Development of MATTERED (modul of heat and temperature based on android) for senior high school

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Abstract. Physics is one of the subjects considered troublesome and unique by understudies, so it requires learning media to be able to get the concept of physics. This study points to create a learning module, to be specific MATTERED on Android-based Temperature and Heat for high school understudies. MATTERED is an android-based interactive module with respect to the concept of temperature and heat which is created within the frame of interactive multimedia. This research design uses Research & Development (R&D). MATTERED wasat that point created and approved by material specialists and media specialists, and tried on physics instructors and 90 understudies of class 11th grade in three high schools within the city of Surakarta, Central Java, Indonesia. Based on the comes about of the approval by the material and media master validator, a score of 87.44% was gotten, and the MATTERED trial on instructors and students each obtained a score of 95.03% and 96%, where all appraisals were included within the exceptionally great category. Based on this, it demonstrates that MATTERED is doable to be utilized in learning physics in class for students of class 11th grade.

1. Introduction

Within the 21st century, technology has an imperative part in our daily lives, particularly in instruction [1,2]. The utilize of innovation in learning can make learning more energetic and can progress students’ learning capacities [3,4,5]. The utilize of smartphones and computers in schools may be a shape of innovation utilization in instruction [6]. Schools that actualize Android-based smartphones when learning can increment intrigued and eagersness for learning, as well as increment students' learning capacities [6,7]. The utilize of other advances, to be specific as instructing materials such as interactive modules, will be more appealing to understudies and can increment understudy interest, and can progress students’ capacities within the domains of cognitive, full of feeling, social abilities, and high-level abilities [1,8]. The interactive module is one of the advanced educating materials based on intuitively mixed media and contains different representations of content, illustrations, pictures, recordings or animations [6,9].

Physics learning is a portion of science learning and one of the imperative subjects in tall school as a implies examining concepts, standards, laws, and hypotheses as well as the relationship between concepts that happen in a watched physical marvel [10]. Most of the material science concepts are unique and troublesome to get, one of which is the concept of temperature and heat. Temperature and heat are materials in learning whose application and marvel can be found within the everyday life of understudies [11,12,13]. Temperature and heat material has numerous calculation forms as in equation
so understudies got to memorize numerous conditions additionally unique and hypothetical concepts[14].

\[ Q = m c \Delta T \]  

(1)

This causes understudies to have trouble understanding and clarifying once more the concept of temperature and heat, where heat is vitality comprising of arbitrary movement and vibrations of molecules, atoms, and particles[12], [14], [15]. So that instructors regularly have trouble overcoming this and cause learning to be less successful and troublesome to progress understudy issue fathoming, and understudies effortlessly feel bored [16], [17]. For the victory of learning, it requires learning media that's able to communicate fabric, concepts, hypotheses and is energetic in learning material science. So that the learning prepare can take put well and can move forward students' understanding of concepts and information, and can pull in and increment understudy learning inspiration. Based on this, it is fundamental to create learning media that meet these criteria.

This considers points to the creation of an android-based interactive learning module called Module of Heat and Temperature Based on Android (MATTERED). MATTERED is an intuitively multimedia-based learning module utilized on android smartphones. MATTERED contains different sorts of representations making it simpler for understudies to get the concepts of temperature and heat which are still abstract. MATTERED is dynamic so that understudies can utilize it anytime and anywhere.

2. Method

This ponder uses the Research and Development (R&D) and the research strategy and employments the ADDIE [7], [18], be that as it may, in this think about the stages as it were utilize three stages, specifically analysis, design and development (ADD) which is appeared in Figure 1.

![Figure 1. Product development chart.](image)

2.1. Analysis Stage

At the analysis arrange, there are a few exercises, to be specific literature thinks about, field thinks about and conducting needs examination. Writing consider is an action of examining and analysing the 2013 syllabus and educational programs (K13) which is connected in schools through a writing survey, other than analysing the criteria and benchmarks that the learning module must have. Whereas the field
considers is the movement of straightforwardly watching and analyzing material science learning on temperature and warm fabric within the classroom. Moreover, conducting a needs examination by conveying a needs examination survey to 3 material science instructors and 30 understudies from three secondary schools in Surakarta. Desires investigation survey contains explanations and questions approximately the learning prepare on temperature and warm fabric, as well as the requirements for Android-based learning media in learning.

2.2. Design Stage
The design organizes, starts with making a MATTERED plan system based on the comes about of writing consider on module guidelines, and the wants of learning media from the come about of needs investigation exercises. At this arrange, reference is collected, inquire about instrument arrangement, and MATTERED plan are made. The disobedient that was organized at the plan arrange were the MATTERED approval instrument, the MATTERED appraisal instrument by the educator, and the understudy reaction instrument.

