Jurnal Ilmiah Sekolah Dasar
Volume 8, Number 2, 2024 pp. 270-281
P-ISSN: 2579-3276 E-ISSN: 2549-6174
Open Access: https://doi.org/10.23887/jisd.v8i2.74010

Upakara Bali-based Electronic Student Worksheets on Geometry Topic for Second Grade of Elementary School

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ARTICLE INFO

Article history:
Received January 11, 2024
Accepted April 10, 2024
Available online May 25, 2024

Kata Kunci:
e-LPKD, Etnomatematika, Upakara Bali, Geometri

Keywords:
Electronic Student Worksheets, Ethnomathematics, *Upakara* Bali, Geometry

ABSTRAK

Kurangnya kontekstualisasi dan inovasi dalam pengembangan materi pembelajaran geometri kelas 2 SD menjadi permasalahan utama yang menyebabkan kesulitan siswa dalam memahami konsep. Penelitian ini bertujuan untuk mengembangkan Lembar Kerja Siswa Elektronik Berbasis Upakara Etnomatematika Bali Geometri untuk Kelas 2 SD. Subjek uji coba dalam penelitian ini meliputi dua orang ahli materi, dua orang ahli media, satu orang guru kelas 2, 6 orang siswa uji coba individu, dan 10 orang siswa uji coba kelompok kecil. Penelitian ini menggunakan model ADDIE (analisis, desain, pengembangan, implementasi, evaluasi). Metode pengumpulan data yang digunakan adalah angket, wawancara, dan observasi. Teknik analisis data menggunakan analisis deskriptif kuantitatif dan kualitatif. Hasil penelitian pengembangan ini adalah produk LKS Elektronik yang meliputi: (a) perancangan dan pengembangan LKS Elektronik berbasis etnomatematika pada Upakara Bali untuk kelas 2 SD Geometri yang meliputi tahap analisis, perancangan, dan pengembangan; (b) hasil uji validitas memperoleh kriteria kualifikasi sangat baik; (c) uji keefektifan termasuk dalam respon guru, nilai uji coba individu, nilai uji coba kelompok kecil termasuk dalam kualifikasi sangat baik. Dengan demikian dapat disimpulkan bahwa Lembar Kerja Siswa Elektronik ini layak digunakan dalam proses pembelajaran. Implikasi dari penelitian ini adalah adanya LKS Elektronik yang valid dan sesuai untuk meningkatkan pembelajaran geometri kelas 2 SD dalam konteks budaya lokal.

ABSTRACT

The lack of contextualization and innovation in developing learning materials for 2nd-grade elementary school geometry has become a major issue leading to students' difficulty in understanding concepts. This research aims to develop an Electronic Student Worksheets Based on Ethnomathematics *Upakara* Bali in Geometry for 2nd-Grade Elementary School. Trial subjects in this study include two material experts, two media experts, one 2nd-grade teacher, 6 individual trial students, and 10 small group trial students. This research utilizes the ADDIE model (analyze, design, development, implementation, evaluation). Data collection methods used were questionnaires, interviews, and observations. Data analysis techniques involved quantitative and qualitative descriptive analyses. The results of this developmental research are the Electronic Student Worksheets product, covering: (a) the design and development of an ethnomathematics-based Electronic Student Worksheets on Upakara Bali for 2nd-grade Elementary School Geometry, including analysis, design, and development stages; (b) validity test results gain criteria of excellent qualification; (c) effectiveness test belongs to teacher response, individual trial score, small group trial score belongs to excellent qualification. Hence, it can be concluded that this Electronic Student Worksheets is suitable for use in the learning process. The implication of this research is the existence of a valid and suitable Electronic Student Worksheets to enhance 2nd-grade Elementary School geometry learning within the local cultural context.

