

Development of Digital-based Table Tennis Teaching Materials

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Abstract. The purpose of this study was to develop HOTS-based digital-based table tennis teaching materials. The research was conducted at Medan State University in May-July 2023. This research uses product development validators consisting of 3 experts, namely 1 material expert and 2 media experts. The model used is the Borg & Ghall model which includes 10 stages. However, in this article what is presented is the data from the expert analysis. Data were collected through questionnaires with percentage analysis techniques. This development research has developed a product called Batent Digital (Digital Table Tennis Teaching Material). This product is a digital-based table tennis teaching material for students. This product has gone through the analysis test of media experts and material experts. Material experts provide a percentage of the feasibility of Batent Digital products of 85.1% and media experts provide a percentage of the feasibility of Batent Digital products of 87.5%. based on the results of the experts' assessment, Batent Digital is conceptually feasible and further research needs to be done for the empirical feasibility of this product.

Keywords: teaching materials, digital, table tennis

1 Introduction

The table tennis course is an essential element of the Physical Education Health and Recreation Study Program program of study, which aims to prepare students for future careers as lecturers within this field. As aspiring educators, it is imperative that they possess proficiency in table tennis skills and adeptness in accurately elucidating the concept of motion during the course of their teaching responsibilities. In order to enhance the comprehension of academic content among students, it is suggested that instructional methods be employed to facilitate ease of understanding (Siregar, 2020). The extraction of information pertaining to student competence in skills to elucidate a concept remains much below the anticipated level. While students possess the ability to perform the task, their proficiency in systematically and accurately presenting it is lacking. The data presented in this study was gathered through the examination of observations conducted during table tennis instruction under the Physical Education Health and Recreation Study Program at Medan State University, Health Sports College, and Indonesian Community Development University. A total of 175 individuals were surveyed, out of which 114 pupils, accounting for 65% of the sample, demonstrated a lack of proficiency in articulating the principles underlying the game of table tennis. The ability of

pupils to execute table tennis skills is evident, nevertheless, their proficiency in delivering a comprehensive and accurate explanation of these techniques is lacking.

Following that, the researcher proceeded to conduct interviews with students in order to gather information pertaining to the reasons contributing to the aforementioned circumstance. The findings from the interview indicate that a contributing cause to students' lower ability levels in table tennis is their limited understanding of table tennis techniques. Many students have focused solely on the application of techniques without actively seeking to understand the fundamental concepts behind them. There appears to be a deficiency among students in engaging with reading materials and educational resources pertaining to table tennis, which can be attributed to a lack of interest in the conventional format of printed instructional materials provided by their instructors. The process of acquiring information typically involves engaging in activities such as reading, observing, listening, experiencing, and applying. In addition to the aforementioned interview findings, the researchers proceeded to gather data from the teaching staff at the three aforementioned campuses using the interview methodology. The objective of this interview was to gather data pertaining to the professors' progress in acquiring table tennis skills. The interviews centered on the learning resources utilized by instructional personnel thus far and their application within the learning environment. The educational materials employed by instructors thus far in table tennis lecture engagements. Various elements of methods and models can be classified as favorable. In terms of teaching material sources, it is observed that lecturers predominantly rely on print-based teaching materials, including books and diktat, while digital-based teaching materials account for only 23% of the total.

As previously elucidated, a contributing factor to the lack of students' proficiency in elucidating fundamental principles of table tennis tactics is the absence of engaging instructional materials for their perusal. The current availability of books and instructional materials has been shown to contribute to a lack of student engagement. I am not inclined towards this option due to the inconvenience associated with carrying actual books, as well as the lack of intellectual stimulation provided by the writing and substance of those books, which fail to engage students' reasoning abilities. In the realm of education, it is imperative for educators to possess the capacity to create and deliver instructional resources, media, tools, and other materials that align with the cognitive abilities and developmental stage of their pupils, without surpassing them. In the current epoch characterized by the swift advancement of technology, students have been habituated to utilizing the internet and possessing Android devices to fulfill their various demands and access desired information. Consequently, students have developed a greater inclination towards engaging in digital activities, predominantly through the use of Android-based Smartphone's (Smeureanu, 2017). Educators should approach this scenario with prudence, specifically by implementing diverse pedagogical innovations to increase students' desire for learning. One of the researchers' proposed solutions to address the aforementioned challenges involves the creation of digitalized table tennis instructional resources and the integration of higher-order thinking skills (HOTS) into the curriculum for university students.

