

Conceptual Change Textbook Based on Local Wisdom of Palembang on Heat and Temperature

Saparini*, Syuhendri, and Murniati

Physics Education Department, Faculty of Teacher Training and Education,
Sriwijaya University, Indonesia
saparini@fkip.unsri.ac.id

DOI:10.20527/bipf.v9i1.9568

Received : 29 November 2020 Accepted : 26 February 2021 Published : 28 February 2021

Abstract

The misconception is one of the learning difficulties that occur in students when learning physics, especially the concepts of heat and temperature. One solution to overcome this is by using a textbook based on conceptual change. The purpose of the research is to develop a valid and practical conceptual change textbook based on the local wisdom of Palembang. This study uses the Rowntree research method and is combined with Tessmer's evaluation at the evaluation stage. Data was collected through a walkthrough and questionnaire. The data were analyzed by looking for the mean score obtained and then converted according to the category of expert validation results and the product practicality level. The results showed that the product developed was categorized as very valid in every aspect of content, language, and design. Meanwhile, the results of the one-to-one and small group evaluation stages each showed that it is practical. This shows that the product developed is suitable to be used and by applying appropriate learning methods expected to reduce students' misconceptions of temperature and heat.

Keywords: Conceptual change textbook; Heat and temperature; Local wisdom; Misconception

© 2021 Berkala Ilmiah Pendidikan Fisika

How to cite: Saparini, Syuhendri, & Murniati. (2021). Conceptual change textbook based on local wisdom of Palembang on heat and temperature. *Berkala Ilmiah Pendidikan Fisika*, 9(1), 88-95.

INTRODUCTION

The concept of heat and temperature cannot be separated from the environment around living things; however, heat and temperature are not directly observable quantities (Alwan, 2011). Previous research states that misconception is one of the problems in learning physics that will always appear anytime and anywhere because students following their learning already have initial concepts obtained from daily experience and their belief in a certain concept (Syaharudin et al., 2015).

Misconceptions often occur in physics concepts, including the concepts of temperature and heat (Baser, 2006) (Alwan, 2011), waves (Barniol & Zavala, 2016) (Admoko et al., 2019) (Tumanggor et al., 2020), mechanics (Kuczmann, 2017; Syuhendri, 2017a; Syuhendri, Nely Andriani, and Saparini, 2019), and other physics concepts. Each of these misconceptions will affect student learning outcomes and understanding of concepts.

Technological developments provide flexibility for teachers and students in finding learning resources. However,

textbooks are still the learning resource chosen by teachers. If not accompanied by other learning resources will be possible changes in students' self-concept. However, the use of technology, especially the internet, can also cause misconceptions because everyone can access the internet and upload their information. However, this information is not necessarily correct that it can cause conceptual changes (Sesen & Ince, 2010). Based on the literature review conducted, textbooks are thought to be one of the causes of misconceptions (Kaltak & Eryilmaz, 2013; Fitrianingrum et al., 2013). Therefore, the role of teachers in managing and planning learning has an important role in learning.

One solution to overcome misconceptions is to use textbooks based on conceptual change. The book is a textbook developed based on the conceptual change theory. There are four conditions for a conceptual change: dissatisfaction, intelligible, plausible, and fruitful (Syuhendri, 2017b). Previous research has developed textbooks based on conceptual change theory on dynamics concept (Samara, Syuhendri, & Muslim, 2020).

Local wisdom is a view of life and knowledge, and various life strategies in the form of activities carried out by local people in responding to various problems in fulfilling their needs (Fajarini, 2014). Local wisdom raised in this research is the local wisdom of Palembang City related to the concept of heat and temperature. Some of Palembang's local wisdom that can be used to explain the concept of heat and temperature are the Ampera Bridge as one of Palembang city's icons, the process of making smoked fish and kemplang crackers. Previous research on the development of physics textbooks by incorporating local wisdom has been carried out (Satriawan & Rosmiati, 2016). However, the textbook did not create to reduce

misconceptions or improve conceptual understanding.

Several textbooks were developed based on local wisdom (Pornpimon et al., 2014; Wahyuni, 2015; Putry et al., 2018; Fitriah, 2020a), fewer research reports develop textbooks in heat and temperature with local wisdom from Palembang. Therefore, this study aimed to develop a conceptual change text based on local wisdom in Palembang city on heat and temperature. The difference between this study and previous research is that there is a component of local wisdom in Palembang, which is expected to make it easier for students to learn the physics concepts given so that misconceptions on heat and temperature can be reduced.