1. INTRODUCTION

Human life and civilization are inseparable from the application of mathematical concepts. Mathematical concepts tend to be abstract as they often involve non-concrete subjects, causing difficulties for learners, especially those in primary school who are used to concrete thinking. Primary school students, typically aged between 6 to 12 years old, are in the stage of concrete operational cognitive development,

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capable of solving relatively complex problems if they are concrete rather than abstract (Bujuri, 2018; Graham et al., 2012). Contextual learning serves as a solution to the abstract nature of mathematics. In this regard, integrating contextual material related to local cultural wisekolah dasarom proves engaging, known as ethnomathematics—an intersection linking cultural anthropology, mathematics, and mathematical modeling developed by experts to bridge the gap between mathematics, culture, and the realities encountered by learners in their daily lives (Prahmana et al., 2021; Turmuzi et al., 2022). Realistic mathematics education based on ethnomathematics offers the advantage of facilitating learners' understanding by presenting situations they have encountered in reality.

Bali Province has a culture relevant to the implementation of ethnomathematics, known as the Bali ceremonial concept. These ceremonies encompass various elements utilized in the Yadnya ritual series in Bali, comprising offerings, sokasi, and more. Implicitly, these ceremonial elements relate to one of the subjects in Mathematics, namely geometry—a mathematical field dealing with points, lines, planes, space, their properties, measurements, and interconnections (Muhassanah et al., 2014; Nur'aini et al., 2017). Geometry plays a significant role in stimulating students' cognitive development; hence, it's vital for primary school students to grasp geometric concepts well. However, the existing geometry teachings haven't fully connected to real-life contexts (Gainsburg, 2008; Rahayu, 2021). Moreover, the current approach to teaching geometry hasn't fully captured students' interest, resulting in them viewing mathematics as a tedious, complex, and overly abstract subject, leading to reduced motivation and interest in learning (Fauzi & Arisetyawan, 2020; Mutaqin et al., 2021).

Upon further examination of the geometry learning issues in second-grade primary school, it's observed that the teaching relies solely on the student's textbook. Consequently, an analysis questionnaire was distributed regarding the curriculum's independent geometry content in flat and spatial figures for second-grade students. Among the five second-grade teachers in Cluster IV, Sukasada District, it's evident that: (1) Indeed, geometry learning in second grade primarily depends on the student's textbook, supported by the questionnaire results, indicating that 60% of teachers mentioned students always use the textbook while studying; (2) Regarding the breadth and depth of the textbook content, 60% of teachers expressed that the material in the textbook, particularly in mathematics involving geometry of flat and spatial figures, tends to be narrow, with 80% stating it's rather shallow. Additionally, from the students' perspective, concerning the depth of the textbook content, out of 25 second-grade students in Cluster V, Sukasada District, 68% indicated that it's shallow.

Deterioration in education relying solely on student textbooks and the limited depth and breadth of materials indicates the necessity for supporting teaching tools. Among these, the learner worksheets (student worksheets) stands as a pivotal element in bolstering the learning process (Liesandra & Nurafni, 2022; Masamah et al., 2023). Student worksheets, intimately linked to instructional aids, serves as a crucial support for educators. Additionally, it acts as an informative teaching material detailing learning objectives, instructional strategies, clear learning experiences, aiding in new discoveries, and optimizing student participation (Nawaz & Ghulam, 2010; Parvathamma & Pattar, 2013). Traditionally paper-based, student worksheets have evolved into electronic formats known as electronic student worksheets due to technological advancements. electronic student worksheets serves as a guide to facilitate student comprehension during the learning process, accessible through electronic devices such as computers, notebooks, or smartphones (Amanina & Muchlis, 2023; Morrar et al., 2017). This transformation fosters increased creativity among teachers and students, fostering engaging and enjoyable learning experiences (Costadena & Suniasih, 2022; Purnama & Suparman, 2020; Putriyana et al., 2020).

The current available student worksheets lack alignment with the essence of learning as they primarily emphasize short materials and exercises, frequently used for assessment purposes. Observations conducted at the cluster iv elementary school in sukasada district highlighted a lack of innovation among second-grade teachers in developing student worksheets materials for geometry. The constraints in student worksheets development, especially electronic formats, stem from technological limitations and teachers' readiness (Gupta et al., 2022; Vorona et al., 2020). Expanding the student worksheets scope and transitioning to electronic versions face challenges due to technological constraints and varying levels of teacher preparedness.

