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## TEACHING MATERIALS DEVELOPMENT BASED ON BASIC COMPETENCE THROUGH DIFFUSION ADAPTATION STRATEGY TO IMPROVE LEARNING PROCESS OF PHYSICS SUBJECT

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### Abstract

*Based on the curriculum of high school education in Indonesia, all senior high school students must be able to acquire all standard competences and basic competences. Unfortunately, most senior high school students in Serang districts, Banten Province, were not able to acquire all standard competences and basic competences operationally. Based on the result of national examination from 2007 to 2013, there were still ten standard*



*competences and basic competences in Physics subject that the students still found difficulties in acquiring the learning materials. It was shown that there were teaching materials which cannot be taught to students due to some teachers' weaknesses in delivering the teaching materials well. To overcome those problems, the researcher developed some teaching materials of Physics subject to be implemented by Physics teachers in Serang districts and city, Banten Province.*

*The researcher used Diffusion Adaptation Strategy (DAS) in order to gather all Physics teachers from Serang districts-Banten Province, Indonesia. The result of the study showed that the teaching materials development with DAS had feedback mechanism towards several level of improvement with the three positive loops. Through Diffusion Adaptation Strategy (DAS), the teachers can acquire the teaching materials very well in 72.6% of improvement, the teachers can also improve their academic and knowledge of Physics teaching materials in 68.3% of improvement, and finally the teachers can improve the learning process of Physics subject in 74.8% of improvement. The teaching materials development through DAS can produce the teachers who can acquire the teaching materials very well, able to use the teaching media, and able to implement various kinds of teaching methods while they are teaching Physics subject in the classroom.*

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**Keyword:** Learning Process, Teaching materials development, Diffusion Adaptation Strategies (DAS), learning process improvement.

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## 1. Introduction

In improving students' understanding of particular subject, educational policy makers should conduct a lesson study which focuses on curriculum development, the quality of the teachers and learning facilities. Berg (1991) stated that the students cannot understand the lesson due to lack of the teachers competence, lack of laboratory for doing experiment, over loading of subjects and learning materials. In line with Suparno's statement (2005) that the teachers' ability in delivering the lesson is one of the reasons why most students were not able to understand the lesson well. Alkarhami also stated (1999) that lack of source book and lack of training for teachers became one of the reasons.

There were some efforts in trying to enhance the quality of education in Banten Province, especially in Senior high school level or Sekolah Menengah Atas (SMA) in district area and also in Serang City. The amount of senior high school in district area (Kabupaten) is 21 public schools and 30 private schools. Those schools and policy makers keep on developing the teachers' competencies. Based on Glover (2005), by giving some program for developing the teachers' common skills and the teachers' specific skills based on their major it was hoped that the teachers can be more professional.

Level of understanding of the Physics subject amongst teachers is different in both district area and city area in Serang, Banten Province. This happens due to differences of minimum understanding criteria of Physics subject or Kriteria Ketuntasan Minimum (KKM) between district area and city area in Serang-Banten. The differences of KKM will give some effects to the level of teachers' competencies in understanding and

developing subject matters to be taught to students.

Based on the illustration, in order to develop the teachers' competence in developing teaching materials, the researchers are interested in conducting a research on developing teaching and learning materials for students based on basic competence in the curriculum. The purpose of the research is to develop and increase the teachers' ability in teaching Physics so that the students' understanding in Physics subject can be improved. The subject of the research is some Physics subject teachers from district and city area in Serang-Banten.

## 2. Physics Lesson Analysis and Strategy of Materials Development

### 2.1 Physics Lesson Analysis

Operationally, some students still find difficulties in acquiring some standard competence and basic competences of national curriculum. Ruhiat and Nandang (2011) had analyzed the result of national examination in district area in Serang by the year 2007 to 2011. The results of analysis were ten to fifteen of standard competence and basic competences of Physics subject cannot be understood by senior high school students. The students' average score were below the average score of district area in Serang-Banten. There were some items from all national examination problem sheets which cannot be acquired by the senior high school students.

The analysis of the score of students' National Examination showed the average value of students of 40 questions that tested at 43.40 with the score of Low Control Limit (LCL) between 37.41 to 71.86 dan Upper Control Limit (UCL) between 49.39-84.99. Some learning materials which were under LCL can be seen on table 1. as follows.