METHOD

This research is development research with the Rowntree model. The Rowntree product development model consists of three stages: planning, development, and evaluation (Prawirdilaga, 2008). The planning stage includes a needs analysis. The development stage is the stage that contains the development of the topic, the design of the conceptual change text, the production of a prototype of one type of product that will use for learning. The evaluation stage did carry out with Tessmer's formative evaluation model consisting of (1) self-evaluation; (2) expert review; (3) one-to-one evaluation; (4) small group evaluation; and (5) Field Test (Tessmer, 1993). However, this research did not carry out until the field test.

This research was conducted in the odd semester of the 2020-2021 school year at a private high school in Palembang with a mixture of male and female students with various economic and educational backgrounds.

The data collection techniques used were walkthroughs and questionnaires. The walkthrough was given at the expert

validation stage, while the questionnaire was given at the one-to-one and small group evaluation stages. The data obtained are then searched for the percentage then converted into the category of expert validation results then symbolized by HVA and the category of product practicality level then symbolized by HEOS.

Table 1 The Category of Expert Validation Results

%	Category
$86 \leq HVA \leq 100$	Very valid
$70 \leq HVA < 86$	Valid
$56 \leq HVA < 70$	Less valid
$0 \leq HVA < 56$	Invalid

(Wiyono, 2015)

Table 2 The Category Product Practicality Level

%	Category
$86 \leq HEOS \leq 100$	Very practical
$70 \leq HEOS < 86$	Practical
$56 \leq HEOS < 70$	Less practical
$0 \leq HEOS < 56$	Not practical

(Wiyono, 2015)

RESULT AND DISCUSSION

The final product produced in this study is a conceptual change textbook based on the local wisdom of Palembang city. The developed textbook consists of 61 pages consisting of sub-chapters of heat and temperature. The first stage is implementing a diagnostic test for the concept of heat and temperature and a needs analysis by giving questionnaires to students. A heat and temperature diagnostic test has been developing previously, namely Temperature Conceptual Evaluation (HTCE) (R. K. Thornton and D. K. Sokoloff, 2001). The test was conducted to capture misconceptions of heat and temperature, while the questionnaire was to capture students' needs for textbooks to be developed. The results of the analysis of the diagnostic test for heat and temperature misconceptions using HTCE are shown in Table 3.

Table 3 Heat and Temperature Misconceptions Based on Diagnostic Test

Category	n	%
Heat dan temperature	18	42.86
The phase change of object form	10	23.81
Properties of materials	10	23.81
Heat transfer	9	21.43

Table 3 results from the diagnostic test for heat and temperature misconceptions conducted on 42 students of class XI at a private high school in Palembang. The results obtained indicate that the misconception of heat and temperature occurs in each category. Furthermore, the results of the needs analysis are presented in Table 4.

Table 4 Student Responses to Needs Analysis

Category	n	%
Use of varied learning resources	35	83.30
Explanation of the concept using a contextual approach	25	59.50
Learning emphasizes the use of formulas rather than concepts	40	95.20
The need for additional teaching materials to improve conceptual understanding	38	90.50
The need for teaching materials that link-local wisdom	15	59.50

Students stated that they found it difficult when asked to solve heat and temperature questions that asked about concepts, so that as many as 90.5% of students felt the need for additional teaching materials that could be used to improve students' understanding of concepts, especially in heat and temperature. Furthermore, as many as 59.5% of students answered the need for teaching materials related to local

wisdom, especially local wisdom around their place of residence. The next stage is preparing an outline of the contents of the conceptual change textbook based on

the local wisdom of Palembang that shown in Table 5 and the design of front and back pages shown in figure 1.