There is currently a lack of prepared instructional material specific to the sport of table tennis. The utilization of digital teaching materials in the context of table tennis tactics holds the potential to instill trust among researchers, as it is expected to be a valuable resource capable of enhancing students' cognitive abilities and facilitating their comprehension of the

underlying concepts. According to Palao (2012), educational technology encompasses the examination and ethical implementation of strategies aimed at enhancing learning and optimizing performance through the creation, utilization, and administration of technological procedures. Technology plays a pivotal role in enhancing educational outcomes and optimizing performance through the utilization and management of efficient technology processes and resources. In addition to this, the instructional materials to be created will be formulated, assembled, and delivered with a focus on advanced cognitive abilities, specifically emphasizing critical thinking, creativity, and collaboration. The utilization of this generated teaching material by students is anticipated to foster critical thinking, creativity, and collaboration, ultimately enhancing their proficiency in table tennis courses.

Table tennis has emerged as a prominent sport, evident from its growing popularity in both societal and educational domains. Numerous individuals actively engage in playing and competing in this activity (Junaidi & Mustofa, 2020). The energy expenditure associated with participating in this sport is relatively low because of its compact playing field and limited range of motion, in contrast to more physically demanding sports such as field tennis, volleyball, and basketball. Individuals who possess the ability to engage in this particular sport are commonly perceived to experience increased levels of happiness, improved physical fitness, and a decrease in mental fatigue.

The elucidation of the concept of table tennis can be expounded upon by analyzing quotations derived from the perspectives of numerous authorities in the field. According to Hodges (1996), table tennis is a sport characterized by the exchange of a small ball between players on a table, with points being awarded to the player who capitalizes on their opponent's error. This perspective posits that each error must be assigned a numerical value, and the cumulative sum of these values determines the success of individual participants. According to Mc. Afee (2009), table tennis is a sport that necessitates the utilization of both lower limb explosive strength and precise hand motor skills. The primary emphasis during the initial stages is to cultivate manual dexterity in order to effectively manipulate the ball. According to Hanif Ahcmad Sofyan (2011), the concept of this particular sport is further elucidated. It is posited that table tennis serves as a leisurely activity that garners significant popularity among individuals of various age groups, including children, adolescents, and older adults, as well as parents. This widespread appeal is observed not only in urban areas but also in rural regions, where the presence of table tennis courts can be found even in the most remote villages. According to Sutanto Teguh (2016), table tennis may be defined as a racquet sport that involves two individuals or two opposing pairs. This particular activity offers numerous advantages to its participants. For this sport to yield benefits, it is imperative that it adheres to the ideals of sportsmanship, encompassing qualities such as fairness, correctness, moderation, and organization (Siregar et al., 2022). If the aforementioned four principles are implemented, there are six benefits that can be derived (Purwanto & Suharjana, 2017). These benefits include the enhancement of coordination and reflexes through the practice of tennis, the burning of calories, the strengthening of friendships, the prevention of dementia, the improvement of body balance, the increase in body muscle strength, and the reduction of injury risks. Given the myriad advantages associated with this particular sport, it is unsurprising that its growth and popularity have been rapid. However, acquiring proficiency in this sport is not a simple task that can be accomplished effortlessly. Players must engage in

dedicated and rigorous practice in order to attain the necessary skills and competence required to participate in this sport (International Table Tennis Federation, 2018).

