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The Effect of Conceptual Change Models on Students' Conceptual Understanding in Learning Physics

N. P. E. A. Sari*, I. W. Santyasa, I. G. A. Gunadi

Department of Physics Education, Faculty of Mathematics and Natural Sciences,
Universitas Pendidikan Ganesha, Indonesia

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Abstract

This study aims at describing differences of students' conceptual understanding in learning physics between students who learn with the conceptual change model (CCM) and direct learning model (DIM). This quasi-experimental research used the pretest-posttest one-way non-equivalent control group design. The study population were students of class XI. The sample was selected by random assignment technique. Data of students' conceptual understanding was collected with a physics conceptual test. The test in the form of multiple choice with written justification consists of 20 items. Data were analyzed descriptively and ANACOVA. As a follow-up to ANACOVA, the Least Significant Difference (LSD) was used to test the comparison of the mean scores of the treatment groups. The results showed that there were differences in conceptual understanding between students' studying with CCM and DIM. Need to make conceptual changes will occur optimally if physics learning uses CCM.

Key words: conceptual change model; direct instruction model; conceptual understanding

INTRODUCTION

The 21st century brings major changes in the pattern of human life. This is synonymous with the use of knowledge and very rapid development of technology. This is also accompanied by the flow of globalization which causes technology to have a very large role in aspects of people's lives. In the 21st century society is a mega-competitive society that continuously pursues quality and excellence, so that there is no place in society without competition which aims to produce quality products and services. Quality products and services are only produced by qualified human resources (Tilaar, 1998). Based on this the Indonesian people are obliged to produce resources, one of the efforts that can be taken to obtain quality human resources. The role of education in developing a nation in facing the area of globalization has been recognized since the formulation of the 1945 constitution. Without an intelligent nation, it is impossible for this nation to participate in competition in the knowledge age (Tilaar, 1998). So that education becomes a very important thing that can bridge individuals so they can compete in this era of globalization. In 21st century Indonesian nation education is not only directed at making students knowledgeable, but also for adopting scientific attitudes (namely, critical-logical thinking, innovative, consistent, and adaptable thinking) and the cultivation of noble values and commendable attitudes in social life oriented to mathematics, science, and humanities (Afandi, Dajidan, Akhyar, & Suryani, 2019).

The development of technology cannot be separated from the development of science, one of which is physics. The development of physics and

*Correspondence Address:
Jl. Udayana No 11 Singaraja-Bali, 81116, Indonesia
E-mail: eviadrianasari@gmail.com

technology is very important because physics development is not only intended for individuals' human needs, but human in general, for the country and even for the world (Santyasa, 2014). The purpose of learning physics as stated in the 2013 Curriculum, which functions to master the knowledge, concepts, and principles of physics as well as having the skills and confidence as a provision to continue education at a higher level and develop the science and technology (Kemendikbud, 2014). Through learning physics, students can not only master the concept but can also be used to overcome problems faced by students in everyday life.

Conceptual understanding is a broad term used to describe a person's understanding of some phenomenon or series of phenomena at a point in time (Brown et al., 2018). Students' concepts understanding is the students' ability to draw the of knowledge that presented through the media in the form of messages or information, which will be integrated in the students' schema or framework in order to build the knowledge related to the initial knowledge that can be functioned together (Muhaimin, Susilawati & Soeprianto, 2015). Mastery and understanding of concepts in learning science, especially physics is very important. Conceptual understanding in learning physics are important keys to applying physics in everyday life. The development of conceptual understanding in the world of science is important for students in today's world if they want citizens who can make decisions about themselves and the world in which they live (Widiyatmoko & Shimizu, 2018). Conceptual understanding can be demonstrated when students can understand ideas in a transformable way, which enables them to apply knowledge into new situations, and across new domains (Saleh & Mazlan, 2019). Based on this, the students' conceptual understanding in learning physics needs to be considered concept knowledge as the basis for building student knowledge and as an asset in the ability to solve a problem.

