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IMPLEMENTATION OF STEM-BASED VOICED INTERACTIVE TORSO (TOBI) IN IPAS LEARNING AT MIN KUDUS

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Abstract. The lack of understanding of MIN Kudus students towards human digestive system IPAS learning is due to the media used that has not been able to present a concrete and detailed picture. This study aims to describe the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning at MIN Kudus along with the responses of teachers and students. This research is included in descriptive qualitative research where the type of research is field research. Data will be obtained through observation, questionnaires, interviews, and documentation. Data analysis that will be carried out includes data reduction, data presentation, and conclusion drawing. The results of this study indicate that the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning at MIN Kudus can improve students' understanding of human digestive system material. This is evident in the activities of teachers with a percentage of 91% in the very good category and students with a percentage of 75% in the good category. While the results of teacher and student responses to design, relevance, attention, satisfaction, and confidence get a percentage of 85% and 81% including in the very good category.

INTRODUCTION

Learning media is seen as an effort made by teachers in bridging the delivery of information to students, to create interesting, fun, and diverse learning activities Pagarra & Syawaludin, (2022). Along with the times, learning media has undergone various evolutions. Initially, media was limited to printed media such as books and modules. However, with the rapid development of technology, various types of new media such as audio, audiovisual, multimedia, video, and digital-based media were born. This development not only supports learning efficiency, but also responds to the demands of the times that require education to produce graduates open to technological changes globally.

However, a big challenge for educators is to create a learning system that integrates knowledge and skills. This aims to make students not only understand the theory, but also be able to apply it in real life in order to create a dignified quality of education in a country. It is stated in Law (UU) Nomor 20 Tahun 2003 Concerning The National Education System Article 1 Paragraph 1, that education is a conscious and planned effort to create a learning atmosphere and learning process that allows students to actively develop their potential. Through quality education, a generation with character and competitiveness can be realized

in the global arena. However, the quality of education in Indonesia still faces significant challenges.

Based on the 2022 Program for International Student Assessment (PISA) report, Indonesian students' science scores decreased by 13 points compared to the 2018 PISA results. With a global average of 102 points and a score of 383 points, only 34.16% of Indonesian students met the international minimum competencies (OECD, 2023). This situation indicates an urgent need for science learning. One of the main challenges in applying science in the field is explaining abstract learning objects (Purnadewi & Widana, 2023). Research conducted by Ismiyanti (2020) explains that the delivery of abstract object learning requires media that can clarify and visualize concepts in real terms, while for concrete objects in learning can be observed and felt directly by students.

The results of interviews with 5th grade IPAS teachers at MIN Kudus show that learning has implemented the Merdeka Curriculum. In learning the sub-matter of the human digestive system, teachers usually use learning media such as audiovisual, multimedia, and videos from platforms such as youTube and powerpoint. However, the use of this media is still considered less than optimal in helping to deliver digestive system material. Students still often experience difficulties in understanding the material, especially because the media used has not been able to display an overview of the digestive system in a concrete and detailed manner. To overcome these obstacles, learning media is needed that is able to describe the material concretely and in detail so that students get a real experience that is manifested by visualizing how the location, shape, and function of human organs. This innovative media is expected to improve students' understanding of human digestive system material.

In the Regulation of the Minister of Education and Culture Number 16 of 2007 Concerning Academic Qualification Standards and Teacher Competencies, it is explained that a teacher is expected to be able to design learning with the use of relevant media to support student needs. Innovative and interactive learning media can help students understand abstract concepts such as mastery and generalization which are often an obstacle in IPAS (Natural and Social Sciences) learning. This is in line with the government's efforts to adopt Science, Technology, Engineering, and Mathematics (STEM) based learning as one of the strategies to improve the quality of education (Savitri, 2024). The STEM approach not only aims to improve students' understanding of science, but also trains them to think critically, logically, and systematically. In addition, this approach is also in line with the global vision of education to prepare the younger generation to face the challenges of the era of technology and digitalization (Riyanto et al., 2021).