The rebellious utilized for information collection were expert approval sheets and physics educator appraisal sheets with each appraisal viewpoint having a score extend of 1-5. The perspectives that were surveyed by the validator and the educator were the reasonableness of the fabric, coherence, and appearance of the media. Then for the understudy reaction instrument employments a survey sheet containing explanations and questions around the utilize of MATTERED in learning with two reply choices, specifically "Yes" and "No". Viewpoints that are evaluated on the understudy reaction survey are the quality of the media, and the benefits of utilizing MATTERED in learning material science. The information gotten were at that point analyzed utilizing displaying information examination[19]:

\[
V = \frac{TSE}{TMS} \times 100\%
\]  

(2)

Information:
- \( V \) = Percentage rating
- \( TSE \) = Total empirical score obtained
- \( TSM \) = Total maximum score

The rate information over is at that point changed over into qualitative expressive information utilizing the criteria in Table 1 [19].

| No. | Percentage (%) | Category       | Adjudgment                                      |
|-----|----------------|----------------|------------------------------------------------|
| 1   | 81.25 ≤ \( x \) ≤ 100 | Very Valid     | The product gets to be accessible on the ground for genuine learning exercises |
| 2   | 62.5 ≤ \( x \) < 81.25 | Valid          | The product may proceed by including something less, doing certain contemplations of expansion less significant and less essential |
| 3   | 43.75 ≤ \( x \) < 62.5 | A poor Valid   | Revise by carefully investigating and trying to find particular shortcomings of the product to culminate |
| 4   | 25 ≤ \( x \) < 43.75 | Invalid        | Revised broadly and on a very basic level around the substance of the product |

2.3. Development Stage

2.3.1. MATTERED Creation
The improvement organize starts with making MATTERED based on the system and plans made within the past plan arrange utilizing App Creator. The show of MATTERED appears in Figure 2. The MATTERED is coordinating with the scientific approach which has five learning steps, be specific watching, inquiring questions, collecting information, partner, and communicating. MATTERED contains enlightening for utilizing, learning exercises with a logical approach, pictures, recordings, and movements with respect to temperature and heat fabric, understudy worksheets (LKPD), test questions, and hone questions, and assessment.
2.3.2. Expert Approval and Educator appraisal
After the MATTERED draft was completed, discussion and approval were carried out to two specialists, to be specific the material master and the media master. Based on the comes about of the approval, enhancements can be made to MATTERED agreeing to proposals and reactions passed on by specialists, so that MATTERED is said to be appropriate for utilize in learning. The approved MATTERED was at that point evaluated by three material science instructors from three auxiliary schools in Surakarta.

2.3.3. Test the Reaction of Understudies
Understudy reaction trials were carried out three times, to be specific one-to-one trials, little bunch trials, and field trials at three secondary schools in Surakarta. Within the one-to-one trial, MATTERED was given to one understudy, in little bunch trials, MATTERED was given and utilized by three understudies, and then the final trial could be a field trial which was conducted on 90 understudies. After utilizing MATTERED in learning, students are inquired to reply to utilize by filling out an understudy reaction survey.

3. Result and Discussion

3.1. Analysis Stage
This inquires starts with the analysis stage. Based on the comes about of the requirements examination survey and the comes about of the interviews, it can be seen that most instructors utilize textbooks as a direct and learning asset to clarify the concept of physics. In any case, instructors moreover feel the impediments and inadequacies of course readings. To overcome these impediments and inadequacies, the educator employs learning media to bolster learning. Be that as it may, the learning media utilized are still reasonably basic, specifically Microsoft PowerPoints on certain materials. In expansion, nearly all understudies have an Android smartphone and utilize it more than 4 hours a day, but it is seldom utilized as a learning medium. The utilize of smartphones as learning bolster is as it was restricted to browsing certain reference materials. Hence instructors and understudies are fascinated by the advancement of the MATTERED material science module.

3.2. Design Stage
The design stage is the plan arrange of the MATTERED system which is based on the educational programs and the comes about of the requirements investigation.

3.3. Development Stages
At this organization, MATTERED is made based on the plan that has been made, which is at that point approved by two experts and surveyed by three physics instructors. Specialists to approve approval rebelliously, approve syllabi, approve understudy worksheets, approve sheets. The comes about of master approval and assessment by middle school physics teacher on MATTERED were made based on
fabric angles, dialect angles and media show viewpoints in Figure 3. Based on the comes about of the approval of two specialists, an average evaluation of 87.44% was gotten which was included within the exceptionally substantial category, and about of the three teachers’ evaluations, it is known that the normal MATTERED evaluation is 96% which is considered exceptionally great and reasonable for utilize in learning. This appears that MATTERED is reasonable for learning physics on temperature and heat fabric within the classroom.