In light of the above issues, it's crucial to develop materials for the mathematics subject, specifically geometry in two and three dimensions. Survey responses from five second-grade teachers indicate that around 60% support the development of geometry materials, while approximately 40% consider it highly crucial. Among students, about 68% express the need for the development of Electronic Student Worksheets for geometry in second-grade elementary school, with the remaining 32% stating it is extremely vital. These limitations impact the learning process and outcomes, evident in students' tendencies to memorize without comprehensive conceptual understanding.

Regarding the issues and development of electronic student worksheets, there are several relevant studies. the first study, focused on interactive electronic student worksheets based on Bali's Jejahitan Etnomathematics in the subject of Planar Geometry for fourth-grade elementary school, this study showed positive results from expert validation and individual to large-group trials, with high post-test scores (Dewi & Agustika, 2022). Additionally, the subsequent study on electronic student worksheets based on etnomathematics in trigonometry demonstrated high levels of validity, practicality, and effectiveness, stating that the electronic student worksheets is suitable, practical, and effective for use in the learning process (Purwati et al., 2023). Further research concerns the development of interactive electronic student worksheet materials introduction to flat shapes based on ethnomathematics for class I students which states that it is feasible and can improve students' mathematics learning outcomes (Prayoga et al., 2022). Further research, regarding electronic student worksheets based on flat geometry material ethnomathematics, if seen from assessment of media experts, material experts as well due diligence by teachers and students, electronic student worksheet media for geometry material based on ethnomathematics got good criteria, so you can It was concluded that the use of electronic students' worksheets was based on flat geometry material ethnomathematics can implemented in learning mathematics, especially in fourth grade elementary school (Liesandra & Nurafni, 2022). The results of further research are in line with the analysis of the effectiveness of electronic student worksheets based on agate ethnomathematics viewed from the student's initial abilities shows that electronic learners' worksheets are based Agate ethnomathematics is more effective than conventional student worksheets (Dafid Slamet Setiana & Nuryadi, 2022).

Based on the aforementioned research outcomes, it's evident that Electronic Student Worksheets as an ethnomathematics-based learning tool is suitable for development. The novelty of this study is provide development of ethnomathematics-based Electronic Student Worksheets specifically for mathematics, geometry material, in second-grade elementary school. Hence, it's crucial to carry out development in this area to produce Electronic Student Worksheets that aligns with the relevant context or material. This research aims to develop an electronic student worksheets Based on Ethnomathematics Upakara Bali in Geometry Material for 2nd-Grade Elementary School

2. METHOD

This study is a Research and Development study aimed at developing a learning tool in the form of Electronic Student Worksheets based on Upakara Bali ethnomathematics in the subject of geometry for second-grade elementary school students. The model used in this research is the ADDIE Model, which consists of five stages, starting from Analyze, followed by the Design phase, then Development, Implementation, and finally, Evaluation. The use of this model is associated with various forms of product development, including models, learning strategies, teaching methods, media, and teaching materials (Sari, 2017; Widyastuti, 2019). The development of Electronic Student Worksheets based on Upakara Bali ethnomathematics is conducted in several stages. The first stage is analysis, encompassing: a) Student characteristics analysis; b) Curriculum analysis; c) Needs analysis; and d) Product analysis. The second stage is design, starting with material determination and storyboard creation. The third stage is the development phase, commencing with storyboarding using the Canva application, then uploading it to the topworksheets page to add attractive features. Following this, validation tests are conducted by both media experts and material experts to review the developed product. The validation tests are based on assessment instruments previously distributed, focusing on the Electronic Student Worksheets's suitability. Besides validation tests, a review is conducted with six second-grade teachers and ten second-grade students for individual and small group trials, respectively, to gather feedback on the developed Electronic Student Worksheets. Implementation and evaluation stages were not conducted in this research due to time, resource, and financial constraints. Thus, this study only reached the validation stage and collected responses from teachers and students regarding the developed product.

