reference resources.

2.5. Proposing to include the process of creating learning films into the teaching method of Physics in the training program at

education universities in order to improve the quality of teacher training.

3. Recommendations

3.1. For the Ministry of Education and Training

3.1.1. Deploying and applying problem-solving teaching on a large scale with the support of learning films, especially the process of building and using learning films.

3.1.2. Disseminating criteria for assessing students' problem-solving ability to teachers to remove difficulties in assessing students' progress.

3.2. For teachers

3.2.1. Researching the process of teaching problem-solving with the support of learning films, researching the process of building and using learning films to be able to design lessons and apply them to teaching in schools in order to develop problem-solving ability for students.

3.2.2. Building a resource repository about learning films to apply the problem-solving teaching process, encouraging and guiding students to make their own films through the steps in the process. At the same time, students will be able to apply knowledge to real-life situations.