Unfortunately, students' understanding of physics concepts is still low, especially in physics. Santyasa, Warpala, & Tegeh (2018) suggest that learning physics for high school is often colored by misconceptions that prevent students from achieving deep understanding. The same thing was conveyed by Asgari, Ahmadi & Ahmadi (2018) that students have problems understanding physics concepts, so that their perceptions and understanding are still subject to misconceptions. Based on this statement, it is reflected that students' low understanding of physics concepts is still marked by misunderstanding or misconception of these concepts. Perdana, Suma, & Pujani (2018) stated that misconceptions can interfere with the concept formation process of students. The result of the study from Sutopo (2016) showed that students experience misconceptions in the sense of understanding a concept incorrectly but believe that the (wrong) conception is true, that is one of the causes of student failure in solving conceptual problems.

One of the factors that influence the formation of student concepts is the teaching method of the teacher, considering that the teacher is a spearhead of education in the field (in the classroom) because it is in direct contact with students. The selection of learning models used by teachers in the classroom can affect the activities and concept formation of students.

A similar problem is thought to have occurred in one of the high schools located in Gianyar district, Bali. SMA Negeri 1 Blahbatuh is one of the high schools that has accreditation A and high-achieving students. Based on the narrative of one of the teachers, especially the subject of physics, students in the class are indeed difficult to understand the concepts of physics. Teachers sometimes still apply conventional learning, because for constructivist learning as suggested in K13 curriculum, students feel less able to follow, so that teachers still use conventional learning.

Conventional learning is a traditional learning model or also called a lecture model because this method has always been used as a means of oral communication between teachers and students in the learning process (Djamarah, 2006). Physics learning that is still carried out with conventional instruction such as direct instruction model (DIM) cannot overcome misunderstanding or misconceptions as a basis for learning so it must be abandoned and converted to a new learning model based on constructivism (Santyasa et al., 2018). Based on this, conventional learning is considered inadequate to support the information of students' scientific conceptions in learning, so that innovative constructive learning is needed. Based on the constructivist theory, in order for students to truly understand and be able to apply knowledge, they must seek and solve problems, find everything for themselves, and struggle with ideas (Trianto, 2009).

One learning model that adopts a constructivist understanding is the conceptual change models (CCM). This model was first introduced by Posner, Strike, Hewson, & Gertzog (1982) and for more than decade this model has greatly influenced studies in the field of student conceptions (Redhana Sudria. Hidayat, & Merta, 2017). According to the conceptual change learning model, an individual must become dissatisfied with their concept. Second, an individual must seek that the new conception can be intelligible and make sure. Third, the learner must feel that these new conceptions are plausible. Thus, those new conceptions are not only true but also can be believable. Fourth, the learner must find the new conceptions fruitful or open (Santyasa, 2017). The conceptual change model (CCM) can bring dissatisfaction towards the students' initial conceptions or ideas about a phenomenon, followed by strengthening scientific concepts. Therefore, it can help the students to create the atmosphere and conditions that enable significant conceptual change so that their understandings are in accordance with understanding of scientific concepts (Dedi, Sahala, & Hamdani, 2018).

This model can cause cognitive conflict that can help student's concepts change from misconceptions to scientific concepts. In this implementation, it includes experimental activities, demonstration, and discussions guided by conceptual change worksheets. The learning process provided by CCM is the excellence factor in achieving the conceptual understanding and characters for students in learning physics (Santyasa et al., 2018).

This study aims at describing differences of students' conceptual understanding in learning physics between students who learn with the conceptual change model (CCM) and direct learning model (DIM) for class XI students.

METHOD

This research was conducted at SMA Negeri 1 Blahbatuh in the second semester of the 2018/2019 academic year. The type of research used is experimental research with one-way pretest-posttest control group design. The research design is as shown in Figure 1 (Santyasa, 2018).

O_1	X_1	O_2
O_3	X_2	O_4

Figure 1. Research design

Notes:

O_1 : Preliminary observations of students' conceptual understanding in the CCM group.

O_2 : The final observation of students' conceptual understanding in the CCM group.