The method used in this development research involves observation, interviews, and distributing questionnaires/surveys. This method includes providing a set of written statements or questions to be answered by respondents. The collected data consists of assessments of the Bali ceremonial tools-based ethnomathematics electronic student worksheet, as well as feedback and suggestions from experts. To obtain this data, data collection instruments are needed. The purpose of these data collection instruments in this developmental research is to conduct preliminary studies, measure the validity, and gauge the responses of teachers and students regarding the electronic student worksheets based on Upakara Bali ethnomathematics in the subject of geometry for second-grade elementary school. The instruments used include observation sheets, interview guides, and questionnaires in the form of a rating scale. The rating scale method aims to process quantitative assessment data and interpret it into qualitative understanding,

allowing the assessors to choose one of the provided qualitative responses (Gregson, 1962; Wiyono et al., 2018). The criteria for the product instruments for subject matter experts, media experts, teachers, and students can be seen in Table 1, Table 2, Table 3, and Table 4.

Table 1. Material Expert Instrument Grid

No.	Aspect	Indicator	Item Number
1.	Curriculum	Suitability of material to Learning Outcomes (CP)	1
		Suitability of material to Learning Objectives (TP)	2
		Suitability of material with Learning Goal Achievement Indicators (IKTP)	3
2.	Language	The use of language is appropriate to the development of students	4
		Use language according to applicable spelling	5
3.	Material	Correctness of material concepts in Electronic Student Worksheets	6
		The material contains concepts that need to be known	7
		Suitability of material to the scope of learning material	8
		Material is easy to understand	9
		Attractiveness of presentation	10
4.	Evaluation	Suitability of the questions to the material	11
		Availability of instructions for working on questions	12

Table 2. Media Expert Instrument Grid

No.	Aspect	Indicator	Item Number
1.	Appearance/ Design	The attractiveness of the appearance/design of the media	1
		The use of fonts and font size is easy to read	2
		Harmony of composition and color combination	3
		Image attractiveness	4
		Suitability of image and text layout	5
2.	Appropriateness	Conformity to Learning Objectives (TP)	6
		Suitability to student characteristics	7
		The material presented is correct	8
3.	Operation	Ease of operation	9
		Smooth operation	10

Table 3. Teacher Instrument Grid

No.	Aspect	Indicator	Item Number
1.	Material	Completeness of information	1
		Suitability of material to Learning Outcomes (CP)	2
		Suitability of Learning Objectives (TP) material	3
		Conformity of material with Learning Goal Achievement Indicators (IKTP)	4
		Suitability of the material presented with the learning material	5
2.	Language	The use of language is appropriate to the development of students	6
		Use language in accordance with applicable spelling	7
3.	Presentation	The material is coherent and systematic	8
		The attractiveness of presenting the material	9
4.	Design/Appearance	Clarity of text presentation	10
		Image attractiveness	11
		Harmony of color combinations	12
5.	Operation	Ease of operation	13
		Smooth operation	14

Table 4. Student Instrument Grid

No.	Aspect	Indicator	Item Number
1.	Appearance	Attractive appearance	1
		The use of fonts and font size is easy to read	2
		Image attractiveness	3
		Harmony of color combinations	4
2.	Material	Clarity of material	5
		Material can increase student motivation	6
		Material is easy to understand	7
		Media appeal	8
3.	Operation	Ease of use	9
4.	Evaluation	Suitability of questions to the material	10

When an instrument fulfills the content validation criteria, it is deemed as a reliable tool. The outcomes of this validation examination encompass the instrument's quality and appropriateness. The content validity entails the participation of 2 judges during the evaluation process. It is utilized to assess the validity level of the grid instrument for Electronic Student Worksheets based on upakara Bali. The Gregory formula is applied in the content validity assessment. The determination of the content validity coefficient involves converting the evaluation outcomes from the judges into a 2 x 2 cross-tabulation.