In order for players to acquire proficiency in this approach, it is essential that they undergo a systematic and rigorous learning process, as emphasized by Zhou (2018). Consequently, it is essential for students to possess a diverse range of capabilities encompassing athletic abilities, technical proficiencies, and effective presentation aptitude. According to the curriculum of this course, the instructional content encompasses ten distinct materials. These materials include the conceptual framework, as well as the historical and cultural context of table tennis, encompassing both local and national perspectives. Additionally, the course covers the equipment utilized in the sport. Furthermore, students are taught fundamental footwork patterns, training goals, and training forms. The course also covers the basic motion patterns and training methods for serves, drives, push strokes, blocks, chops, and spin strokes. Moreover, students are instructed on the rules and regulations governing table tennis matches, as well as various physical exercises and techniques specific to the sport. Lastly, the curriculum includes a section on table tennis refereeing and modifications. This particular topic is essential for students to master within a single semester. By successfully acquiring this knowledge, it guarantees that future health and physical education instructors will possess the necessary skills to effectively instruct pupils in the sport of table tennis within an educational setting.

Teaching materials are essential learning items that educators must develop for presentation to students during the learning process. Teaching materials refer to resources utilized for the purpose of facilitating discussion and exploration of the content within a certain course or subject. According to Suciati (2018), teaching materials encompass a range of systematically organized materials, including information, tools, and text. These materials are designed to present a comprehensive representation of the competencies that students are expected to acquire and are utilized in the process of learning. With the objective of strategizing and evaluating the execution of educational activities. Some examples of educational resources include textbooks, modules, handouts, learning kits and systems (LKS), models or mockups, audio materials for teaching, interactive teaching materials, and other similar resources. According to Yermiandhoko and Yoyok (2020), teaching materials encompass many types of resources employed by educators to facilitate the instructional process inside the classroom setting. According to Abdul Majid (2005), teaching materials encompass many types of resources that are utilized in the facilitation of teaching and learning processes. According to the Ministry of Education and Culture (Kemendikbud, 2016), teaching material refers to the content that students are required to study in order to facilitate their learning process. Teaching materials, as defined by Andi Prastowo (2011), refer to resources utilized by educators or learners to enhance the educational experience. Various forms of reading materials include books, workbooks, printed copies, digital formats, and photographs. Educational materials, both in written and non-written forms, are designed to enhance students' knowledge and expertise.

Higher-order thinking Skills (HOTS), also referred to as HOTS, include a set of cognitive abilities that involve critical thinking, logical reasoning, reflective thinking, metacognition, and creative thinking. These skills are considered to be of a higher level, requiring advanced cognitive processes. The concept of Higher Order of Thinking Skill (HOTS) pertains to a cognitive skill that extends beyond mere memorization. It encompasses a range of advanced

cognitive abilities, including creative and critical thinking, as well as problem-solving (Kanca, 2017). According to Abdullah Sani (2019), higher-order thinking Skill (HOTS) refers to the cognitive ability to engage in strategic thinking, use information to effectively address problems, critically examine arguments, engage in negotiation processes, or make accurate forecasts.

The creation of instructional materials for table tennis is tailored to its inherent characteristics, encompassing its status as a product, a process, and a scientific mindset. This approach aims to instill scientific attitudes inside students as well. In order to cultivate higher-order thinking skills (HOTs) within the context of table tennis instruction, educators must possess a comprehensive understanding of the subject matter being taught as well as a mastery of effective learning strategies. Educators have the ability to employ diverse learning methods, including project-based learning, problem-based learning, and discovery/inquiry learning. According to Daryanto and Karim (2017), the utilization of these models can facilitate the implementation of learning activities that target higher-order thinking skills (HOTS) among educators. In addition to this, it is imperative for educators to possess a comprehensive comprehension of the attributes associated with higher-order thinking skills (HOTs). The distinguishing features of learning on the Higher Order of Thinking Skill (HOTS) encompass a focus on inquiry and questioning. The process of critically evaluating arguments and evidence, establishing the meaning of concepts, arriving at conclusions, employing logical analysis, processing and applying information, and utilizing information to address issues. In order to assess an individual's cognitive capacity, Bloom provides a framework that categorizes thinking ability into low and high levels. The cognitive processes encompassed in this framework include (C1) the act of recalling information, (C2) comprehending and making sense of it, (C3) applying acquired knowledge, (C4) critically examining and breaking down complex concepts, (C5) assessing and forming judgments, and (C6) generating new ideas and solutions. Therefore, it is evident that the criteria for assessing higher-order thinking skills encompass levels C4-C6, which involve the cognitive processes of analyzing, evaluating, and producing. When engaging in the cognitive processes of analysis, evaluation, or creation, individuals are actively involved in higher-order thinking skills (HOTS).