O_3 : Preliminary observations of students' conceptual understanding in the DIM group.

O_4 : The final observation of students' conceptual understanding in the DIM group.

X_1 : Treatment with CCM.

X_2 : Treatment with DIM group.

The population in this study was all class XI MIPA consisting of 7 classes with a total of 252 people. The sample in this study was taken based on random assignment techniques and the selected class consisted of 2 classes, namely XI MIPA 1 as a CCM class with a total of 36 students and class XI MIPA 5 as a DIM class with a total of 36 students, so that the total sample used was 72 students.

The research instrument used was a test of conceptual understanding of physics with sound waves and light waves consisting of 20 multiple choice questions which were expanded and guided by the cognitive dimensions of the understanding process according to Anderson and Krathwohl (2001) with a range of scores from 0 to 4. Conceptual understanding tests were developed based on the indicators of concept understanding namely: interpreting, setting an example, classifying, summarizing, concluding, comparing, and explaining. This conceptual understanding test has a distribution internal consistency that moves from 0.40 to 0.83 and the reliability of the test is 0.878. The data collected in this study included changes in students' conceptions in the form of misconceptions experienced by students as well as understanding of students' initial conception in the form of pretest scores and students' conceptual understanding in the form of posttest scores. The data analysis technique used in this research is descriptive analysis technique and one-way covariance analysis (ANACOVA).

The descriptive analysis technique used to describe students' conceptual understanding, which included the percentage, average value, and standard deviation of students' conceptual understanding test result, and to describe the types of misconceptions experienced by students based on the subject to see a change in conceptions in students before and after treatment. One-way covariance analysis technique (ANACOVA) used to determine the relationship between covariate variable (students' understanding of initial concepts) and the dependent variable (understanding of physics concepts).

To test hypotheses that have passed assumption tests such as normality test, homogeneity test, and linearity test. Further test with LSD (Least Significant Difference) was used to test the significant mean value between groups. The hypothesis used in this study are:

$H_0 : \mu_1 = \mu_2$: There is no difference in students' conceptual understanding of physics who learn in the CCM and students who learn in the DIM.

$H_0 : \mu_1 \neq \mu_2$: There is a difference in students' conceptual understanding of physics who learn in the CCM and students who learn in the DIM.

Notes:

μ_1 : The average score of students' conceptual understanding of physics of students in the CCM group.

μ_2 : The average score of students' conceptual understanding of physics of students in the DIM group.

Hypothesis testing is done by using the F test. The criteria in this test are if the significance value obtained from the calculation is smaller than the specified significance value, then the calculated F value is significant which indicates H_1 is accepted and H_0 is rejected. The criteria using LSD testing is that there are differences in the average value of the dependent variable between group if $|\mu_1 - \mu_2| > LSD$, then H_0 is rejected.

RESULT AND DISCUSSION

As the learning model, CCM and DIM have different syntax. The different syntax of CCM and DIM as shown in table 1.

Table 1. Syntax of CCM and DIM

Phase	Learning Model	
	CCM	DIM
Phase 1	Presentation of conceptual and contextual problem	Deliver the goals and prepare the students
Phase 2	Presentation of misconceptions confrontation	Demonstrate the knowledge or skills
Phase 3	Presentation of confrontation denial	Guide training
Phase 4	Proof of concepts	Check the

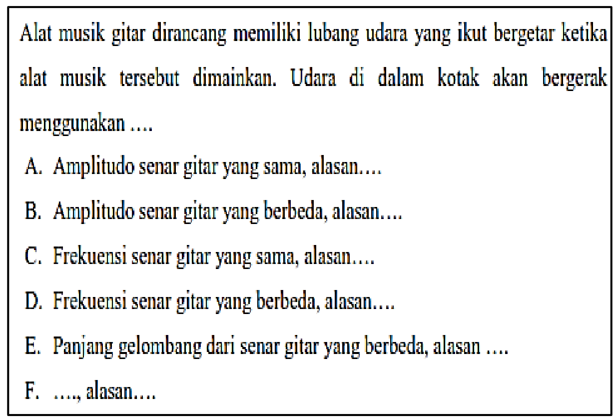
	and principles scientifically	students understanding
Phase 5	Representation of materials and contextual examples	Provide the opportunities for advanced training and information
Phase 6	Confirmation through questions	-

Based on Table 1, it can be seen the differences that using the CCM can give opportunities to the students for the cognitive conflicts, which is confirmed by the proof of the concept scientifically to build the students' concept. Meanwhile, the syntax of the DIM is less in providing the opportunities for the students to build their knowledge.