3. RESULT AND DISCUSSION

Result

This development research resulted in a product: an electronic worksheet based on upakara Bali ethnomathematics for second-grade geometry in elementary school. The research was conducted from September 20, 2023, to October 2, 2023, at SDN. 2 Sukasada. The research activities followed the ADDIE research model, consisting of five stages: analysis, design or planning, development, implementation, and evaluation. However, due to time, manpower, and financial constraints, the implementation and evaluation stages were not carried out in this study. Consequently, the research only reached the validity testing and understanding the responses of teachers and students regarding the developed product. The first stage is the analysis phase. The initial analysis conducted was on the characteristics of the students, revealing that the average age of second-grade elementary students is between 7 to 8 years old. Children aged between 6 to 12 years are in the stage of concrete operational cognitive development. The characteristics of children at this age differ from the perspectives of parents or older individuals, so educators must be capable of encouraging children to form appropriate concepts, particularly in mathematics learning. Hence, there's a need for worksheets that can prompt students to build a concept, and the development of electronic worksheets based on upakara Bali in ethnomathematics seems suitable for addressing this situation.

The next analysis is the curriculum analysis. The curriculum analysis conducted here involves assessing the learning outcomes in the Merdeka Curriculum as the basis for developing electronic worksheets for students based on Upakara Bali in ethnomathematics. The outcomes of the curriculum analysis concerning geometry topics in second-grade elementary school can be seen in Table 5.

Table 5. Learning Outcomes And Achievement of Learning Goals Geometry Material for Second Grade Elementary School

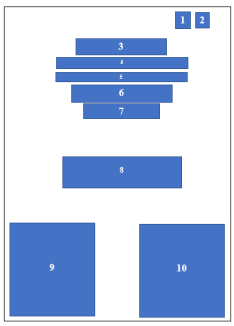
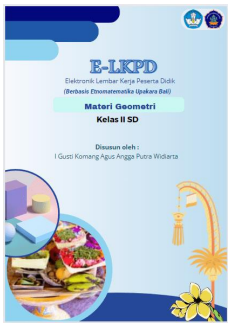
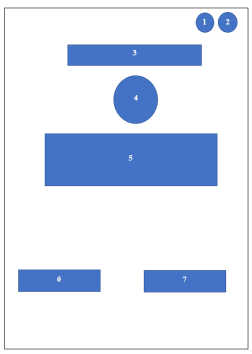
Learning Outcomes	Learning Objectives
Fase A At the end of Phase A, students are able to recognize various flat shapes (triangle, quadrilateral, polygon, circle) and solid shapes (rectangular prism, cube, cone, sphere). They can compose and decompose flat shapes (triangle, quadrilateral, polygon). Students can also determine the position of objects in relation to other objects (front, back, top, bottom).	1. Through the completion of electronic students worksheets, students can accurately identify the characteristics of flat shapes (triangle, quadrilateral, and circle). (C4-TPACK, Critical Thinking, Collaboration, Communication, Creativity). 2. Through the completion of electronic students worksheets, students can accurately identify the characteristics of solid shapes (rectangular prism, cube, cone, and sphere). (C4-TPACK, Critical Thinking, Collaboration, Communication, Creativity). *3.* Through the completion of electronic students worksheets, students can accurately compose and decompose flat shapes (triangle, quadrilateral, and circle). (C5-Critical Thinking)*)* *4.* Through the completion of electronic student worksheets,

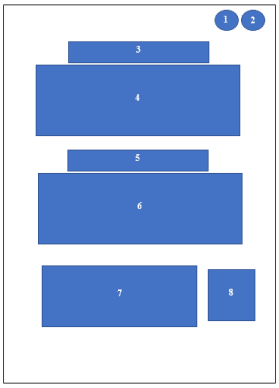
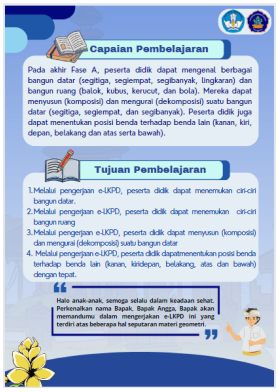
Learning Outcomes	Learning Objectives
	students can accurately determine the position of objects in relation to other objects (right, left, front, and back). (C5-Critical Thinking)

