Implementation of Materials Science Design, Technology and Society Based on Dual Coding Theory (Pgsd Program Module Open University)

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Abstract: *Designing learning materials contains science technology and society in social studies required the development appropriate materials with the social science subject's characteristics. By material based on dual coding theory become an alternative development of innovative materials. The aims of this study are (1) to know visual information and verbal (dual coding theory) in STM material as learning support of social studies (2) to know how concrete verbal information and meaningfull better (dual coding theory) in STM material as learning support of social studies for students of long distance distance education. The method of research are done by three steps(1) The initial concept of pattern-based material dual coding, (2)developing learning material journal design in STS material-based dual coding, (3) validating the journal material design. The number of sample is determined about 80 students and chosen by proportional purposive sampling areas as research subject. The research result indicates that there is an increased understanding of the students when learning materials are presented using visual and verbal in textbooks. Comprehension is reduced when the learning material is presented through text. The results also show that the material based on dual coding can improve student understanding regardless of learning style preferred by students, and students who intuitive learning style tends to have a better understanding.*

Keywords: *STS, Dual Coding Theory, Social Studies*

1. INTRODUCTION

During its development, higher education paradigm shift dramatically from elitist develops into mass and now it changes into universal [1]. It means that higher education seen as a basic right of every society. Mass and universal education system requires a significant change in terms of institutional diversification, the ability to accommodate a heterogeneous student population, changing the characteristics and patterns of profession and academic work, the increasing control of the institutional management, and the development of applying of long distance higher education system [2]. A paradigm shift proposed by some experts such as Makagiansar [3] that entering the 21st century education will have a shift of paradigm changing include: (1) from learning by steps to lifelong learning, (2) from study which focuses on mastery of knowledge to holistic learning, (3) from the image of the confrontational teacher-student relationship to the image of the partnership, and (4) from teachers emphasizing scholastic knowledge (academic) to focus on the balance of education value, (5) from campaign against illiteracy to campaign against technology, culture, and computer, (6) from the appearance of the isolated teacher to the appearance of team work, (7) from the exclusive concentration on competition to cooperative orientation. Danumiharja[4]argues that learning approach used in the knowledge century is a mixed approach which the combination between learning approaches from teachers, learning from learners, and learning by themselves. In knowledge century, characterized by: Teacher as facilitator, mentor and consultant; Teacher as a friend to learn that learning is directed by learners not only curriculum, Open learning, strict with limited time and flexible as necessary, mainly based on projects and problems. Real world and reflection with the principle of the survey, investigation and designing, discovery and creation, collaboration and focusing on the community. The result is open, creative diversity, computer as a tool of all kind of learning, and a dynamic multi-media interaction.

The successful of student learning is determined by internal and external factors. Internal factors include the factors in students themselves, such as learning motivation shown by persistence in learning. Meanwhile, external factors refers to the condition or encouragement from students outside which come from family and environment of society. Meanwhile, the psychosocial aspects that affect student learning reflected to the inability of students to coordinate the psychosocial aspects such as family, work / tasks, social functioning, social environment, and so on. These are the aspects that gives color to the development of student individually.

In fulfillment of independent study which must be applied by students of long distance education need a teaching materials which also has the characteristics of self-learning purposes. Assessing the printed teaching materials (module) as a medium of learning, according to Ellington and Race [5], printed teaching materials designed with simple language, communicative, and unclear, which involves the process of stuidents' thinking, as well as to evaluate the level of learners mastering in self-learning process. Meanwhile, media can enhance learning activities[6, 7]. Media can help them to create a better mental models which help students' understanding . As an example, a book (module), which contains text only requires us to have prior knowledge of what discussed in the book, therefore we can create mental models. Without the priority of the knowledge (prior knowledge) about the material covered, mental models created can be inaccurate. When the book included pictures, the learner will be easier to make mental models to be more complete and precise. Thus, through media, a learner has the ability to explore places, in the virtual world, which never be seen directly. Media increase the ability of humans to learn. Learning can not be separated from the processes of absorption of visual and verbal information. Reality developed more long distance education students are rarely differentiate visual and verbal information in the learning process. These conditions also affect the learning process which accepted verbally or visually by the students at the Open University (UT).