Previous research related to learning media has been done before, such as in multimedia research by Nadhifah et al (2022), flipbook by Gusti et al (2023), and Augmented Reality (AR) by Resti et al (2024) but there are still gaps in terms of combining physical elements with technology to create learning by adhering to Visual, Auditory, and Kinesthetic (VAK) for students. Multimedia and flipbook-based learning is learning using screen-based media without physical elements that can be operated directly by students, so students' kinesthetic involvement is limited. In addition, media with the use of Augmented Reality (AR) requires technological devices such as smartphones. This can be an accessibility constraint in certain school environments. Therefore, we need interactive learning media based on learning in the current era, namely STEM and using VAK (Visual, Auditory, and Kinesthetic) learning principles that can create real, interactive, and innovative learning (Evi Yupani & Widana, 2023).

Science, Technology, Engineering, and Mathematics (STEM)-based voiced interactive torso (TOBI) is an innovative learning media designed to overcome challenges in learning abstract concepts, such as the human digestive system. In terms of science, the interactive torso with sound helps students improve their ability to identify concrete and detailed information related to the material described by the media. In technology, this media utilizes touch sensors that can interact directly when touched with sound output. From an engineering perspective, it involves creative and innovative design engineering to create a three-dimensional human body model that can be used interactively. The mathematics element is realized through analyzing the information they get and conveying their ideas or observations, both verbally and visually, using mathematical concepts (Riyanto et al., 2021).

In addition, this media integrates the principles of VAK-based learning (Visual, Auditory, and Kinesthetic) which can increase student engagement and interest in lessons Mustari et al., (2021). The visual aspect of TOBI is displayed in the form of a three-dimensional torso that describes the anatomy of the human body in detail, making it easier for students to visualize the location and function of organs. The auditory aspect is strengthened by voice explanations that inform the function of each organ clearly and easily understood. Meanwhile, the kinesthetic aspect emerges through students' interaction with the media, where they can touch and replace organs on the torso using integrated sensors, providing a more thorough and real learning experience. By combining these three elements, TOBI creates a more immersive learning experience, helping students not only understand the concept of the human digestive system more concretely, but also develop critical and analytical thinking skills.

Based on the above problems, the researcher is interested in conducting research with the title "Implementation of STEM-Based Voiced Interactive Torso (TOBI) in IPAS Learning at MIN Kudus."

METHOD

This research is descriptive qualitative research, which is used to describe the actual situation in the field regarding the application and response of teachers and students to the STEM-based Implementation of Interactive Torso with Voice (TOBI) in IPAS learning at MIN Kudus. The subjects of this study were 27 students and IPAS teachers of class V-C MIN Kudus. The selection of research subjects is based on a purposive sampling approach used by researchers in sampling data sources with certain considerations (Sugiyono, 2016). In this case, researchers used class V-C because of the problem of learning the human digestive system and the low critical thinking skills of students. The process of collecting data on learning outcomes through observation was carried out by systematically recording and interpreting existing information. Structured questionnaires were used to obtain data on teacher and student responses to the learning process. This questionnaire consists of pre-determined questions that help in measuring certain aspects of teachers' and students' learning process. Meanwhile, unstructured interviews allow for more open discussions, thus enabling researchers to gain deeper insights into students' experiences, challenges and perceptions of learning activities. In addition, documentation was carried out by taking photos as evidence of ongoing activities, which supported the analysis of student and teacher involvement in the Implementation of STEM-based Voiced Interactive Torso in IPAS Learning at MIN Kudus. Data analysis includes data reduction, data presentation, and conclusion drawing.

The questionnaire is made in the form of closed questions consisting of 15 questions with a rating scale as in the table below.