Based on the observations and interviews, the needs analysis reveals that: (1) students tend to struggle in understanding mathematical concepts, particularly in geometry, impacting their relatively low performance in this subject, (2) Geometry in Mathematics classes primarily involves memorization for students, hence they lack a profound understanding of the material, (3) Students tend to work unsystematically, relying solely on purchased worksheets from school, which only contain brief content and various types of exercises but lack depth, (4) There's a lack of electronic student worksheets based on upakara Bali ethnomathematics. Considering these points, there's a significant need for worksheets that meet standards, are easily accessible, and offer practical value. The final analysis is the product analysis. Three criteria determine the suitability of worksheets: didactic, constructional, and technical criteria. Didactic criteria relate to fulfilling the principles of effective learning in a worksheet. Constructional criteria involve linguistic aspects. Technical criteria pertain to writing based on established guidelines.After the analysis phase, the process continues with the design stage. In this phase, the design and construction of electronic worksheets for students based on upakara Bali etnomatematics are undertaken. The initial step involves determining the content. The chosen content is based on the analysis conducted and focuses on geometry for both flat and solid shapes at the second-grade level in accordance with the Learning Outcomes outlined in the Merdeka Curriculum. Following this, the creation of a storyboard for electronic worksheets based on Upakara Bali etnomatematics is carried out to obtain an initial overview of the product design.

The next step involves consulting with the supervising lecturer to gather feedback and advice regarding the created design, allowing for potential improvements. Subsequently, it proceeds to the development phase. At the development stage, there is an activity to develop an electronic worksheet for students based on Upakara Bali etnomatematics, which has been tailored based on feedback from the supervising lecturer. The initial process involves visualizing the storyboard into the desired electronic student worksheet layout using the Canva application, formatted to the size equivalent of an A4 paper, measuring 21 cm x 29.7 cm. The visualization referred to can be observed in Table 6.

Table 6. Visualization of Electronc Student Worksheets

Storyboard View	Electronic Student Worksheets Visualization
Cover View	Cover View
	
Developer Profile View	Developer Profile view
	

Storyboard View	Electronic Student Worksheets Visualization
Electronic Opening Display Of Student Worksheets	Electronic Opening Display Of Student Worksheets
	

When the storyboard has been successfully visualized into the desired electronic worksheet layout, the development process continues by uploading it onto the topworksheets page. This is done to add features that will make the electronic worksheet interactive for students. The process of adding these features can be seen in Figure 1 and Figure 2.

Figure 1. Process of Adding Audio to User Instructions Text

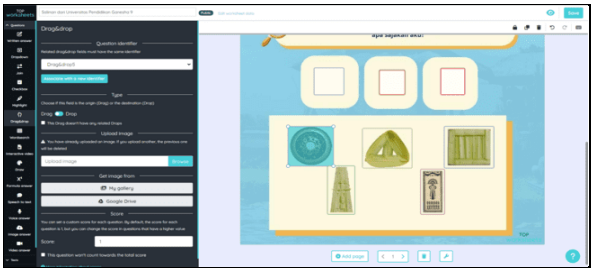


Figure 2. Process of adding the Drag and Drop feature

When the electronic worksheets for students have been successfully uploaded and are ready for use, before further implementation, validity and product testing are conducted. Validity testing involves two experts: a subject matter expert and a media expert, each comprising two individuals. As for the responses from teachers and students, they are obtained through assessments conducted by one second-grade teacher, six individual student trials, and ten students participating in small group trials. Based on the completed research, it can be stated that the electronic worksheets for students based on upakara Bali ethnomathematics in geometry material for second-grade elementary school are valid and practical. The results of the feasibility test can be presented in Table 7.

