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AUGMENTED REALITY (AR) BASED KIDNEY ORGAN HANDOUT IS PRACTICAL IN HELPING CLASSICAL LEARNING OUTCOME OF HIGH SCHOOL STUDENTS

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ABSTRACT

Biology learning is often perceived as difficult by students due to the abundance of abstract material, including the Topic of kidney organs in the excretory system. This Topic requires specific visualization to help students understand the concepts more easily and thoroughly. Therefore, this study aims to develop an Augmented Reality (AR)-based kidney organ handout as a practical learning medium to help high school students achieve mastery learning. This research employed a practical instrument in the form of student response questionnaires and learning outcomes through a post-test. The students' practicality assessment fell into the "convenient" category, with a percentage of 91.45%. Student learning outcomes after using the handout showed a minimum mastery criterion of 82.75%, exceeding the minimum threshold. Based on these results, the AR-based kidney organ handout is an effective learning medium that can support high school students in achieving mastery of the learning material.

PENDAHULUAN

Education is a conscious and planned effort to create a learning and teaching environment that enables students to actively develop their potential, fostering spiritual and religious strength, self-control, personality, intelligence, noble morals, and skills essential for themselves and society (Ujud *et al.*, 2023). The implementation of education in Indonesia is currently based on the independent curriculum, in which the independent curriculum (KurMer) appears as a bold and innovative approach to developing student competencies. However, the implementation of curriculum independence is not a simple thing, especially when speaking about skills relevant to teaching with development technology (Hendry *et al.*, 2023).

Learning science at the high school level often faces various obstacles, especially related to limitations, tools, adequate aids, and visual media. This makes it challenging to understand biological concepts, especially those involving organ structure and function system body man-like system excretion. Challenges This impacts low-interest learning and understanding of the material presented (Rungkat *et al.*, 2023), especially in the system excretion in the kidneys, which is one of the Topics in biology that is often considered difficult and lacking interest for students. This is proven by research conducted by Simorangkir *et al* . (2020), who stated that the main issues

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faced in learning system excretion cover the understanding of the structure and function of kidneys, terminology complex, as well as the process of urine formation is abstract and difficult to visualize.

In accordance with the results distribution questionnaire analysis, the need for learning media for teachers and students carried out at SMA Muhammadiyah 3 Jember, SMA Negeri 2 Jember, SMA Negeri 3 Jember, and SMA Negeri Pakusari which consisted of 38 respondents show that 92.5% of respondents experience difficulty visualize material system excretion, especially in terms of structure and function kidney in production urine to the excretion process, and agree the need for learning media special as tool help teaching. In addition, the problems faced in learning system excretion at Muhammadiyah 3 High School, Jember shows that Not yet availability special teaching materials in learning system excretion. Students only depend on search information in a way independent of *Google* without an existing structured guide. In addition , the utilization of technology in schools This Still limited to use *PowerPoint* , images , and instructional videos tend to produce conventional teaching materials without visualization special support understanding draft in a way deep . Condition This at risk cause misconception , because information obtained from various source Not yet of course valid and appropriate with draft scientifically correct (Wicaksono *et al.*, 2021) .

One of teaching materials that can used is *handout* . *Handout* is material written material prepared by a teacher for enrich knowledge students . *Handouts* are usually taken from a number of literature that has relevance with the material taught or competence basic and material the main thing to do mastered by students (Nurhaida, 2018) Utilization technology in *handout* allows student more active in learn and improve results Study in a way significant (Hafsah *et al.* , 2023) . Approach This in line with research conducted by Richard Mayer, who argues that learning more effective when information served through combination assisted images , text , and sound (multimedia) technology Because condition This will utilise visual and verbal pathways of the brain child in a way simultaneously (Wahyuni *et al* ., 2024) .

One of innovation technology that is starting implemented in the world of education is *Augmented Reality* (AR), namely technology that combines virtual elements with environment real in a way interactive . The use of AR can give information with clear , *real-time* , interesting , interactive and educational (Carolina, 2022) . Use *Augmented Reality* (AR) in learning system excretion in the kidneys allow student For see internal organ structure more form real (Fitriyah, 2023) . Validity use *Augmented Reality* (AR) in the learning process has also been confirmed through various study . Based on the results of the validity test obtained from results study Musliadi *et al* ., (2022) found that average value of total usage *Augmented Reality* (AR) in support the learning process is x = 4.8 so that can concluded that mark This including in valid category . With evaluation the show that use *Augmented Reality* (AR) is considered worthy For used in learning .