Table 1. Question Score Categories

Category	Question Score	
	Positive	Negative
Strongly Agree (SB)	5	1
Agree (S)	4	2
Less Agree (KS)	3	3
Disagree (TS)	2	4
Strongly Disagree (STS)	1	5

The descriptive analysis of observation sheets and questionnaires can use the following formula: Percentage= $\frac{R}{SM} \times 100\%$, Description: Percentage= Percentage value sought, R=Raw score obtained by the teacher/student, SM= Maximum score, 100= Fixed number (Indriani, 2023).

After finding the results of the descriptive percentage analysis, then interpreted with the following criteria:

Table 2. Percentage Criteria Questionnaires and Observation Sheets

Percentage (%)	Criteria
$81\% \leq PR < 100\%$	Very Good (SB)
$61\% \leq PR < 80\%$	Good (B)
$41\% \leq PR < 60\%$	Good Enough (C)
$21\% \leq PR < 40\%$	Less Good (K)
$PR < 20\%$	Very Less Good (SK)

Source: (Kusumawardhani et al., 2022)

RESULTS AND DISCUSSION

Voiced Interactive Torso (TOBI) is an innovative learning media of human anatomy torso sculpture that has been modified by adding components that make it interactive through touch with sound output.

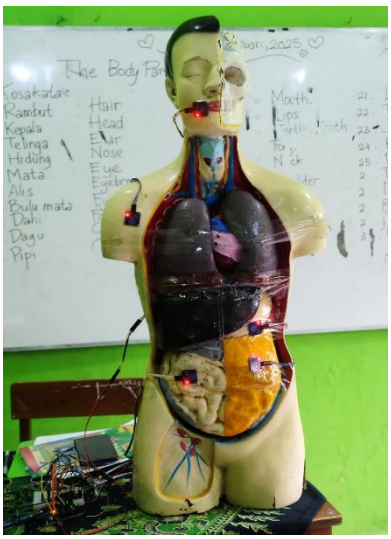

Image 1. Voiced Interactive Torso (TOBI)

Based on Figure 1, it shows the shape of the Voiced Interactive Torso (TOBI) media with equipment such as a torso statue of the human body anatomy and other components, namely touch sensors, arduino uno r3, cables, df mini players, memory cards, breadboards, and speakers. The working system of the Voiced Interactive Torso itself starts when the media is turned on. Then the coding that has been made is entered into the arduino uno r3. Arduino uno r3 will spread the information to all components connected to it until all components are ready to execute commands. Touch sensor becomes the first component to receive touch information. The information is then conveyed to the arduino, df mini player, and speaker so that sound output occurs.

Image 2. Teachers and Students Use Media

Based on Figure 2, it is known that teachers and students use the Voiced Interactive Torso (TOBI) based on the Science, Technology, Engineering, and Mathematics (STEM) approach as well as Visual, Auditory, and Kinesthetic (VAK). In terms of science, the Voiced Interactive Torso (TOBI) helps in identifying visual information of human digestive organs concretely and in detail. In technology, it utilizes the touch sensor of each digestive organ to bring out the kinesthetic aspect of students. Engineering involves the auditory aspects of students in terms of techniques and how the media works. From the Mathematics perspective, it is realized in the analysis of information on calculating human digestive organs.

The application of STEM-based Voiced Interactive Torso (TOBI) learning media in IPAS learning can be seen from the activities of teachers and students using a systematic observation sheet (Mohune & Rahmat, 2021). The results of the observation sheet analysis show that:

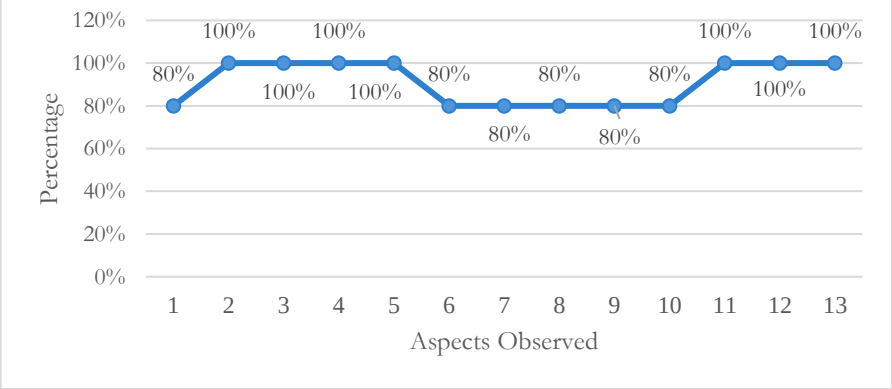

Image 3. Results of Teacher Activity Observation Sheet Analysis

Based on Figure 1. The results of the analysis of the teacher activity observation sheet can be seen in the observed aspects 1) The teacher provides learning objectives gets a good category score of 80%; 2) Creating a positive environment gets a very good category score of 100%; 3) Inviting students to get involved from the beginning gets a very good category score of 100%; 4) Explaining the material gets a very good category score of 100%; 5) Identifying organs (science) gets a very good category score of 100%; 6) Kinesthetic aspects through touch (technology) gets a good category score of 80%; 7) Techniques and ways of working (engineering) got a good category score of 80%; 8) Counting organs (mathematics) got a good category of 80%; 9) Summarizing the results of the discussion got a good category score of 80%; 10) Guiding the presentation got a good category score of 80%; 11) Feedback got a very good category score of 100%; 12) Learning reflection got a very good category score of 100%; 13) Moral and motivational messages got a very good category score of 100%. The results of observations of teacher activity can be seen on average the observer gives a percentage of teacher activity in the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning, namely a value of 91% with very good criteria

Meanwhile, the results of the students observation sheet can be presented in the form of a picture below.

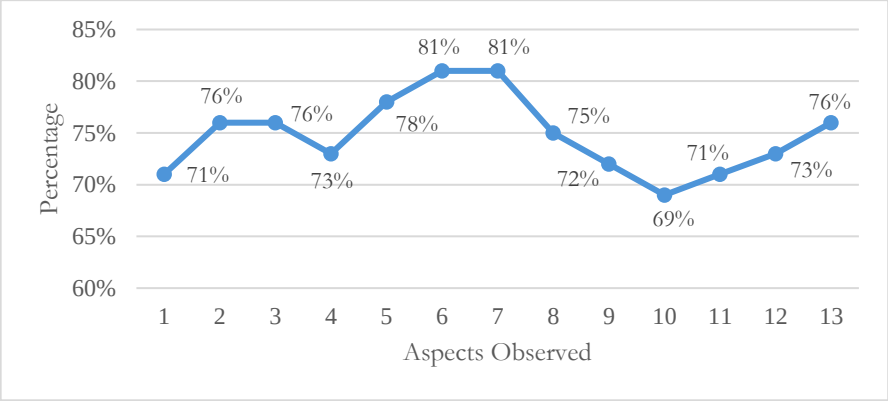

Image 4. Results of Students Activity Observation Sheet Analysis

Based on Figure 1, the results of the analysis of the Students Activity Observation Sheet can be seen in the observed aspects 1) Students pray before learning gets a good category score of 73%; 2) Preparing seating and stationery got a good category score of 76%; 3) Listening to learning objectives got a good category score of 76%; 4) Observing using visual and auditory aspects (science) got a good category score of 73%; 5) Identifying organs (science) got a good category score of 78%; 6) Using kinesthetic aspects through touch (technology) got a very good category score of 81%; 7) Solving problems (engineering) gets a very good category score 81%; 8) Counting organs (mathematics) gets a good category 75%; 9) Summarizing the results of the discussion gets a good category score 72%; 10) Forward presentation gets a good category score 69%; 11) Actively responding to feedback gets a very good category score 71%; 12) paying attention to learning reflections gets a good category score 73%; 13) paying attention to moral and motivational messages gets a good category score 76%. Based on table 1 Observation of Students Activities, it can be seen that on average the observer gives a percentage of teacher activities in the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning, namely a score of 75% with good criteria.