2 Method

This study is focused on conducting research and development in order to create digital teaching materials in the form of applications. The research methodology employed in this study is based on the development model proposed by Borg and Gall (2007). The present study was carried out at three academic institutions, specifically Medan State University, Health Sports College, and Indonesian Community Development University. The participants in this study consist of individuals who will potentially utilize the product under development. The target audience of this research product comprises students specializing in health and recreation physical education. The focus of this study pertains to students enrolled in health and recreation physical education programs. The table provided displays the quantity of subjects to be included in the investigation. The preliminary product trial was conducted on a limited sample size of 30 individuals. The study involved conducting a product trial on a significant sample size of 90 participants across three campuses. Subsequently, the effectiveness of the product draft was assessed on a subset of 60 individuals. The data collection methods employed in this study encompassed the utilization of questionnaires,

interviews, and tests. Data collection methods, such as questionnaires and interviews, were employed to gather information regarding the viability of the generated products. Specifically, the focus was on HOTS-based digital teaching materials, which were evaluated through validator tests, small-scale product field testing, and large-scale product field tests. Subsequently, an examination was undertaken with the purpose of gathering data pertaining to cognitive learning outcomes and student aptitudes.

3 Result and Discussion

The primary body of the text should be composed in Times New Roman font, with a font size of 10 points, and aligned to be properly justified. Italics may be employed to convey emphasis, whereas the usage of bold typesetting is generally discouraged. The objective of this study is to provide instructional resources for table tennis that are digitally based. In order to achieve this objective, the process undergoes multiple stages to ensure the production of a highly efficient product. In order to ensure the smooth execution of the various stages of the process, it is imperative to engage in thorough planning to ascertain the requisite requirements. In the course of this developmental investigation, the researcher and the study team undertook various preparatory measures, which encompassed: One should establish a structured timetable in order to ensure the methodical and efficient execution of research activities, commencing with the product design schedule and concluding with the product effectiveness test. The process of product design had a duration of three weeks, during which an assessment was conducted to estimate the expenses associated with development. This assessment encompassed the identification of sources and the evaluation of team contributions. The expense of this research was derived from the subsidy fee provided by the Medan State University campus, amounting to 25,000,000 rupiah. The allocated funds are designated for the purposes of conducting research activities, facilitating product design, advancing application development, acquiring expert services, and conducting product testing. (c) undertaking the necessary preparations for the establishment and enhancement of the requisite facilities and infrastructure throughout the course of the development process. The required infrastructure for this research includes an indoor room, a table tennis court, a betting system, a net, table tennis balls, a camera, and other necessary equipment.

The learning resources in the form of teaching materials that have been generated via study are known as digital teaching materials. The attributes of this instructional resource can be discerned by its color, material composition, and writing design, so endowing it with an appealing quality for pupils. Teaching materials are systematically organized to enhance readers' comprehension of the information. In addition to this, the digital instructional resource possesses the capability to function in both offline and online settings, thereby facilitating effective communication between educators and students. Furthermore, this teaching material can be conveniently accessed through electronic devices such as smartphones, androids, and computers, ensuring accessibility from any location. The utilization of teaching materials that incorporate aspects of higher-order thinking (HOTS) and are accompanied by the implementation of suitable instructional strategies can enhance the level of interactivity between educators and students during the learning process. The technique being discussed in this context encompasses various approaches that have the potential to enhance students'

higher-order cognitive processes. Examples of such approaches are Problem-Based Learning, Project-Based Learning, and Discovery Learning.

The teaching materials that have been generated in this research endeavor aim to adhere to the principles of instructional material development. Digital instructional resources prioritize the development of process skills and foster an environment conducive to active learning. Therefore, the significance of instructional resources is growing. The utilization of teaching resources can effectively enhance students' ability to engage in independent learning. The digital teaching materials' storyboard encompasses the primary menu or fundamental structure, which presents the following components: Graduate study program results, Course Learning results, Course Description, Course Objectives, Materials, Assessment, and Learning Resources. The storyboard includes two main sections, namely an overview of the fundamental aspects of table tennis and a detailed explanation of the regulations governing table tennis equipment. The instructional resource comprises six distinct activity components, including initial assessments, exploration, collaboration, demonstration, elaboration, and real-world application. The provided image depicts the educational software program that has been designed for student learning purposes.