Apart from being valid, a media must also be fulfil element practicality . In research (Fitriyah, 2023) use *Augmented Reality* (AR) as a learning medium stated practical used and helpful in reach objective learning . In line with matter said , the research conducted by Afnan *et al.,* (2024) which shows that technology *Augmented Reality* (AR) is considered very practical by students , with more from 90% of responses positive . AR is assessed capable serve experience interesting , interactive , and easy learning understood . In addition , realistic digital visualization from organs

and biological processes help student understand draft abstract with more Good .

Learning using learning media based on *Augmented Reality* (AR) can also give influence to results Study students . This is because of through use *Augmented Reality* (AR) can visualize draft abstract For understood and structured an object model , and give more view interesting . Result data Study from study Thahir *et al.,* (2021) who achieved mark criteria minimum completeness (KKM) with use implementation *Augmented Reality* (AR). Research results the in accordance with theory put forward by Yuliono *et al* ., (2018) state that use *Augmented Reality* (AR) in the learning process can accepted by students , as well as rated capable For used with Good in learning in the classroom . Based on problem said , then researcher mean to developing learning media *handout* based *Augmented Reality* (AR) on the system excretion humans , especially the kidney organs which are practical and can be used help high school students in reach completeness results Study biology . Development of learning media This aiming provide teaching materials in special that visualizes draft abstract in a way clear through technology *Augmented Reality* (AR), all at once answer limitations of learning media that have been This Not yet give optimal support in understand structure and function of the kidney organ at high school level .

RESEARCH METHODS

Study This use method study *research and development* (R&D) and the research models used in study This is ADDIE. The ADDIE model consists of of five stages that is stages *Analyze, Design, Development, Implementation,* and *Evaluation* . As for the stages development *handout* based on *Augmented Reality* (AR) on the material system excretion in the kidneys as following :

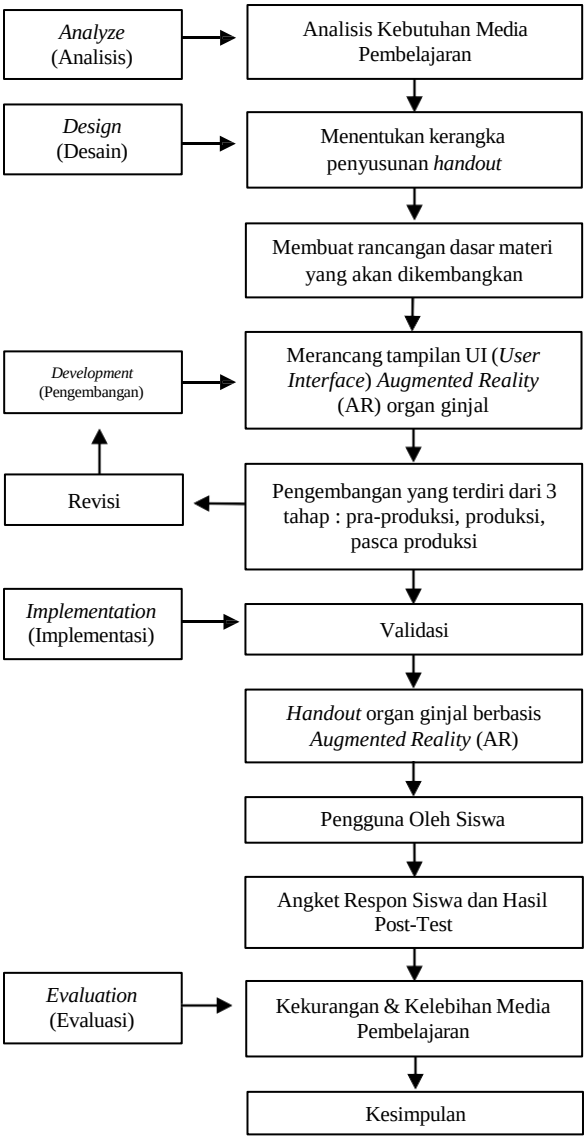

Figure 1. Stage Development Kidney organ *handout* based on *Augmented Reality*
Source : Modified from Destiara (2020)

(1) *Analysis* at this stage This that is do analysis learning media needs for teachers and students . (2) *Design* , at the stage This is done with make design *Augmented Reality* (AR) based *handouts* with determining framework compilation development *Augmented Reality* (AR) based *handouts* , making the design base the material to be developed , and designing UI (*User Interface*) *Augmented Reality* (AR) system display excretion in the kidneys . (3)

Development , at the stage This researcher do activity making product *handout* based on *Augmented Reality* (AR) with various stage like design *modeling* 3D objects , animation process , matching 3D objects with *marker* as well as prepare media that displays required information . (4) *Implementation* , at the stage This researcher do duplicate / produce media that has been developed in form product , then conducting field tests . (5) *Evaluation* , at the stage This researcher do evaluation For do repair towards existing learning media developed .