Teachers and students integrate four disciplines namely science, technology, engineering, and mathematics through the media Voiced Interactive Torso (TOBI) making learning IPAS

human digestive system in the classroom a combination of understanding the concept of material against applications in life related to critical thinking skills in problem solving (Sukendra at al., 2023). This is reinforced by the results of observations showing an emphasis on critical thinking skills in the aspect of STEM activities when using media. It is also said in Ahsani & Nurhaliza (2021) that STEM integration learning at elementary school age creates thinking according to one's own imagination so that it allows for the active formation of a good and creative mindset.

With media supported by technology-based interaction, the Voiced Interactive Torso (TOBI) makes two-way interactive learning between media and users. This will result in teachers and students automatically being able to show confidence and high motivation in learning IPAS of the human digestive system (Hanik et al., 2021). Another study revealed that the combination of technology with interactive learning media is the key to driving the motivation of student involvement and the emergence of deep understanding of the material (Hasnawiyah & Maslena, 2024).

Data collection on teacher and learner responses was carried out by distributing questionnaires to teachers and 27 students. Furthermore, respondents answered a questionnaire containing 5 indicators with 15 statement items and 5 alternative answers, namely SS (Strongly Agree), S (Agree), KS (Less Agree), TS (Disagree), and STS (Strongly Disagree). This can be presented in the form of a graph below:

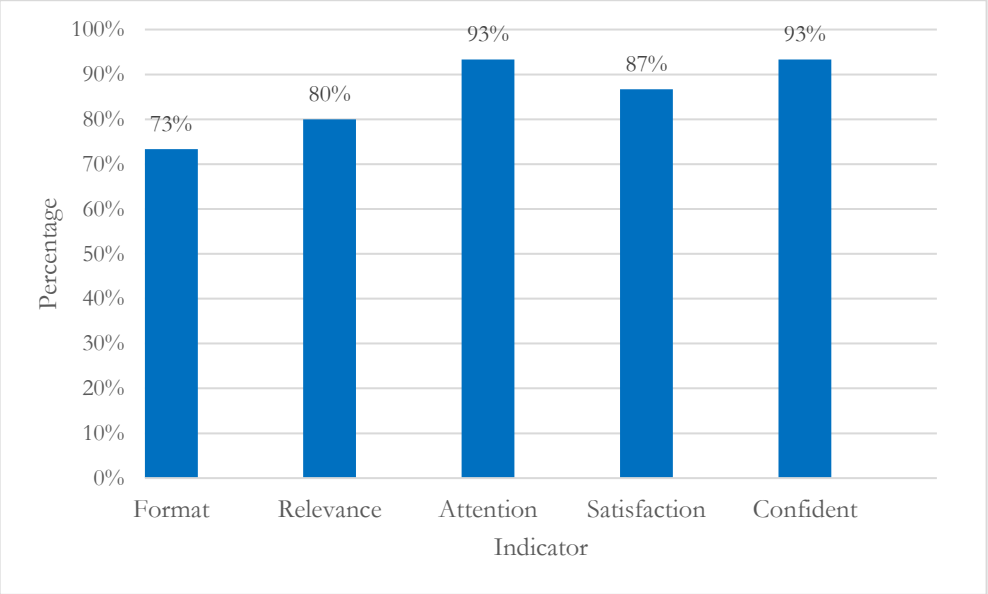

Image 5. Teacher Response Questionnaire Results

The results of the teacher response questionnaire show that the format indicator gets a good category score of 73%. The relevance indicator received a good category score of 80%. The attention indicator gets a very good category score of 93%. The satisfaction indicator gets a very good category score of 87%. The confidence indicator gets a very good category score of 93%. The results of the teacher response questionnaire on the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning show an average score of 85% with very good criteria.

Meanwhile, the results of the student response questionnaire can be presented in the form of a picture below.