Referring to the concept-based teaching materials Dual Coding Theory (DCT), material teaching of Open University can be said has a quality if the way they are presented meet the standards determined, the material is up to date, and students can easily learn. Presenting of good teaching materials are in accordance with the guidelines set by the UT. The material written in the teaching materials are expected to be up to date. While, the indicators of teaching materials are easily learned by the students which can be seen in the results of evaluation of student learning. To maintain the quality of teaching materials of Open University, the evaluation of teaching materials need to be done. Evaluation of teaching materials of long distance need to do by involving the elements which can provide the improvements of the parts of module, such as for the materials, media, language, graphic design, lecturers or tutors and students which ultimately makes a Book Topic (BMP) which has excellent quality.

The essence of this research is to design a verbal and visual-based material in an effort to make teaching materials of social science subject as a text book learning can improvement the development of students' understanding, therefore, Dual Coding Theory is exist. Based on the background of research, this study aims to: 1) know how visual information is higher than verbal information (dual coding theory) in STM material as learning supporting of social science in long distance education students. 2) know how verbal information which is concrete and meaningfull is better (dual coding) in STM material as learning supporting of socialscience in long distance education students.

2. DESIGN OF RESEARCH METHODS

This research is development research which use mixed methodology such as qualitative method, development of reconstruction model, and quantitative.

At the first stage, this research uses qualitative method. As done by Darrow [8] who studied about the concept of connectivism-based learning theory, this study begins by collecting data and information from various sources to gain an understanding of the DCT concept of long distance education in Indonesia[8-10]. To obtain the data and information, Darrow [8] collects from journals, books, online databases, interviews, and observations.

Model of approach in this research is designed with research and development approach (research and development). Gall and Borg [11, 12] illustrate that research and development comes from an industry-based development model, which is used as a product to design and develop a quality of new product.

Assessing the effectiveness of the final model design test developed is done by involving three UPBJJs by two sample groups, which are experimental group and control group. The number of

experimental groups is as much as control group. From the three UPBJJ involve six lecturers of social science subjects. The six lecturers consist of three lecturers for experimental group and three others for control group. The existence of similarity or similarity of the categories in these two groups, so design used is matching only pretest-posttest control group design [11-13]. These two groups are each given pre-test and post-test, as well as self-evaluation questionnaires, but only one group which is given a treatment. The steps taken in model testing conducting in this study are Preparation, Quasi experiment implementation, and Analysis and interpretation of design results.

In the third stage (reconstruction test) is also conducted by monitoring and evaluation of the impact from the experimental results. This activity is conducted to find out how far the impact of the results of the implementation of this developed reconstruction in giving contributing to learning process of social studies and student learning achievement (motivation, attitudes and aspirations of students and lecturers of PGSD). Finally, the model / product of this study is expected to be implemented by lecturers in teacher education of elementary shcool students in particular, and PIPS educators in general.

3. RESULTS AND DISCUSSION

3.1. Results Study of Introduction

This research stage is intended to identify and analyze the ongoing conditions in the course of national history and world history courses for students of history education courses especially related with condition of students' thinking skills.

3.1.1. Lectures and Student

Most of the lecturers have background qualification of education in two strata. Most of these lecturers come from local private university institutions and education officials. On the other hand, most of the lecturers also work as teachers teaching in junior and senior high school. The reason that most respondents lecturer regarding the subject matter tutorials and social science subject for elementary school is because of the material presented in the module. There are some concepts that are difficult to develop by tutors and students do not understand the concept. The limitations in material development are also become an obstacle in decomposing the material as a whole.

3.1.2. The Aim of Subject Competency

To answer the question, what the main aim of the subject given to students, the respondences (lectures) give varies answers. Based on the number of respondences giving the same answer and classified, it is arranged in sequence on the table billow which is started from the most respondence to the least.

Table1. *Lectures' View about the competency of subject for teaching education for elementary students of Open University*

Ranked of Answer	Description of Lectures's Answer
1.	Mastering the material/ knowledge
2.	Understanding STS material and related with the condition of nowdays
3.	Exposing the pettern of critical thinking and have perception in the future related with STS material
4.	Students think realistically, every event has relation with STS' cases
5.	Developing the thinking based on STS material Dual Coding-based
6.	Become a professional elementary school teacher and able to do STS material development in each school
7.	Understand the meaning of STS concept Dual Coding-based

If looked at lectures' answer about main aim of learning implementation to students, it is obtained that most of lectures put the mastering of STS material as the main aim than developing thinking skill. When they are asked what the basic thinking of those lectures, those give varied answers such as:

- Open University produce elementary teacher, therefore they have to master the material

- Those students are elementary teacher, therefore they have to be able to develop the material

Varied answers given by those respondents (lectures) bring the effect how social science subject is conducted. Giving dictation of the material become appropriate conducted if lectures' goal only to deliver the material and teach for tests "teaching to test". In contrast, it will be different with lectures having learning goal to develop the material and Dual Coding-based. As clearly it can be referenced to the previous research result about how the developing of material, learning method, and media/ learning source used by those lectures having different views.