Table 7. Average Validation Score of Material Experts, Media Experts, Teacher and Student Responses

No.	Subject	Outcomes	Qualification
1.	Material Experts	97.5%	Very good
2.	Media Experts	98%	Very good
3.	Teacher Response	99%	Very good

No.	Subject	Outcomes	Qualification
4.	Student Response (Individual Trial)	95%	Very good
5.	Student Response (Small Group Trial)	96%	Very good

From the product trial results to determine the suitability of the elektronic student worksheets by experts and students, it can be stated that the product is suitable for use in learning. During the product's feasibility testing, there were recommendations from experts that required revisions, presented in Table 8, and the revised results are depicted in Figure 3.

Table 8. Comments and Suggestions from Material Experts and Media Experts

No.	Respondents	Comments and Suggestions
1.	Material Experts	
	R1	No revisions, the media is suitable for use.
	R2	That's good, revise your goals.
2.	Media Experts	
	R1	1. In learning outcomes, add top-down elements. 2. Videos, images contain the source if they are not self-made. 3. For activity 5 because there are more than 1 activities, it is given 5a, and so on. 4. Conclusions are numbered. 5. The tempo of the narrator's voice is slowed down.
	R2	-

Figure 3. The Results of Revisions by Material Experts and Media Experts

Discussion

This development research utilizes the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The reason for choosing this model is because its application is more detailed and better suited for developing electronic worksheets for students based on ethnomathematics. Moreover, its process is more systematic. This model is structured in a programmed manner where its activities are systematically ordered as an effort to solve learning problems related to the learning resources, thus aligning with the learners' needs and characteristics (Muruganantham, 2015; Tegeh & Kirna, 2013).

The first analysis conducted is the need analysis based on this, there's a need for student worksheets that can facilitate students in constructing concepts. The development of electronic worksheets based on Upakara Bali ethnomathematics is considered suitable to address this situation. The results from observations and interviews indicate that all second-grade teachers in that cluster lack innovativeness and creativity in developing teaching materials, especially concerning student worksheets in geometry (Reamer, 2019; Salirawati, 2004). There's a tendency to create Student Worksheets containing only brief materials and exercises, whether in objective, fill-in, or essay formats. This indicates that the essence of the student worksheet is not fulfilled, particularly regarding the discovery of new concepts by students themselves, among other aspects (Ibda, 2015; Nuryati & Darsinah, 2021). This is attributed to several reasons, including limitations in development capabilities and other factors such as limited time, numerous demands in implementing the Merdeka Curriculum, and readiness in conducting teaching. Furthermore, there hasn't been any further development in the form of electronic student worksheets due to limited technology adaptation among teachers, making it less feasible to develop electronic student worksheets. Therefore, developing materials in geometry with a learning tool that guides in concept discovery becomes crucial.

After the analysis phase is completed, it proceeds to the second stage in the ADDIE Model, which is the design phase. In this phase, the design of an electronic worksheet for students based on Balinese ceremonial math tools is carried out. This starts with aligning the content with the learning outcomes of second-grade geometry in elementary schools following the Merdeka curriculum. Subsequently, a storyboard for the developed electronic worksheet for students is created. Once the initial product design in the form of a storyboard is completed, the next step involves consulting the supervising lecturer for feedback and suggestions regarding the storyboard, enabling improvements before advancing to the subsequent stage, which is development.

The next stage is the development phase. In this phase, development occurs based on the agreed-upon design with the supervising lecturer. The development activities begin by visualizing the storyboard using the Canva application, which is then uploaded and adjusted on the topworksheets page to accommodate desired features. Subsequently, validity testing is conducted by both media and subject matter experts to review the developed product (Rahayuningsih, 2018; Salirawati, 2004). This validation process is based on assessment instruments that have been distributed, containing criteria for the suitability of electronic worksheets based on Balinese ceremonial math tools in second-grade geometry mathematics at elementary schools. The validity test involves two types of experts: subject matter and media experts, each comprising two individuals. The purpose of the validity test is to obtain feedback regarding the developed electronic worksheets for students. If the electronic worksheets are deemed unsuitable, revisions are carried out based on the input from both experts.