Table 5 Material Outline on Conceptual Change Textbook

Basic competencies	Indicator	Concept	Local Wisdom
3.5. Analyzing the effect of heat and heat transfer which includes the thermal characteristics of a material, capacity, and heat conductivity in everyday life	Students can describe the meaning of temperature	Temperature	the process of making roasted kemplang
	Students can name a temperature measuring device.		
4.5 Planning and conducting experiments on the thermal characteristics of a material, especially concerning the capacity and heat conductivity, along with the presentation of results and their physical meaning	Students can analyze changes in temperature to the size of objects (expansion of objects).	Expansion	an explanation of the expansion on the Ampera bridge and Limas House
	Students can explain the meaning of expansion.		
	Students can mention various kinds of expansion in everyday life.		
	Students can analyze the relationship between heat and the temperature of the object and its shape.	Heat	jumpatan fabric manufacturing process
	Students can explain the heat capacity and specific heat of objects.		
	Students can explain the sound of the Black Principle.		
	Students can mention the application of the Black Principle in everyday life.		
	Students can explain heat transfer by Convection, Conduction and Radiation	Heat Transfer	the process of making smoked fish (Ikan Salai)



Figure 1 Front and Back Pages of Textbooks

The development stage begins with designing a conceptual change text with the following systematics: (1) situation; (2) questions; (3) answers and reasons; (4) dominant misconception; and (5) correct concept explanation (Syuhendri, 2017b). The systematics are then applied to each sub-concept to explain the misconceptions that often occur in these sub-concepts, as shown in figure 2.

Teks Perubahan Konseptual

Pengertian Suhu

Situasi dan Pertanyaan:

Kemplang panggang merupakan salah satu cemilan khas kota Palembang yang berbahan utama tepung dan ikan giling. Setelah disalut sedemikian rupa, selanjutnya adonan kemplang yang telah matang dipotong-potong kemudian dijemur dibawah sinar matahari. Jika adonan kemplang tersebut dipotong menggunakan pisau secara manual, maka akan diperoleh potongan yang tidak seragam sehingga ada yang lebih tebal dibandingkan potongan lainnya. Potongan adonan kemplang tersebut selanjutnya disusun pada wadah aluminium selanjutnya dijemur dibawah terik matahari. Menurut pendapat Anda, potongan kemplang manakah yang akan terlebih dahulu kering?

Tuliskan jawabannya!

Miskonsepsi yang sering terjadi

Benda yang memiliki ukuran lebih besar akan membutuhkan suhu lebih besar dibandingkan benda berukuran lebih kecil, dengan kata lain ukuran benda mempengaruhi suhu yang dimiliki benda tersebut.

Konsep yang benar

Perlu diketahui bahwa suhu merupakan derajat panas atau dinginnya suatu benda. Pada proses pembuatan kemplang, sebelum potongan adonan kemplang yang telah masak

tersebut memiliki suhu yang sama. Meskipun memiliki ketebalan yang berbeda, suhunya tetap sama karena kedua potongan kemplang yang berbeda ukuran tersebut dipanaskan dibawah sinar matahari dengan perlakuan sama. Hal tersebut berarti, pengaruh kalar yang diberikan pada kedua potongan kemplang sama sehingga suhu kedua potongan kemplang tetap sama. Jika terus menerus dipanaskan dibawah sinar matahari, tentunya kemplang dengan potongan lebih tipis akan kering terlebih dahulu. Hal ini berarti keringnya kemplang terjadi karena lamanya penyinaran yang diberikan. Jadi perbedaan ukuran potongan kemplang atau ukuran benda tidak mempengaruhi kecepatan kemplang untuk kering.

Selanjutnya apa yang terjadi jika potongan kemplang yang berbeda ukuran tadi diletakkan menggunakan oven pada suhu dan waktu yang sama? Menurut Anda kemplang manakah yang akan kering terlebih dahulu? Tentunya kemplang yang lebih tipis akan kering terlebih dahulu karena kemplang yang lebih tebal membutuhkan waktu lebih lama untuk kering. Hal ini menegaskan bahwa pada kondisi yang serupa, dua buah benda akan tetap memiliki suhu sama meskipun ukuran berbeda.



Nama kemplang berasal dari Southern dialect Melayu lokal Sumatera yang berarti "memukul" untuk merujuk proses perataan adonan krupuk. Kemplang dikembangkan di kota pesisir di bagian selatan Sumatera yang secara tradisional meliputi Sumatera Selatan, Bangka Belitung dan provinsi Lampung.

(Sumber: <http://penipikkerupuk1707.com/sejarah-kemplang/>)



Figure 2 Conceptual Change Text on Subconcept of Temperature
After checking the developed prototype, they were then validating it to

3 experts, including validating content, language, and design. The recapitulation results of expert validation are shown in table 6.