3.1.3. Developing the Material

Connection with material development, all lectures respondents said that they used the actual issues/event which happen this time. In example, analogy in give subject material explaination. This case is rather different with student respondets' answer. They said that there are only some lectures explaining the material by giving STS material understanding. Most of students (85 percent) said that their lectures seldom teach them to discuss, analyze the issue about the up to date event in STS contex and the other (15 percent) said that lectures never discuss or explain about the issues which related with up to date event in their learning. Some of students (10 percent) in one of the subject research place said that they were directed in discussion event to analyze the actual event (example: reformation, election, economic crisis).

From the interview result, it found that students tend to glue in understanding material in module and discuss with friends rather than lectures. A group of students respondent said that didn't get the explaination about STS material widely from their lectures, they prefer to get the explaination from other source such as "google" or their friend that understanding more about the material. This is the main reason that they are passive to join the class, give response in discussion. Those students' behaviors caused by lectures give unsatisfied answer which make students didn't more understand. From those answer by students and lecture bring up the idea that it need a module which bridge both of argument seems opposite in activity, motivation, learning independent, and thinking skill in social study.

3.1.4. The Using of Literature/ Material Resource, Media and Medium/Infrastructure

Most of lectures (60 percent) said they don't feel difficult in preparing the literature need in subject taught. If they feel difficult they will cover their luck of literature with newspaper articles and journal. While the other respondents (40 percent) said that they feel difficult to prepare the literature because they feel ancient, lack in English and the price of the book which is expensive. They also said that the lack of variation in module didn't really help them and students. To resolve the lack of the literature for students, some of lectures borrow some book to be copied.

Meanwhile, there's some of them explain various important issues from another source for students. During TTM process in tutoring class, studnets often note/summarize the material delivered by tutor while tutor explain the content of the material. According to observation result of the researcher in one of the subject taught, the explaination given by lecture tends to review the material delivered without description or examples.

Relating with the use of visual in material of module, there are only 15 percent of respondents (lectures) use the primary source in analyzing STS Dual Coding based (document, pictures, graph, colomn, chat, etc), while the others never used at all. Lectures give students primary source, such as giving students chance to analyze various cases in society. Students have never done to do interpret themselves. In contrast, most of lectures answer the quetionary that they used primary source. After interviewed they assume that by using material issue by visual give new inovasion in learning in long distance education and reduce the material gap which need up to date analysis. This data is strengthened by observation result and almost all of the students' answer in questionary which said that STS material dualcoding based is alternative source of learning which can give new experience in criticize the concept existed.

All of students said that they have never done the analysis, interpret STS material through primary sources. The result of the analysis has been received by them as lectures' interpretation based on writer's module's interpretation. So, students only receive reproduction of the analysis from the

previous module. From interview result, most of students said they only receive what lectures' delivery to be material tested and they seldom involve in activity that introduce them to give interpretation students' version of STS material analysis in module. On the other hand, they don't have experience how to analyze STS analysis in various social cases.

Learning medium used as general is good enough, both of discussion groups can give the subject material in TTM by infocus, though it is still limit of the number, and rolling of the using. Both of discussion group also use white board, which mean that there is no infocus or electrical used which is limited. The limit of medium used prepared by discussion group effect the spirit and lecture's behavior in running the process of learning. Even one of the lecture give response related with those case that they didn't teach for college students but for senior high school students.

3.1.5. Learning Method

In using the method often used, lecture gives more than one answer of the method. From those answers are arranged based on the most answers to the less answers appear such as presented in the table below.

Table2. *Lectures' argument about the method often used in TTM*

Answer Ranked	Answer
1.	Talk/lecture
2.	Discussion
3.	Giving task
4.	Question-answer
5.	Inquiry
6.	Problem Solving

The dominant of lecture method used is justified by students. Their response for the question which method used by lectures in learning process, such as talk, discussion, question-answer, noted, giving task and make as interpretation result of the material in module. In detail, respondents' response can be seen in the table below.