**Table 1.** The Analysis of National Examination Score of Physics Teaching Material

1	Analyzing the influence of force on pedal system to determine an units of something
2	Applying Newton law about motion to determine an units of rotation
3	Formulating magnetic force of coil with electric current that moved inside the magnetic field
4	Formulating the Faraday induction inside the wire coil
5	Analyzing optical system
6	Analyzing moving wave inside the media to determine the amount of it



7	Analyzing RLC circuit to determine the amount of it
8	Using Kirchoff law to determine the units of electricity relate to electricity circuit
9	Analyzing the motion to determine the units of kinematik
10	Analyzing interference and diffraction to determine the amount of it
11	Applying Bernoulli law in the flow of fluid
12	Analyzing quantum phenomena qualitatively *quantum phenomena (Characteristics/radiation)
13	Implementing parabola concept to determine the units of Physics
14	Time of contraction and time of diltasi, equity of mass energy inside something and mass–energi to the body movement toward the thing
15	Identifying atom (JJ Thompson/Ernest Rutherford/Niels Bohr)
16	Analyzing the graphic of thermodynamics to determine the effort made by gas
17	Producing the result of measurement with the rule of significant figures
18	Analyzing electrical circuits with 2-3 electrical resistance to determine the current size and electrical voltage in the circuits
19	Analyzing static fluid to determine the amount of it
20	Applying the law of electro static force inside the plot charge
21	Identifying the physical quantity of circular motion to determine the units of it
22	Applying formulation intensity level on propagation of sound
23	Analyzing collasion by applying law of conservation of momentum
24	Analyzing the character of radioactive elements & applying in the daily life
25	Analyzing the motion system of the object on the rough area by using Newton law

Based on the analysis of national examination in Serang district, Banten Province, Physics subject materials which under LCL were different. Students from some public and private schools which were on the remote area from government offices got the average score under LCL. While students from public schools in Serang district such as SMA Negeri Ciruas, SMAN Cinangka, and SMAN 1, SMAN 2 and SMAN 3 in Serang City could understand basic competence of Physics subject. Therefore, it showed the teachers' different competences in understanding Physics teaching materials.

It was stated in Untag Journal (2006) that teachers should have good understanding on Physics subject materials and also can deliver the lesson creatively. Students' understanding in a concept can best describe the

relation between one concept with other concepts so that they can memorize and recall every concept of Physics subject very well. Triana (2007) stated that the reasons why some students find difficulties in understanding particular concept of Physics were caused by many abstract concepts in Physics subject.

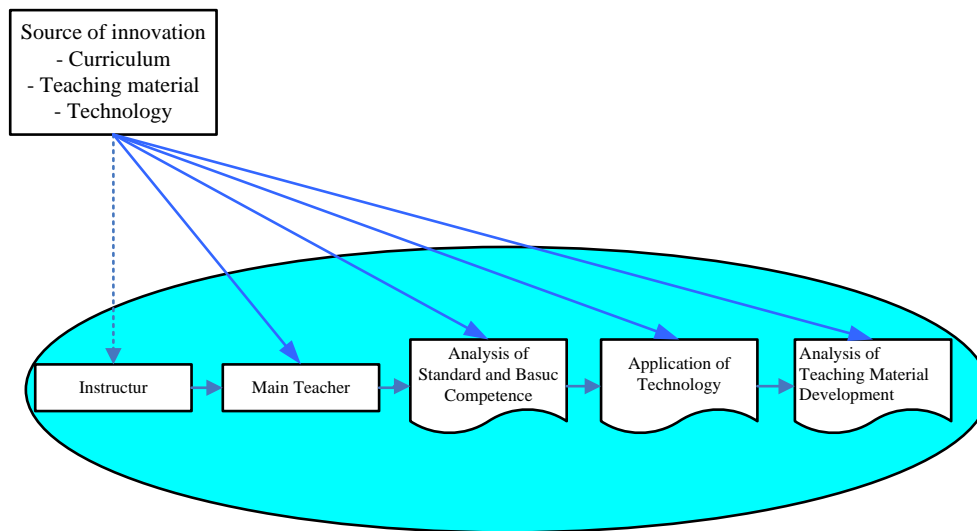
## 2.2 Strategy of Physics Teaching Materials Development

Teaching materials development can enhance the teachers' competence such as paedagogic competence, social, and professional competence. Therefore, Physics teachers from different schools should collaborate to each other to improve teachers competence in Physics subject.