Table 6 Recapitulation Of Expert Validation Results

Aspect	%	Category
Content	91.30	Very valid
Language	95.20	Very valid
Design	93.10	Very valid

The products that have been validated are then revised according to suggestions from the validator. Some of the suggestions are added application examples at the end of the concept explanation stage in each conceptual change text, add a picture illustration accompanied by an explanation of the local wisdom discussed, and add some sample questions according to the product being developed. The next evaluation stage is a one-to-one evaluation. This stage was carried out by selecting three students representing class at a private high school in Palembang, and the results obtained were 90.8%, including the very practical category. As for the suggestions given in the one-to-one evaluation stage, it is necessary to add example questions and add pictures to make it more interesting.

The draft was revised according to the suggestions given by the one-to-one evaluation. Small group evaluation implemented on nine students of class XI at a private high school in Palembang. The result was that 93.3% was categorized as very practical. Table 7 shows a recapitulation of the results of the one-to-one and small group evaluation stages.

Table 7 Recapitulation of One-To-One and Small Group Evaluation Results

Stages	%	Category
one-to-one evaluation	90.8	very practical
Small group evaluation	93.3	very practical

The results of the product developed shows very valid and very practical. This shows that the book can be used in heat and temperature learning as additional teaching material besides the primary textbook. The research results are in line with previous research that states that conceptual change text teaching materials have been successfully developed for material temperature and heat in high school that are valid and practical (Paga, K. L., Syuhendri, S., & Kistiono, 2018).

Although there have been many studies on the use of the theory of conceptual change in physics learning, not much has discussed heat and temperature concepts. For example, Badiro succeeded in using conceptual change theory to develop android-based learning media for the solar system and moon phases (Badiro et al., 2019).

Some of the previous studies mentioned focus on using the conceptual theory of change to reduce misconceptions of physics but have not used the local wisdom of the area around students as the focus of research. This is because local wisdom can be used as a contextual learning source to make it easier for students to learn. Fitriah said that the application of local wisdom in learning physics could train students' religious character (Fitriah, 2020b). The application of appropriate learning models can also reduce students' misconceptions of physics, such as the use of interactive simulations (Dega et al., 2013), cognitive conflict-based learning (Madu & Orji, 2015), and learning cycles (Syuhendri, 2017b).

CONCLUSION

This research has successfully developed a textbook of conceptual change based on Palembang city's local wisdom on heat and temperature that is valid and practical. The product developed can be used to reduce

students' misconceptions about heat and temperature. The limitation is that this product needs to be tested in the real classroom context to explore further how this book could change some students' misconception. Future research is expected to use this textbook in learning to determine its effectiveness in reducing misconceptions of heat and temperature.

REFERENCE

- Admoko, S., Yantidewi, M., & Oktafia, R. (2019). The implementation of guided discovery learning using virtual lab simulation to reduce students' misconception on mechanical wave. *Journal of Physics: Conference Series PAPER*, 1417, 1–7.
- Alwan, A. A. (2011). Misconception of heat and temperature among physics students. *Procedia - Social and Behavioral Sciences*, 12, 600–614.
- Badiro, D., Syuhendri, S., & Fathurohman, A. (2019). Pengembangan media pembelajaran aplikasi android berbasis teori perubahan konseptual materi tata surya dan fase bulan mata kuliah ipba. *Jurnal Inovasi Dan Pembelajaran Fisika*, 6(1), 103–112.
- Barniol, P., & Zavala, G. (2016). *Mechanical waves conceptual survey: Its modification and conversion to a standard multiple-choice test*. 010107, 1–12.
- Baser, M. (2006). Instruction on students' understanding of heat and temperature. *Eurasia Journal of Mathematics, Science and Technology Education*, 2(2), 96–114.
- Dega, B. G., Kriek, J., & Mogese, T. F. (2013). Students' conceptual change in electricity and magnetism using simulations: A comparison of cognitive perturbation and cognitive conflict. *Journal of Research in Science Teaching*, 50(6), 677–698.