The data obtained from this study were data on student conceptual changes in the form of student misconceptions, students' initial conception of physics, data on students' conceptual understanding.

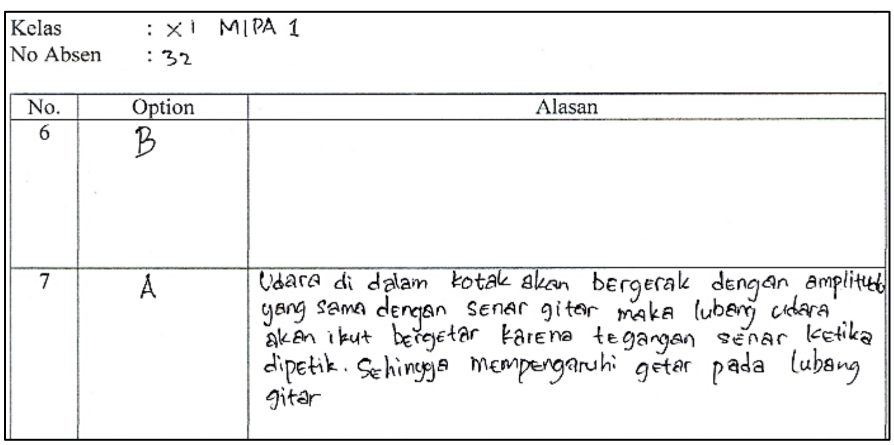
Students' conceptual changes

The students' conceptual changes are based on an analysis of the misconceptions experienced by students. The following are examples of questions and students' answers to provide an overview of students' misconceptions. Example question about sound waves with resonance sub-subject in the test conceptual understanding as shown in Figure 2 and the answer of students who experience misconception as shown in Figure 3.


Alat musik gitar dirancang memiliki lubang udara yang ikut bergetar ketika alat musik tersebut dimainkan. Udara di dalam kotak akan bergerak menggunakan ....

A. Amplitudo senar gitar yang sama, alasan....
B. Amplitudo senar gitar yang berbeda, alasan....
C. Frekuensi senar gitar yang sama, alasan....
D. Frekuensi senar gitar yang berbeda, alasan....
E. Panjang gelombang dari senar gitar yang berbeda, alasan ....
F. ...., alasan....

Figure 2. Example question


Kelas : XI MIPA 1
No Absen : 32

No.	Option	Alasan
6	B	
7	A	Udara di dalam kotak akan bergerak dengan amplitudo yang sama dengan senar gitar maka lubang udara akan ikut bergetar karena tegangan senar ketika dipetik. Sehingga mempengaruhi getar pada lubang gitar

Figure 3. Example of students' answer

Based on figure 2, the choices are in the form of misconceptions choice on options A, B, and D and scientific choices on option C, and an empty choice F if students have an answer other than the option provided.

Based on Figure 3, students experience a misconception by assuming the vibration of an object due to another object (resonance) due to the amplitude's influence. Types of misconceptions experienced by students based on the analysis of students' answers presented in Table 2. The percentage change obtained indicates the students' conceptual changes before and after treatment.