In the Physics teachers' community in Serang district and Serang City area, every teacher helps each other, share ideas, and also develop Physics teaching materials regularly at school. Models of teaching materials development and teaching method had been developed by educational expert in Indonesia such as Affandi, Ngurah, and Nur (2011), the development model of teaching method in Physics subject through jigsaw and peer tutor. This kind of peer tutor was conducted by the certified teacher toward some non-certified teachers. Furthermore Nur Kh, Hindarto, dan Sulhadi (2011) created teaching materials about opticals subject based on life skill project. Strategy of diffusion adaptation was conducted in relation to the teaching material development based on standard competence.

Diffusion Adaptation Strategies (DAS) was a kind of strategy in material development which aim at designing a good academic circulation between Physics teachers. Chen, et.al. (2012) had done an analysis of Diffusion Adaptation to distribute optimisation and spreading the net of teaching model. Paolo, DL (2014) had made Diffusion Adaptation to distribute estimation of random Gaussian Markov. Ratcliff, Trisha, dan Gail (1999) membuat koneksi dan model difusi waktu reaksi. Furthermore, Kelly (2012) conducted a diffusion of innovation and the application for the transfer of technology, action and analysis for health information.

In implementing teaching material of Physics subject, the researcher used jigsaw model of teaching. In jigsaw activity, the teachers were grouped into two groups, expert group and participant group. An expert group consisted of senior high school teacher with high level of KKM, and participant group consisted of lower level of KKM. The Diffusion Adaptation Strategies (DAS) process of Teaching material development were described in figure 1.

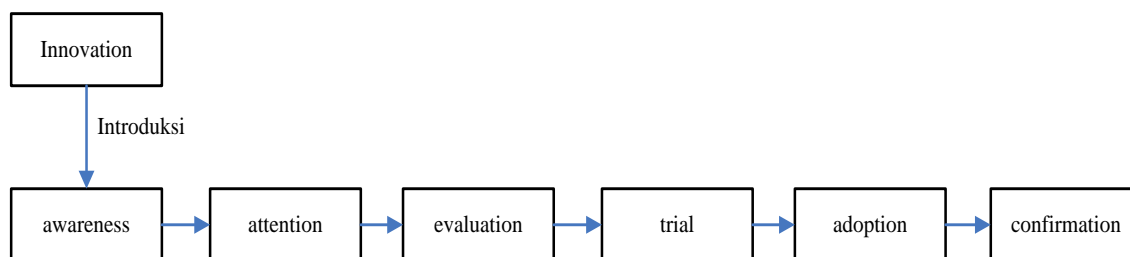


**Figure 1.** Diffusion process in teaching material development

Figure 1. describes about the diffusion process in developing teaching material based on national curriculum, competence based curriculum, standard competence and basic competence, and the use of technology were the basis of the teaching learning process. Instructor and main teacher discussed about competence based curriculum, standard competence and basic competence, and then tried to use technology in the teaching-learning process. All teachers were involved in the development of teaching materials so that they would be more understood about teaching materials being used in the classroom.

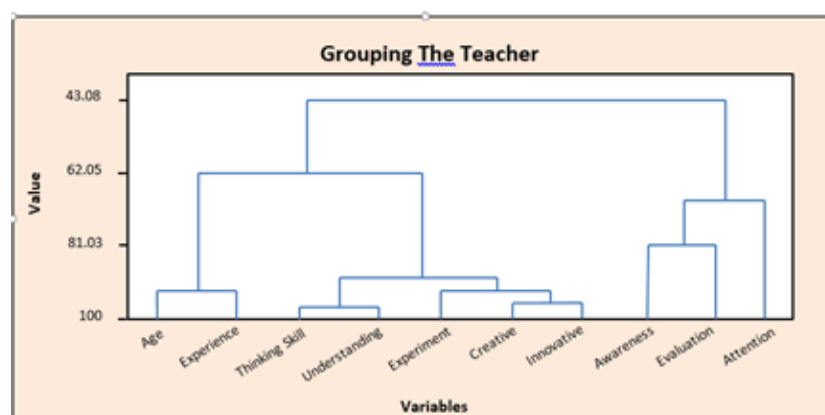
### 3. Method

Sample of the research are Physics teachers in Serang districts and serang city. According to Mundy (2000) adoption process was conducted in several stages; (1) awareness, (2) interest, (3) evaluation, (4) trial, (5) adoption, (6) confirmation. After finishing an adoption process, the diffusion proses were implemented. Soekartawi (1988) stated that diffusion is a process in which an innovation was spread to particular individual and group in a social system. Adnyana, et.al. (1999) described diffusion as enculturation of adoption from an individual to another individual in a system of social community. The process of adoption and diffusion of teaching material development can be seen in figure 2.