Table3. *Students' responses about the method often used by lectures in TTM*

Responses	The number of group discussion's responses (Cinangka dan Lebakwangi)	The number of group discussion respondents (Balikpapan dan Lahat)	The number of group discussion respondents (Cikokol dan Pondokcabe)
Talk	26 (34,7%)	32 (43,5%)	32 (38,8%)
Discussion	25 (31,9%)	20 (30,1%)	21 (27,7%)
Question-answer	16 (23,6%)	11 (19,4%)	12 (20,8%)
Summarizing resume	3 (9,7%)	2 (6,9%)	4 (12,5%)
Number	71 (100%)	65 (100%)	69 (100%)

From the result of researcher observation find that three of the method is the most methods used in learning. There is one lecture applying the inquiry method for the experimental research. The background of the problem tested the inquiry method according to the lecture (SY). The reason is because of boring feeling of the students to learn social science subject by talk and discussion method which is considered as old pattern for them.

Related with the using of talk and discussion method used, most of lecture respondents (61,9 percent) said that they don't satisfied with the using of the method. According to them, there are several methods they feel suitable with the subject tough but it is rather difficult to be done such as giving task method, inquiry, and problem solving and jigsaw method. While the other part of lecture (28,5 bpercent) said that talk and discussion method are suitable as an effort to give the understanding of the material and critical skill for students toward the material given. And other less of lectures (9,5 percent) said that talk method is the most suitable method for students' condition that don't have literature, spirit, and passive in learning. Another reason, almost every discussion activity, all students are active and only 2-3 students that have critical thinking. To achieve material goal, talk method is considered more suitable. In detail it is presented in the table below.

Table4. *Lectures' responses toward the method used in TTM activity of subject learning of social science*

Responses	Number of Respondents
Belummampuuntukmengembangkanketrampilanberpikirmahasiswadalammenganalisismateri Couldn't able to develop students' critical thinking skill in analyzing the material	58 (61,9%)
Cukuppuas, karenamampumemberikanpemahamanmateri dan mengembangkanketrampilanberpikirmahasiswa Satisfied enough, because could give the understanding of the material and develop the students' thinking skill	23 (28,5%)
Sudahsesuaidengankondisimahasiswa Appropriate with the students' condition	12 (9,5%)
Number	93 (100%)

While, from students responses result in questionary, about the method they feel appropriate dan direct them to understand STS material dual coding based during the learning are discussion, question-answer, inquiry, field study, doing interpretation of the reading, and presenting analysis result of the topic in front of the class. From students responses result it is known that the lectures seldom give students discussion activities or interpret the reading, field study and inquiry. Tough these methods are the methods they like because challenge them to thinking.

Respondents said that they feel motivated to learn and feel proud of the study program they choose because they feel the process of learning involve them to have high critical thinking. They said that they are invited to analyze the social phenomenal which related to the material given, through question-answer method, how is social phenomenal? Why does it exist? Which one is easier of the era? Why these cases exist in Indonesia? Etc, by lectures' guidance students find out those questions then presented and doing discussion into take conclusion together.

From observation and interview result, question-answer activity often get at the end of the learning activity, some of students prefer to be not asked. In contrast, question-answer activity can be motivated students to learn the issues in social phenomenal.

3.2. Developing Material Book Dual Coding Based Theory (Stage 2)

3.2.1. Developing the Tool of the Module

The activity of developing module device is conducted on 16th -21st January 2017 by arranging and developing several designs which will oriented to the students of teacher education of elementary school teacher of undergraduated program of Open University. From those criterions can be a guideline for researcher in developing book design by pay attention to the instrument as presented below:

Tabel5. *Criterions can be a guideline for researcher in developing book design*

No.	Indicator	Instrument
1.	Language/verbal	Vocabulary, sentence, message, communication, concept, imaginary, concreteness, meaningfulness.
2.	Visual Ilustration	Pictures, graph, colomnn, table, map, shape, symbol, color, diagram, animation, imaginary, concreteness, meaningfulness.
3.	Kinds of information saved in Very Long-Term Memory (VLTM) based on adaptive function	Spatial ability, characteristics around the world, social relationship, social value, motoric skill, perceptual skill
4.	Content of material/ main topic	The quality of material/substance (appropriate concept with the need; material deep; emensity of material; appropriate learning model; giving example/case; the instruction of answer)
5.	Organizing material	concreteness, meaningfulness, characteristics of knowledge field
6.	The formation of textbook	The shape of form (content/shape, size and picture illustration), the form of material (kinds and size of letter, the relation between illustration and writing and color), language and legibility, balance, proportion, rhythm, unit, effectiveness of form pattern in general