Table 2. Percentage of students' misconceptions and their conceptual change

Subject/Types of Misconceptions	Misconception in each learning model			
	CCM (%)		DIM (%)	
	Pre-test	*Post-test*	*Pre-test*	*Post-test*
Sound Wave				
Longitudinal waves have a direction of propagation and direction of vibrations perpendicular	50.00	16.67	61.11	30.56
Sound is a transverse wave because the direction of propagation and direction of the vibrations are perpendicular	44.44	5.56	38.89	22.22
Sound can only propagate through the air because only air can be used as an intermediary	61.11	5.56	61.11	13.89
Hitting a drum harder increases the pitch and frequency of the sound	69.45	2.78	66.67	33.33
The source of sound comes from the person who blew it	25.00	8.33	33.33	22.22
Resonance happens with the same amplitude	55.56	5.56	47.22	27.78
The speed of sound propagation is smaller during the night than during the day because it is affected by pressure	55.56	0.00	52.78	11.11
The speed of sound propagation during the day is the same as during the night	33.33	8.33	19.44	13.89
Sound travel through the air faster because the density of molecules is loose	80.56	2.78	72.23	38.89
The change in the frequency of the sound heard by the observer is caused by its distance from the source, not due to its relative movement. The closer the louder	75.00	11.11	69.45	16.67
The frequency of sound in air is smaller than in water, because sound waves propagate faster in the air than in water	19.45	8.34	30.56	13.89
When sound enter a denser medium, the wavelength decreases	61.11	22.22	41.66	30.55
The sound of the flute is caused by a resonance that shakes the flute material	72.23	33.34	77.78	50.00
The intensity of hearing damage is above the intensity threshold	86.11	19.45	80.56	52.78
The sounder sources there are the greater the frequency	88.89	27.78	77.78	55.56
Light Wave				
Radio waves are not the same as light waves because radio waves need a medium to propagate	69.45	16.67	83.33	58.34
The color of soap bubbles occurs due to the refraction of light, the refracted light changes color of the light bubbles like in a rainbow	80.56	22.22	77.78	63.89
Wavelength is proportional to frequency	77.78	8.33	75.00	22.22
Light that passes through a narrow gap is diffracted only	80.56	25.00	69.44	55.56
The merging of the two waves could not possibly be weak, but only become stronger	58.33	16.67	75.00	22.22
Light refracted by air can form an orange color in the sky	52.78	2.78	63.89	47.22
Percentage of Mean Misconceptions	**61.77**	**12.83**	**60.71**	**34.66**
Percentage Decreased Misconceptions	**48.94**		**26.06**	

Based on Table 2. Students who learn using the CCM experience a greater change in concept, namely by a decrease in misconceptions by 48.94% compared to students who learn using the DIM who experience a decrease in misconceptions by 26.06%.

Students' Conceptual Understanding

The distribution of data on students' initial conceptual understanding in the experimental group is presented in Table 3 and data on students' conceptual understanding is presented in Table 4. The differences in the students' pretest and posttest mean scores are presented in Figure 4. The differences in the students' pretest and posttest for each dimension are presented in Figure 5.

Table 3. Mean value (M) and standard deviation (SD) of students' initial conceptual understanding

Class	Model	N	M	SD
XI MIPA 1	CCM	36	79.03	6.22
XI MIPA 5	DIM	36	47.01	5.54

Table 4. Mean value (M) and standard deviation (SD) of students' conceptual understanding.

Class	Model	N	M	SD
XI MIPA 1	CCM	36	37.47	5.17
XI MIPA 5	DIM	36	35.52	5.74

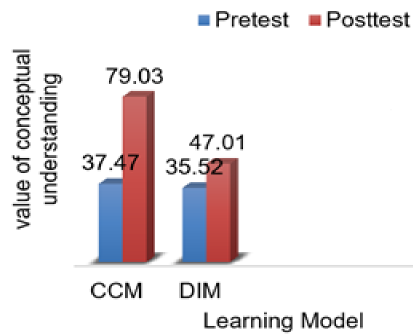


Figure 4. Comparison of the mean value of pretest and posttest for each group.