The outcomes of the expert evaluation conducted on this developed product. The data reveals that Material Expert I achieved a percentage level of 83.3% (classified as good), while Material Expert II attained a percentage level of 86.9% (also classified as good). Both specialists provided a positive evaluation of the product, indicating that the developed product is of high quality. The provided graph depicts the outcomes of the validation conducted by material experts.

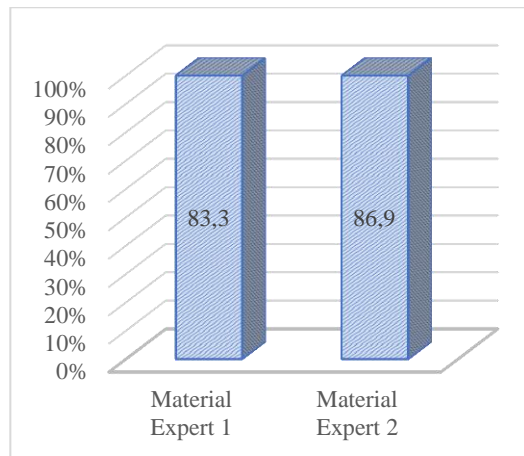


Fig 1. Results of Material Expert Validation on Table Tennis Digital Teaching Materials

Media experts on the developed product. It can be seen that media expert I gave a percentage level of 86.8% (good) and media expert II of 88.2% (good). Both experts gave a good assessment of the product, this means that the product developed is good. The following graph illustrates the results of media expert validation.

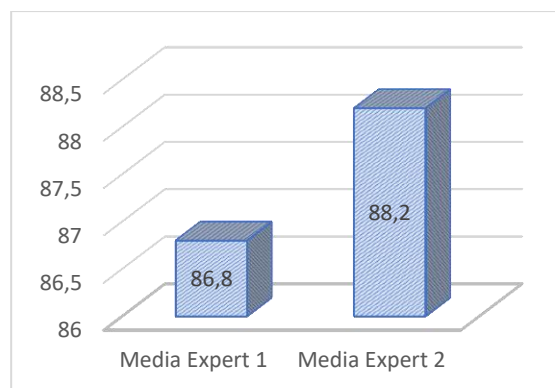


Fig 2. Results of Media Expert Validation on Table Tennis Digital Teaching Materials

The outcomes of validation by experts of the product aim to enhance teaching materials in order to improve conceptual understanding. This, in turn, helps to minimize obstacles encountered by the major users when utilizing the teaching materials, hence facilitating the achievement of the study's objectives. The teaching materials that have been developed are focused on the application of table tennis principles. These materials are designed with the intention of achieving specific learning objectives. The content and materials included in these teaching materials are tailored to suit the characteristics of the students. Additionally, the materials aim to present factual information in a manner that is easily comprehensible, accessible, and cost-effective (Bosica et al., 2021). When creating instructional materials, it is imperative to follow a systematic approach and avoid arbitrary decision-making. The process of developing instructional materials should align with the relevant curriculum guidelines. According to Ariyanto et al. (2022), this will undeniably facilitate the process of creating instructional resources for educators. The objective is to develop high-quality interactive educational resources that effectively facilitate student comprehension and align with fundamental learning objectives. The utilization of printed and interactive teaching materials facilitates the efficient dissemination of educational content to pupils. These teaching tools enable educators to deliver content that aligns with the fundamental competencies or subject matter that students are required to attain.

4 Conclusion

Based on the results of the development and analysis of validation by material experts and media experts, digital-based table tennis teaching material products are feasible from the material and media aspects, for this follow-up to the results of this analysis, researchers need to conduct field tests to determine the level of product use. Research is part of the tri darma of higher education for researchers, for the implementation of this research is inseparable from the assistance provided by Medan State University. For this reason, the researcher would like to thank the Rector and the Head of LPPM of Medan State University for funding and assisting the administration of this research.

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