**Figure 2.** *Process of Diffusion and Adoption in Developing Teaching Material*

The process of adoption and diffusion of teaching material development through DAS was implemented by grouping the teachers based on their age, their teaching experience, their way of thinking, and their understanding toward teaching materials, and their awareness to improve their competencies, their attention towards toward science and technology, and also the teachers were creative and innovative.



**Figure 3.** *Grouping the teachers*

Data collecting technique of the research were taken by disproportionate stratified random sampling. Based on the technique, the researcher got 16 people as the sample. There were 16 Physics teacher from Banten, 10 teachers were from Serang district, while the teacher from Serang City were 6 people.

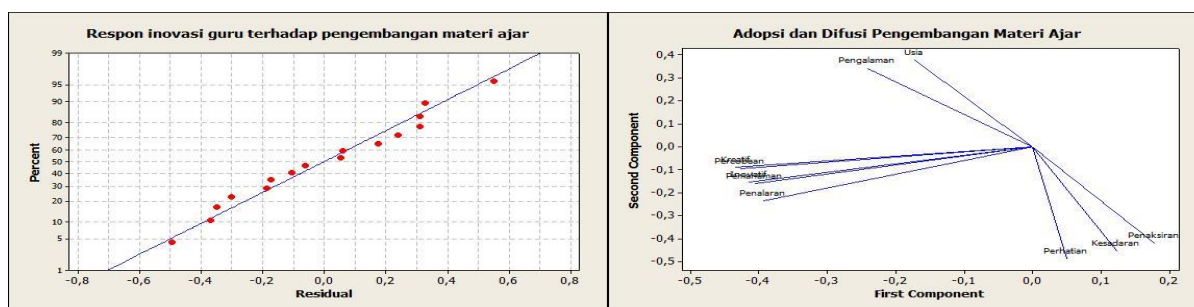
Based on figure 3, the teachers are grouped into two big groups. In the first group, the teachers are grouped again into small group based on age and teaching experiences, the ability of thinking, teachers' understanding in Physics teaching materials, creative and innovative teachers and teachers who like doing experiment. In the second group, the teachers are grouped again into small group based on attention, awareness, and the ability to create science and technology.



## 4. Results and Discussion

Based on the analysis of teachers characteristics such as; age, teaching experience, the way of thinking, awareness. The result of research analysis showed that teaching material development by using DAS can enhance the teachers' competence. The teachers' movement and circulation can give some influences toward the teachers' academic competences, pedagogic competence that can be seen by the ability of teachers in creating teaching media and applying best method in teaching Physics. The result of analysis in developing teaching materials can be seen on figure 4.

It can be seen on figure 4. (a), the teacher's innovation in a group in developing teaching material. The teachers were motivated to be more creative and innovative in developing teaching material. While on figure 4. (b) showed that several variable gave effect on adoption and diffusion in developing teaching material. The teacher's age and teaching experience on the first level, while some teachers on the second group consisted of: thinking ability, understanding, trial/experiment, creative and innovative. Next, on the third group consisted of: attention, awareness, and the teacher's evaluation on teaching material. All those variables focused on one point, that was developing Physics subject teaching materials.