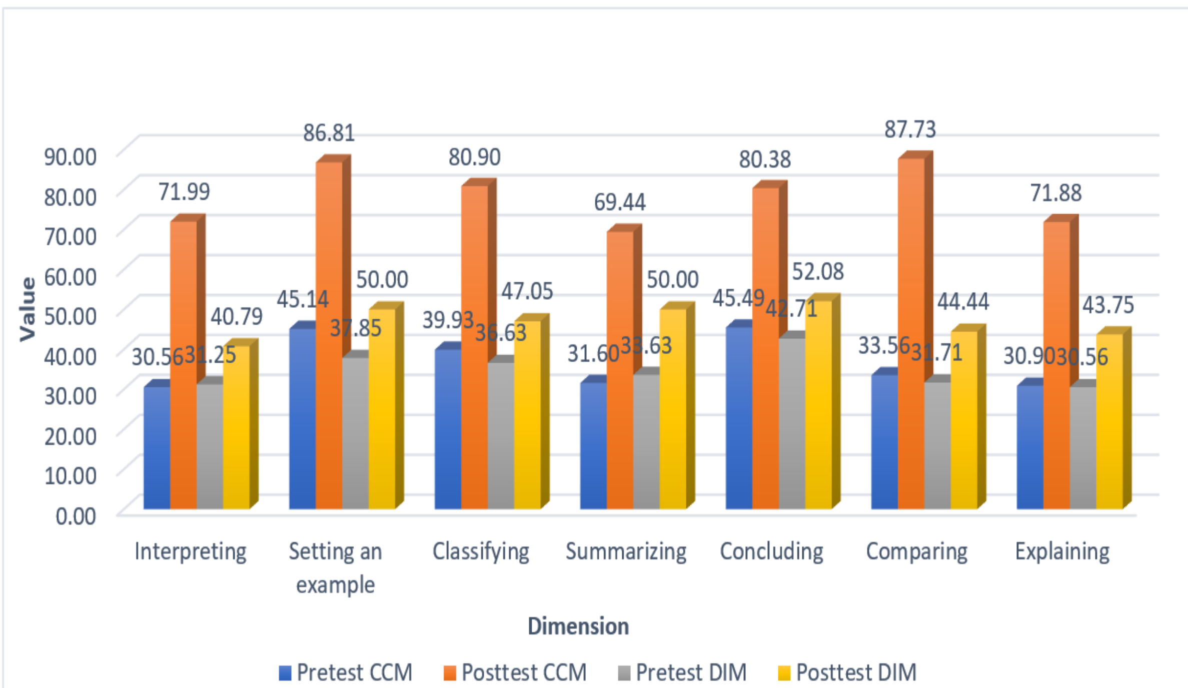


Figure 5. Comparison the average percentage of each dimension

Hypothesis testing was carried out using the one-way ANACOVA test with help of the SPSS 25.0 for windows program. The test results are available in Table 5.

Table 5. ANACONA result

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12050.498	2	6025.249	317.602	0.000
Intercept	2212.657	1	2212.657	116.633	0.000
Pretest	243.776	1	243.776	12.850	0.001
Model	10849.166	1	10849.166	571.880	0.000
Error	1309.002	69	18.971		
Total	196372.000	72			
Corrected Total	13359.500	71			

a. R Squared = 0.902 (Adjusted R Squared = 0.899)

Table 5. indicates several things, namely: First, the pretest lane which is the understanding of the students' initial concepts, shows a statistical value of F = 12.850 with a significant value of 0.001. The significance value obtained is less than 0.05 (0.001 < 0.05), which states that there is a significant influence between the covariates (the initial conceptual understanding) on students' conceptual understanding.

Second, the effect of the independent variable on the dependent variable, the method line shows the statistical value, namely F = 571.880 with a significance of 0.001. The significance value obtained is smaller than 0.05 (0.001 < 0.05) so that the decision that can be taken is H_0 is rejected. This indicated that there are significant differences in students' understanding of physics concepts (which are influenced by the learning model used in learning activities).

As a follow-up to the covariance analysis, an analysis of the difference in the mean value of students' conceptual understanding between the CCM group and the DIM group was carried out through LSD (Least Significant Difference). The results of the LSD test are presented in Table 6.