- Fajarini, U. (2014). Peranan kearifan lokal dalam pendidikan karakter. *SOSIO DIDAKTIKA: Social Science Education Journal*, 1(2).
- Fitriah, L. (2020a). Students' response to the basic physics textbook integrated with faith, piety, and local wisdom. *Jurnal Ilmiah Pendidikan Fisika*, 4(1), 23.
- Fitriah, L. (2020b). *Use of Islamic and Local Wisdom Textbook to Train the Religious Character of Prospective Physics Teachers*. 8(3), 157–169.
- Fitrianingrum, N., Sunarno, W., & Harjunowibowo, D. (2013). Analisis miskonsepsi gerak melingkar pada buku sekolah elektronik (bse) fisika sma kelas x semester i. *Jurnal Pendidikan Fisika*, 1(1), 75–80.
- Kaltak, D., & Eryilmaz, A. (2013). A content analysis of physics textbooks as a probable source of misconceptions in geometric optics. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 28(28–2), 234–245.
- Kuczmam, I. (2017). The structure of knowledge and students' misconceptions in physics. *AIP Conference Proceedings*, 1916(December).
- Madu, B. C., & Orji, E. (2015). Effects of cognitive conflict instructional strategy on students' conceptual change in temperature and heat. *SAGE Open*, 5(3).
- Paga, K. L., Syuhendri, S., & Kistiono, K. (2018). *Pengembangan Bahan Ajar Berbasis Teori Perubahan Konseptual untuk Materi Suhu dan Kalor SLTA*. Sriwijaya University.
- Pornpimon, C., Wallapha, A., & Prayuth, C. (2014). Strategy challenges the local wisdom applications sustainability in schools. *Procedia - Social and Behavioral Sciences*, 112(Iceepsy 2013), 626–634.
- Prawirdilaga, D. S. (2008). *Prinsip Desain Pembelajaran*. Prenada Media Grup.
- Putry, A. A., Warsono, W., Supahar, S., Jumadi, J. (2018). Students and teachers' necessity toward multimedia learning modules (MLMs) based on benthik local wisdom to provide students' physics initial knowledge. *Journal of Physics: Conference Series*, 1097(1).
- R. K. Thornton and D. K. Sokoloff. (2001). *Heat and Temperature Conceptual Evaluation*. Physport.Org.
- Samara, R. A., Syuhendri, S., & Muslim, M. (2020). *Pengembangan Teks Perubahan Konseptual Handout untuk Remediasi Miskonsepsi Materi Dinamika SMA/MA*. *Jurnal Inovasi Pembelajaran Fisika*, 7(1), 55–63.
- Satriawan, & Rosmiati, M. (2016). Pengembangan bahan ajar fisika berbasis kontekstual dengan mengintegrasikan kearifan lokal untuk meningkatkan pemahaman konsep fisika pada mahasiswa. *Pendidikan Sains Pascasarjana Universitas Negeri Surabaya*, 6(1), 1212–1217.
- Sesen, B. A., & Ince, E. (2010). Internet as a source of misconception: "Radiation and radioactivity." *Turkish Online Journal of Educational Technology*, 9(4), 94–100.
- Syahrudin, N., Daud, N., Mustamam, M., Karim, A., Wan, S., Wan, N., & Rahman, N. A. (2015). Misconception and difficulties in introductory physics among high school and university students : an overview in mechanics. *EDUCATUM Journal of Science, Mathematics and Technology*, 2(1), 0–0.
- Syuhendri; Nely Andriani; and Saparini. (2019). Pemahaman Konsep dan Miskonsepsi Mahasiswa Calon Guru pada Hukum Keppler. *Jurnal*

- Kependidikan*, 3(1), 263–275.
- Syuhendri, S. (2017a). A learning process based on conceptual change approach to foster conceptual change in newtonian mechanics. *Journal of Baltic Science Education*, 16(2), 228–240.
- Syuhendri, S. (2017b). Pengembangan teks perubahan konseptual (tpk) untuk pengajaran perubahan konseptual. *Seminar Nasional Pendidikan IPA, Vol 1 (2017)*, 682–691.
- Tessmer, M. (1993). *Planing and Conducting Formative Evaluations*. Kogan Pag.
- Tumanggor, A. M. R., Supahar, S., Kuswanto, H., & Ringo, E. S. (2020). Using four-tier diagnostic test instruments to detect physics teacher candidates' misconceptions: Case of mechanical wave concepts. *Journal of Physics: Conference Series*, 1440(1).
- Wahyuni, S. (2015). Developing science learning instruments based on local wisdom to improve student's critical thinking skills. *Jurnal Pendidikan Fisika Indonesia*, 11(2), 156–161.
- Wiyono, K. (2015). Pengembangan model pembelajaran fisika berbasis ict pada implementasi Kurikulum 2013. *Jurnal Inovasi Dan Pembelajaran Fisika*, 2(2), 123–131.