3.2.2. The activity of orientation of module development stage I

The implementation of orientation of module design development in stage I is followed by 73 students from two groups of study. This activity is held on 6th February 2017. On the stage of material orientation submitted regarding with the introduction of module characteristics and question-answer about the essence of module dual coding-based. Most of orientation participants asked about modul with dualcoding based for students' ability in learning material.

First orientation is very difficult to apply because students are still uncommon toward the modul with dual coding as material thought in tutoring, although they have been introduced the material related with other forms in previous material. Most of students' comment shows that module they done is very difficult applied. The form model they were used has no related each other.

After introduction activity toward the essence of module, continued by orientation to the pattern of module formation as pattern orientation. Students give assessment and observe the parts of module pattern which has been prepared. From those participants response well and the rest of them less enthusiastic because they have not understood yet the module of dual coding.

Orientation activity involves many of students with time limited. Therefore the researcher gives the homework to students to analyze the draft related with the characteristics of the module as a background draft during one week.

3.2.3. The Implementation of STS Material Book with Dual Coding in Open University

- The experience and knowledge from implementation of STS material book can be evaluated together and followed up to improve the other component.

- Students have new experience in interpret the page of learning quiz in material book.

- The beginning of implementation is difficult to be applied because the material book of dual coding is still common for students.

- Students give assessment and observe the parts of the procedure of dual coding material book

3.2.4. The Result of Implementation

- The book of Dual coding material is designed through the stage of Apersepsion-material analysis-reflection (through meaningfull practice)

- Some of the book of Dual Codingmaterial development has been optimal used by students, mainly in reflection stage.

- Recording in a part of reflection performance become cohesiveness in interpret the material

- Applying the material book with dual coding in social science subject seems cohesive with the process to dig up some material which can be elaborated with online media.

- Obtained from various understanding meaningfull material which related to the using of the book of dual coding material as tutor's reflection and students as the process of material enrichment.

- Students seem enthusiastic in reflect the material understanding in exercise page and has initiative in doing the discussion with friends.

3.2.5. The Result of Implementation and Analysis the Adventagous of Material Book:

- Students can practice and dig up the information which can be references of stabilization of the concept and meaningful material.

- Basic competency in learning activity helps students to know the goal of learning. Students have clear description about the goal of learning which will achieve.

- The social science theme which have cases material can grow independent learning because the explanation which is interesting through pictures or visual media.

- The social science theme which has cases material can train students to discuss, work together and communicate the idea in group situation.

- Material with Dual Coding support the students understanding in the process of knowledge which is relative remembered.

3.2.6. Implementation of Reflection

- A part of material book pattern need to be improved because it has not given the optimal result yet, mainly in dig up students' understanding toward STS material concept.

- Improving the form of pattern need to be adjusted with tutor's understanding and students. The next the changing of book pattern produce the book of material revision.

- After the result of improvement on some form of book pattern and the content of material applied in some students when joining the face to face tutoring show that the material book is suitable and effective.

- The using of material book is more giving interested for students to dig up and interpret the material.

- Tutor is easier to understanding some materials to be described and delivered to students. The evaluation obtained from the material book applied show that the tutor more enjoy and give the soul in tutoring.

4. CONCLUSION

The position of science, technology and society are more essential un modern society era which create complex problems. These realities will more felt if in the explaination give more information that problem solving requires the position from various of knowledge.

Science, technology, and social material development is as study applied as an effort to give the insight to students in study about science. The concept of STS covers all of the spectrum about critical events in education process, such as goal, curriculum, learning strategy, evaluation and learning preparation.

In STM material development Dual coding-based, every memory of visual and verbal work has limited capacity. Therefore, when the visual and verbal information in the form of teks displayed, there's probability that visual memory cannot save all the information and caused some ofmemory will lost. The same case may happen when the source of verbal information in auditorial displayed together with visual teks. But if visual information is displayed as visual and verbal information displayed as auditorial, so it will open the chance visual and verbal memory work together and the receiver is easier arrange the teks' code because the information is captured as maximal.

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