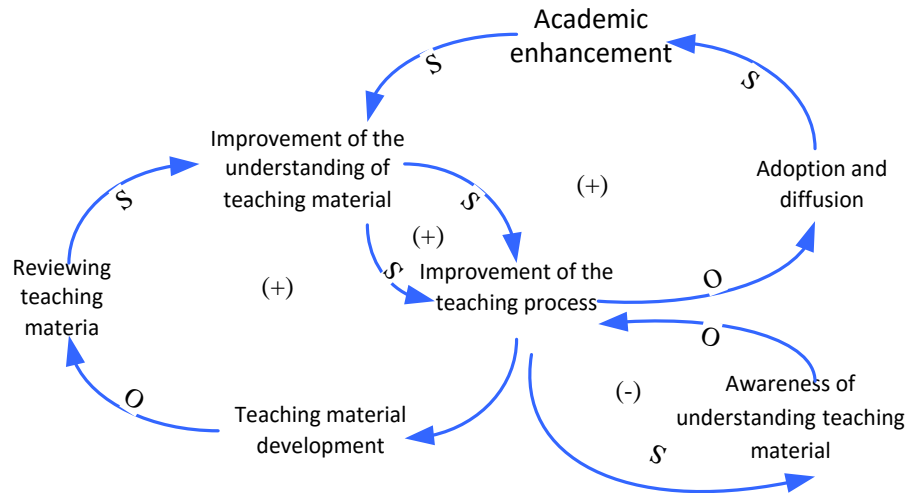


(a)

(b)

**Figure 4.** The Result of Adoption and Diffusion through DAS

The relationship among variables in the system of the improvement of teaching Physics in Senior High School (Sekolah Menengah Atas) was shown in the causal diagram on figure 5.



**Figure 5.** Causal diagram on improvement of the Physics teaching process

Based on figure 5, the system of the improvement of teaching Physics in Senior High School through DAS had feedback mechanism towards several level of improvement in the three positive loop. The first positive loop showed the effect of improvement in understanding the teaching material. Through formal constant of normal improvement, the improvement of understanding the teaching material can support the improvement of the teaching-learning process of Physics subject. The second positive loop showed the effect of teaching material development towards the teachers' academic skill. Through multiplier variable in understanding the teaching material, the teaching material development can effect toward the teachers' level of academic skill. The third positive loop showed the effect of the teaching material development towards the teaching-learning process. Through multiplier variable in academic skill, the teaching material development can affect the teaching-learning process.

The result of observation of the teaching material development, adoption and diffusion through DAS can be seen on table 2. as follows:

**Table 2.** The average score during observation of teaching material development

Average	Understanding the materials	Academic Competence	The Teaching-Learning Process
<b>Before teaching material development</b>	55.4	58.0	53.6



After teaching material development	95.6	97.6	93.7
The percentage of Improvement	72.6	68.3	74.8

Based on table 2, before and after the teacher got the training on teaching materials development, the average percentage of the teachers' understanding and improvement on developing teaching materials are 55.4 and 95.6 of 16 teachers who joined the training. The average score of improvement percentage is 72.6%. The average score of academic competence before the materials development is 58.00 and 97.6 with the average score of improvement is 68.3%. The average score of the teaching learning process in delivering the teaching material before adoption is 53.6 and after the diffusion is 53.6 and 93.7 with the increasing number 74.8%.

The improvement of teaching-learning process of Physics subject was influenced by the number or rate of increment and decrement in understanding the teaching material. The increment or improvement of the teaching-learning process was determined by enhancer and multiplier factor in the teaching material development. The multiplier of the teaching material development was determined by the training activity of understanding the teaching material and the training of the teachers' academic skill.

Training in understanding the teaching material was influenced by the multiplier of teachers' creativity in which this variable was also influenced by integration and acceleration constants.

The development of teaching materilan through DAS can produce the teachers who understand the teaching material and able to use the teaching media and implement multi method in teaching Physics subject. The only potential thing to lower down the process of teaching was the decreased rate which was influenced by the awareness in understanding the teaching material.

## 5. Conclusion

In developing the teachers' competence and the teaching materials needed some strategies. The teaching materials development was implemented through diffusion and adoption by using DAS. This diffusion and adoption had been done to the teachers as the sample of the research. Sample data of the research were 16 Physics teachers from Banten, 10 teachers were from Serang district, while the teachers from Serang City were 6 people. The process of adoption and diffusion of teaching material development through DAS was implemented by grouping the teachers based on their age, their teaching experience, their way of thinking, and their understanding toward teaching material, and their awareness to improve their competencies, their

attention towards toward science and technology, and also the teachers were creative and innovative. The result of research analysis showed that teaching material development by using DAS can enhance the teachers' competence. The teacher's movement and circulation can give some influences toward the teachers' academic competences, paedagogic competence that can be seen on the ability of teachers in creating teaching media and applying best method in teaching Physics. The system in improving the process of Physics teaching learning by using DAS had feedback mechanism towards several level of improvement. The teaching material development by using DAS can produce the teachers who acquire the lesson material very well, can create and use various teaching media and also can implement multi methods in the teaching-learning process.

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