![Figure 3. Average expert validation results and assessment by middle school physics teacher on MATTERED.](image)

Within the material viewpoint, the legitimacy rate is 90% for experts approval and 96% for surveyed by instructors, with the exceptionally substantial category. Though within the dialect angle, MATTERED gotten a legitimacy of 87% for expert approval and 93% for evaluation by instructor, with the exceptionally substantial category. Angles of dialect are viewed from great dialect rules and the exactness of sentence structures, the utilize of compelling, communicative sentences, and consistency within the utilize of terms. Within the viewpoint of the media display, MATTERED gotten an approval score of 85% for experts judgment and 99% for assessment by educators, which falls into the exceptionally substantial category. The viewpoint of media display is seen from the appropriateness of the color of the letters with the foundation, the appropriateness of the area of the substance, intelligently for users, and the appropriateness of recordings, pictures, and activities to the concept of temperature and heat. In line with past ponders [11,14,20] the fabric, dialect, and appearance of the media utilized within the module instructing materials can make learning that’s dynamic, cohesive, and makes a difference understudies unravel issues. Typically also in line with past thinks about [13,14] that intelligently learning modules can offer assistance instructors pass on concepts, make understudies more dynamic, and offer assistance make strides in students’ conceptual understanding.

After being approved and evaluated, MATTERED is at that point given to understudies to be utilized in learning, typically done to decide understudy reactions to MATTERED. The one-to-one trial was carried out on 3 understudies. The comes about of understudies ‘responses within the one-to-one trial arrange are appeared in Table 2. Based on the comes about of the one-to-one trial, understudies provide a reaction that MATTERED is exceptionally supportive in learning and more curiously and increments understudy inspiration. In any case, there are a few sentences that are still troublesome for understudies to get or are equivocal so that enhancements within the MATTERED dialects are required so that understudies can get the messages passed on.

| Table 2. Understudy reactions to the utilize of MATTERED in a one-to-one trial |
|-----------------------------------------------|
| Aspect                          | Criteria  | Percentage (%) |
| ease of understanding the concept | Very Good | 100             |
| Attractive media display         | Very Good | 100             |
| Ease of legibility              | Very Good | 87              |

In little gather trials carried out on 9 understudies, the comes about of students’ reactions in little gather trials are appeared in table 3. Based on the comes about of little gathered trials, understudies reacted that MATTERED was exceptionally helpful for understudies in understanding the concepts of temperature and heat, and learning was more curiously.
Table 3. Understudy reactions to the utilize of MATTERED in little gather trials

| Aspect                        | Criteria       | Percentage (%) |
|-------------------------------|----------------|----------------|
| ease of understanding the concept | Very Good      | 97             |
| Attractive media display      | Very Good      | 100            |
| Ease of legibility            | Very Good      | 95             |

The final trial could be a field trial. At the field trial organize, 96% of understudies gave a positive reaction to the utilize of MATTERED in learning. The field trial stage was carried out on 90 understudies. Understudy reactions to the field test have appeared in Figure 4.

![Figure 4. Understudy reactions to the utilize of MATTERED in field trial](image)

Based on field trials that have been carried out, the normal understudy reaction to the ease of understanding the fabric is 96%, intuitively media show is 96%, and the perspective of meaningfulness is 98%. Understudies concede that it is simpler to get its temperature and warm fabric when utilizing MATTERED amid learning compared to conventional learning. In expansion, understudies discover learning utilizing MATTERED more curiously and increment their inspiration to memorize. Typically in line with past thinks about [11,20] that intuitively instructing materials can increment understudy inspiration and movement, progress understudies 'conceptual understanding abilities, and progress students' issue tackling abilities.

4. Conclusion

The comes about of this consider were the item of an intelligently learning module on temperature and heat material for tall school understudies named MATTERED. MATTERED is ready based on the K-13 educational programs syllabus and a logical approach that has five learning steps, specifically watching, inquiring questions, collecting information, partner, and communicating. Based on the comes about of information examination, it was found that MATTERED was exceptionally substantial to utilize for learning and gotten a positive reaction from understudies. The validators gave a score of 85.7%, 95.03% scores from the teachers, and 96% of understudies reacted that the utilize of MATTERED in learning can increase understanding and inspiration to memorize.

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