Table 6. The significance of the difference in the mean value of students' conceptual understanding

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.
DIM	CCM	-31.184*	1.304	0.000
CCM	DIM	31.184*	1.304	0.000

Based on Table 6, it shows that there is a difference in the mean score of students' conceptual understanding between the CCM group and the DIM group $\Delta\mu = \mu(I) - \mu(J) =$ 31.184 with a standard deviation obtained is 1.304 and a significance value of 0.001. The significance value obtained is less than 0.05 and the $\Delta\mu$ value is greater than the LSD value. Based on the calculation, the LSD value is 2.047. The result indicates that there is a difference in the mean value of conceptual understanding between the CCM and DIM group. So, that the understanding of the physics concept of students who learn with the conceptual change model is relatively better than that of the group of students who learn using the direct instruction model.

This study obtained several results, namely: Based on the misconceptions experienced by students, both groups had misconceptions regarding the material of sound waves and light. The results of the study confirmed previous findings related to misconceptions in the same field. Eshach, Lin & Tsai (2018) shows that materialistic thinking poses a significant barrier to students' understanding of sound. Sutopo (2015) in his research, showed that the fundamental concepts regarding sound waves have not been understood by most students, and there are even some cases of misconception. Porter & Heckler (2019) findings indicate that many misunderstandings about wave functions persist throughout students' graduate experience, even after instruction. Meanwhile the research by Pejuan, Bohigas, Jaen & Periago (2012) shows the main model misconception found was the notion that sound is propagated through the travelling of air particles, even in solids. The presence of misconception in both groups indicates that conceptual changes experienced by students were not complete where after the implementation of the learning model in the two groups there were still misconceptions experienced by students. This is because changing students' conceptions is not easy.

Generally, a new conception is unlikely to displace an old one, unless the old one encounters difficulties, and a new intelligible and initially plausible conception is available that resolves these difficulties. That is the individual must first view an existing conception with some dissatisfaction before he will seriously consider a new one Posner, Strike, Hewson & Gertzog (1982). Changes in preconceptions and misconceptions toward scientific conception occur in very limited quantities, or only few new conceptions are formed that can be integrated by learners into the knowledge they already have (Santyasa, 2017). The consistency or stability of students' misconceptions occurs because students follow conceptions based on their learning experiences, even if the conception are not scientifically appropriate, which can be a barrier for students to study subjects in physics which result in student difficulties when facing learning material with scientific basic concepts (Zulfikar et al., 2019).

The misconceptions experienced by students on the materials of light waves and sound waves are caused by factors that can affect students' misconceptions. Widiyatmoko and Kinya (2018) state that the factors that can contribute to student misconceptions are students' daily experiences, language used, teachers and text-books. The other factor is students were depending on the internet to solve the problems as they were too lazy to find textbooks in the library to overcome their misconception in understanding physics concepts (Trisniarti, Aminah & Sarwanto, 2020).

Reconstruction of student misconceptions can be carried out in learning activities that facilitate conceptual change, so that teachers as learning providers play a role in encouraging conceptual change as reconstruction of student misconceptions into scientific conceptions (Zulfikar et al., 2019). The low level of the conceptual understanding is because teachers' learning method focuses on giving formulas or mathematical formulations rather than the conceptual problem, therefore makes students not understand the concept. Furthermore, one of the efforts to decrease students' misconception is that teachers must know the level of students' conceptual understanding and teachers must also be able to conduct an analysis of learning indicator achievement (Ratnasari & Suparni, 2017).

Teaching is not just meaning to inform or to demonstrate the use of knowledge to students, teachers must encourage students to create a meaning (Chen & Wang, 2016). Teachers had an important role in learning, especially in choosing the right models to support the changes of student's concepts into scientific concepts. One of the models that can be applied in learning is the conceptual change learning model. Based on the research result, it was found that students in the CCM group were able to experience greater concept change than students in the DIM group. Reviewed based on the result of the pretest, posttest, and analysis of each dimension of conceptual understanding, it shows that student in the CCM group have a better understanding of the concept than the DIM group which indicates that the conceptual change learning model is able to help student understand the concept better than the direct learning model.