After teaching materials completed so will done validation teaching materials that will be validated by 2 lecturers of Biology Education at Muhammadiyah University of Jember and 1 subject teacher lesson biology of Muhammadiyah 3 High School, Jember. After validation going on , then done stage next that is revision products provided by validators. Stage furthermore is test eligibility teaching materials through trials to student class XI of Muhammadiyah 3 Jember High School. Trial done in two stages , namely trial group small involving 5–10 students and a trial group big involving One class XI of Muhammadiyah 3 High School, Jember.

Practicality test of learning media done by students For evaluate how far the media is easy used , understood , and supports the learning process . Data analysis is carried out with measure results response student to developed products . Data from the results of practicality tests of learning media analyzed based on step following :

Table 1 Rating Scale Practicality *Handouts*

Alternative Answer	Score
Strongly agree	4
Agree	3
Don't agree	2
Strongly Disagree	1

Source : Modified from (Roesmawati *et al* ., 2022) .

Data obtained to be continued with a calculation based on the amount score obtained adapted from (Pratiwi *et al* ., 2021) , with the formula as follows:

$$\textbf{Presentase} = \frac{\text{Jumlah skor hasil penelitian}}{\text{Jumlah skor maksimum}} \times 100$$

After percentage obtained , done grouping in accordance criteria like following .

Table 1.1 Criteria Practicality *Handouts*

Criteria	Criteria Interval
Very Practical	75% - 100%
Practical	50% - 74%
Enough Practical	25% - 49%
Not Practical	0% - 24%

Source : Modified from (Charissudin *et al.,* 2021)

Learning outcomes student in study This obtained from the trial product *handout* based on *Augmented Reality* (AR) which has applied in the learning process , with use results *post- test* which includes question choice double and essay *tests* . A analysis results Study student measured through achievement mark the completion set by SMA Muhammadiyah 3 Jember, which functions as reference For evaluate whether student has reach competence base in accordance applicable curriculum . As for level completeness results Study Students at Muhammadiyah 3 High School Jember were measured based on achievement mark minimum completeness (KKM) set of 73.

RESULTS AND DISCUSSION

Products developed in the form of *handout* based on *Augmented Reality* (AR) on the material system excretion human . *Handout* This arranged based on literature from book lessons and books relevant

biology , then integrated with technology *Augmented Reality* (AR) especially in the kidney organ section . This media designed For facilitate the learning process biology , in particular material system excretion human . Before tested to students , *handout media* based on This *Augmented Reality* (AR) has tested by experts and obtained percentage by 85.44%. With Thus , this media has fulfil standard eligibility from aspect content , presentation and appearance , as well as worthy used in activity learning .

Practicality from learning media based on *Augmented Reality* (AR) is developed tested through learning class XI at Muhammadiyah 3 High School Jember which consists of from 29 respondents . Learning implemented with use *handout* that has been equipped feature *Augmented Reality* (AR), which is designed For visualize the kidney organs in the system excretion in 3D. In its implementation , students use each of *their mobile phones that* have paired application *Augmented Reality* (AR) for scan *marker* or picture specifically contained in the *handout* . After scanned , application will displays a 3D model of the kidney organ that can enlarged , and observed from various angle . Through appearance this , students can in a way direct observe structure of the kidney organ with more clear and interactive . This process allow student Study in a way independent and also in groups with practical and interesting way . Approach learning This in line with study Zainal *et al* ., (2024) who utilized technology *Augmented Reality* (AR) for visualize system urinary tract , including the kidney organs , in 3D shape . Through product learning said , students can observe anatomy kidney in a way concrete from various corner through camera mobile phone , so that create experience learn more interactive and fun (Zainal *et al* ., 2024) . With Thus , the use of *Augmented Reality* (AR) is proven effective in increase understanding student to material complex like structure kidney in system excretion .

Figure 1.1 Process Learning with Use *Handouts* AR Based

Handouts based on *Augmented Reality* (AR) is developed this , is designed with consider practicality of media in the learning process . For evaluate how far this media can used in a way practical , then practicality test conducted through distribution questionnaire sheet response students . This is in accordance with statement (Prafitasari, 2024) which states that practicality of learning media need practical test reviewed from response student after using media with do distribution questionnaire to response students . This test aiming For know response student to convenience use of media and the extent of the media capable help student in the learning process . Following results response student to *Handouts* based on *Augmented Reality* (AR):