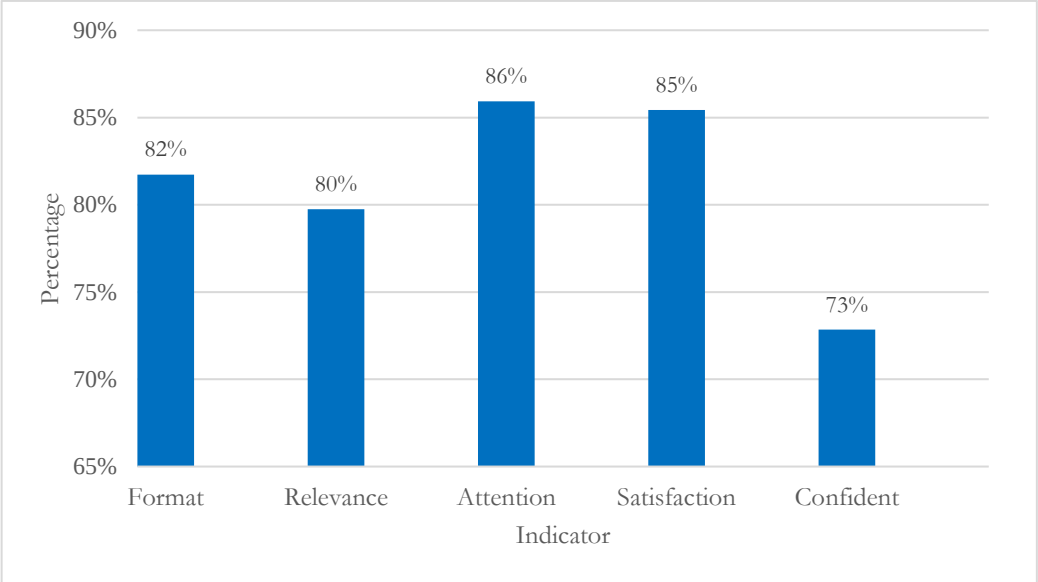

Image 6. Students Response Questionnaire Results

The results of the student response questionnaire show that the format indicator gets a very good category score of 82%. The relevance indicator gets a good category score of 80%. The attention indicator gets a very good category score of 86%. The satisfaction indicator gets an excellent category score of 85%. The confidence indicator gets a good category score of 73%. The results of the teacher response questionnaire on the implementation of STEM-based Voiced Interactive Torso (TOBI) in IPAS learning show an average score of 81% with very good criteria.

The positive response from both teachers and students indicates the effectiveness of using appropriate learning media. Initially, students faced difficulties in understanding the material when the media used did not align with their characteristics and learning styles. According to Karomah et al (2023), the use of teaching media can stimulate curiosity and interest in students, making the learning process more engaging. Similarly, Ariyanti & Ahsani (2022); Sumandya & Widana (2022) highlight that learning media can capture students' attention, encouraging them to be more active in discussions by asking questions and expressing opinions.

The application of audio-visual media, such as the STEM-based Voiced Interactive Torso (TOBI) with a Visual, Auditory, and Kinesthetic (VAK) approach, has been shown to facilitate a better understanding of the human digestive system in IPAS learning. This aligns with the findings of Suryadin et al (2017), which suggest that VAK-based learning enables students to absorb, filter, and process information more effectively through sensory modalities, including sight, hearing, and movement. Furthermore, Rukayah et al (2021) emphasize that interactive learning media provide more realistic, engaging, and user-friendly content, along with clear instructions, ultimately enhancing the quality of science education in elementary schools.

CONCLUSION

The implementation of STEM-based Voiced Interactive Torso (TOBI) was conducted to teachers and students of class V-C. Learning IPAS of the human digestive system using this media is proven to be effective in improving students' understanding through the utilization

of the senses of sight, hearing, and movement which is realized in the ability to think critically on STEM values. Teacher and student responses were very good, showing interest that arose to attention and satisfaction that triggered confidence in learning. The researcher hopes that future researchers can present STEM-based Voiced Interactive Torso (TOBI) on the relevance of learning that requires anatomical torso sculptures other than the human digestive system with more interesting media formats and content and according to the needs of students in learning.

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