The results obtained in this study are in line with research by Lee (2014) it shows that teaching science through the conceptual change model is a good way of helping students to learn science. Asgari et al., (2018) which found that the development and understanding of education has increased with conceptual change teaching methods besides that it is more effective in removing and modifying student misconceptions and student contributions to learning activities. Redhana et al., (2017) finding learning problems viewed from conceptual change model and showed the problems that related to the aspect of conceptual change model by Posner which are necessity, intelligibility, plausibility, and fruitfulness in learning activities, by knowing the learning problems especially problems related to the students' misconception, the teacher can design effective lesson plans to improve students' understanding and remediate the students' misconceptions.

Pebriyanti, Sahidu & Sutrio (2015) found that the conceptual change learning model was effective in overcoming student's misconceptions of physics. This shows that CCM is superior to traditional teaching in teaching and learning physics concepts in detecting and correcting student misconceptions. Santyasa et al., (2018) show that students' conceptual understanding and their character is very different between students who learn with conceptual change learning models and direct learning models.

The conceptual understanding and character of students both collectively and individually for students who learn with conceptual change learning models are significantly higher than students who learn with direct learning models. So that the effect of the conceptual change learning model is higher than the direct learning model in achieving conceptual understanding and character of students in studying physics. Whereas research conducted by Syuhendri (2017) shows that traditional learning fails to improve students' conceptual under-standing because the instructor has not turned his attention to the importance of his approach so that it does not attempt to investigate students' preconceptions, this study provides strong beneficial result that traditional classes do not get N-gain after instruction, this reinforces that to change learners' conceptions can only be done by applying conceptual change learning. Based on some of these studies, misconceptions need to be resolved in order to improve students' conceptual understanding of physics, one of which is by applying the CCM. Through the model there will be a reconstruction of scientific knowledge in students so that the misconceptions experienced by students can be remediated and will have the opportunity to lead to conceptual changes of students from misconceptions to scientific conceptions.

The learning process provided by the conceptual change learning model is a factor of excellence in achieving conceptual understanding and character for students in learning physics. The advantages possessed by the conceptual change learning model are not provided by the direct learning model (Santyasa et al., 2018). When compared with the traditional methods, the conceptual change approach is a much better alternative to deal with misconception problems (Ozkan & Selcuk, 2012). That traditional science teaching is not effective in increasing students' understanding and argumentation skills in learning concepts (Sari, Faranie & Winarso, 2017). In contrast to the conceptual change learning model, the direct learning model rarely presents cognitive conflicts related to the concept being taught where the students' system learns the concept by rote memory so that students have less opportunity to build their knowledge. So that students have a greater chance of experiencing misconceptions.

The findings of this study have implica-tions, namely the use of learning models in the learning process has a different effect on students' understanding of physics concept, the CCM can be considered as an alternative learning model to improve students' understanding of physics concepts, this model can trigger cognitive conflicts that can assist students in changing the concept from misconceptions to scientific concepts. Conflict activities in the application of the CCM include experiment, demonstrations, discus-sions guided by conceptual change worksheets, which aim to facilitate students in the conceptual change process. Teachers can optimize their role as mediators and facilitators who can help students in learning activities. The application of the CCM is also supported using conceptual change text that are oriented towards presenting contextual and conceptual problems, providing disclaimers that help the occurrence of cognitive conflict in students and contextual examples of related concepts.

CONCLUSION

Based on the result of the research, the result of data analysis and the discussion that has been conveyed, the conclusion that can be drawn from this study is that there are differences in the students' conceptual understanding of physics between students who learn using CCM and students who learn using DIM in class XI SMA Negeri 1 Blahbatuh (F = 571.880 with a significan-ce of 0.001). The students' conceptual under-standing of physics of students who learn using the CCM shows relatively superior results com-pared to the students who learn using the DIM. To improve the physics learning process that optimal-ly accommodates student conceptual changes, it can be done by using the CCM.

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