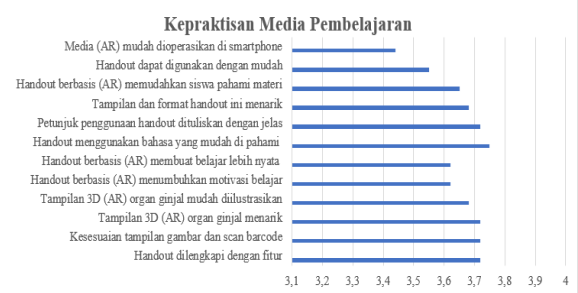

Figure 1. 2 Average Score Graph of Questionnaire Results Response Student

Based on results **Figure 1.2** on the graph the practicality of the learning media above , can concluded that learning media based on *Augmented Reality* (AR) is considered very practical by respondents . This is seen from majority indicators that obtain average value above 3.5 out of scale maximum 4, and in overall converted become percentage so that to obtain practicality of learning media by 91.45%. Based on results obtained mentioned , learning media based on *Augmented Reality* (AR) can said to be very practical and feasible used . This is in line

with research conducted by Syafar *et al* ., (2023) which obtained level practicality of learning media *Augmented Reality* (AR) is 88.9% and includes in category **"very practical "** .

With the existence of learning media based on This *Augmented Reality* (AR) can make student interested and enthusiastic in the learning process in class . This is proven with acquisition indicator with mark highest in graph contained in Figure 1. **2** includes " instructions use *handout* written with clear ", " *handout* use easy language understood ", " 3D view (AR) of the kidney organ interesting ", " suitability appearance images and *barcode scans* ", as well as " *handouts "* equipped with features ". Fifth category the show level high practicality , with an average percentage of 3.73. This is show that through *handout* based on This *Augmented Reality* (AR) , students can feel experience learn more interactive , informative and easy understood . Use *handout* based *Augmented Reality* (AR) allows student see appearance more visual images realistic , so that increase interest in learning , especially on the material system excretion that requires specific visualization . Visualization 3D objects create atmosphere learn more interactive , and assessed capable increase involvement student as well as make it easier understanding to the material presented . This is in line with findings Arzak *et al* ., (2023) stated that that *Augmented Reality* (AR) media is very helpful visualization draft in learning , and in a general can increase quality learning .

Augmented Reality (AR) media has a number of weakness based on results questionnaire response students in Figure **1.2** , especially related with use technical indicators , such as " easy (AR) media operated on *smartphones* " and " *handouts* can used with easy " shows mark the lowest , namely around 3.44–3.55. This is reflect that although content The material and media display are very good , users Still experience difficulty technical in operation of the media . Weaknesses this is also explained in study Marisa *et al* ., (2022) who mentioned that constraint general Use of *Augmented Reality* (AR) media in the environment education is incompatibility device students , as well as need specific device hard like camera and scanner *barcode* that has not been Of course owned all students . Therefore that , it is necessary noticed return aspect convenience usage in various device For ensure greater accessibility wide . With ensure greater accessibility wide through convenience usage in various devices , it is expected that the learning process can followed by all student in a way maximum . This is become important For be noticed Because based on results evaluation learning , still there is part students who have not reach Criteria Minimum Completion Criteria (KKM) set at Muhammadiyah 3 Jember High School.

Criteria The minimum completeness criteria (KKM) set at SMA Muhammadiyah 3 Jember are: of 73. Based on results evaluation learning , it is known that as many as 24 students succeed to obtain values above the KKM that have been set , while 5 students other Still be under Standard . Achievement This show that majority student 82.75% has fulfil completeness study , while the rest need mentoring or remedial for achieve learning targets . This data show that majority student has reach results satisfying learning with use *handout* based on *Augmented Reality* (AR). Presentation completeness this also shows that part big student has understand material with good and helpful in the learning process . Use *Augmented Reality* (AR) in learning biology proven capable help student in reach mark criteria minimum completeness (KKM). Selajan with research conducted by Musliadi *et al* ., (2022) which shows that learning media biology based on *Augmented Reality* (AR) for students Class XI SMA is considered very practical and effective , with mark

completeness reaching 73 and 83.73% of students succeed fulfil criteria completeness learn . With Thus , the use of learning media based on *Augmented Reality* (AR) is proven become tool help that can support student reach standard mark criteria minimum completeness . This shows that integration the right technology No only increase quality learning , but also facilitates achievement competence student in a way more evenly .

CONCLUSION

Conclusion from study This show that learning media kidney organ *handout* based on *Augmented Reality* (AR) gets very practical assessment that is by 91.45% and capable of help completeness Study high school students up to 83.73%. This result confirm that use *handout* based on *Augmented Reality* (AR) provides solution to challenge learning biology that is still dominated difficulty visualization draft abstract , and strengthen importance utilization technology For support understanding materials and results Study student .

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