The validity testing phase for this product involves two types of experts: subject matter experts and media experts, each comprising two individuals. The validity test with subject matter experts covers several aspects: curriculum, language aspects, material aspects, and evaluation aspects. The average percentage score from all subject matter experts evaluating the developed electronic worksheets for students is 97.5%, qualifying as excellent. This finding aligns with research that categorized Interactive Ethnomathematics-based student worksheets as "highly valid" (Dewi & Agustika, 2022). It is also consistent with research that categorized ethnomathematics-based student worksheets as "highly valid" based on the validity aspects assessed by subject matter experts, including curriculum, language, material, and evaluation aspects (Purwati et al., 2023). Further research concerns the development of interactive electronic student worksheet materials introduction to flat shapes based on ethnomathematics for class I students which states that it is feasible and can improve students' mathematics learning outcomes (Prayoga et al., 2022). Further research, regarding electronic student worksheets based on flat geometry material ethnomathematics (Liesandra & Nurafni, 2022). The results of further research are in line with the analysis of the effectiveness of electronic student worksheets based on agate ethnomathematics viewed from the student's initial abilities shows that electronic learners' worksheets are based Agate ethnomathematics is more effective than conventional student worksheets. Based on the aforementioned research outcomes, it's evident that Electronic Student Worksheets as an ethnomathematics-based learning tool is suitable for development (Dafid Slamet Setiana & Nuryadi, 2022).

The media expert validity test also includes several aspects. These aspects include appearance or design aspects, feasibility aspects, and operational aspects. Based on these aspects, in terms of validity, media experts obtained an average score percentage of 98% with very good qualifications. The results of the media expert validity test, obtained findings that were in line with research which found that electronic student worksheets in Ethnomathematics-based Mathematics Learning Flat Geometry Material could be categorized as very valid from the media expert's point of view (Ginsburg et al., 2008; Liesandra & Nurafni, 2022; Nuryati & Darsinah, 2021).

Overall, the findings in the assessment of teacher and student responses align with other research stating that ethnomathematics-based electronic student worksheets can be categorized as "highly suitable" based on teacher responses (Liesandra & Nurafni, 2022). Additionally, other studies indicate that ethnomathematics-based electronic student worksheets are considered "highly suitable" based on both individual and small group trial responses (Dewi & Agustika, 2022). Comments and suggestions from both teachers and students indicate very positive feedback, with no suggestions used as revision material. The assessment of teacher and student responses ranges between 90% to 100%, qualifying as excellent overall. Hence, this ethnomathematics-based electronic worksheet utilizing Upakara Bali ethnomathematics for second-grade geometry is deemed suitable and valid for implementation in teaching related subjects and grades.

The implications of this research are that teachers can use this ethnomathematics-based electronic student worksheet utilizing Balinese ceremonial math tools as a reference or specialized teaching tool specifically for second-grade geometry. Through the use of this electronic student worksheet, students will have the opportunity to independently explore geometric concepts. Additionally, the integration of Balinese ceremonial math tools into this electronic student worksheet will contribute to contextualized learning

implementation, making the learning experience relevant to students' daily lives. Furthermore, utilizing technological advancements, appealing visual displays, audio, and video will accommodate various student learning styles, catering to both auditory and visual learners. The limitation of this research lies in the time constraints that led to stopping at the development stage, involving only validity testing and assessment of teacher and student responses without proceeding to the effectiveness testing in the implementation stage and evaluation phase. The recommendation provided is for the next researcher to conduct further studies regarding the developed product to determine its effectiveness.

4. CONCLUSION

It can be concluded that the electronic worksheet for students based on Upakara Bali in the context of second-grade geometry in elementary schools is highly suitable and valid for use. This conclusion is drawn from the expert validation results and assessments of teachers' and students' responses, all of which indicated a very high qualification. It is recommended that other researchers follow up the results of this research by conducting effectiveness tests. Apart from that, the results of this research can also be used as a reference in carrying out further research related to the development of teaching materials that are more innovative, creative and enjoyable for students in learning.

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