

Augmented Reality Card Media (KARISPENMA-AR) and Its Effect on Students' Higher-Order Thinking Skills in Primary Science Learning

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ABSTRACT : Problems science learning on the material system digestion humans at MI Roudlotul Ulum Jabalsari Sumbergempol motivated by the use of media that is still conventional in the form of board write so that learning tend passive and participant educate experience difficulty understand complex concept . Research This aim For explain the process of developing Card media System Digestion Man based on Augmented Reality (KARISPENMA-AR) and know improvement ability think level tall participant educate class V through use of the media . Research This use method *Research and Development* (R&D) with the ADDIE model which includes *Analysis, Design, Development, Implementation, and Evaluation* . Data collection techniques are carried out through interviews , observations , tests , and questionnaires . Data were analyzed use technique analysis validity , analysis response participant educate and analyze ability think level high . Research results show that the KARISPENMA-AR media was developed based on analysis profile participant education , curriculum , and materials . Validation of media obtained score 93.3% of media experts and 100% of expert material with category very valid. Response participant learn in group tests small reached 85% with category good . The pretest and posttest results show improvement average value from 53% to 81%. With Thus , KARISPENMA-AR media is effective used For increase ability think level tall participant educate .

Key words: KARISPENMA-AR, *Augmented Reality* , Ability Higher Order Thinking , Science .

INTRODUCTION

The digital era is marked with rapid development technology information and communication that influences various field life , including education . Utilization digital technology is driving occurrence transformation of the learning process become more effective , interactive , and innovative . Data from the Central Statistics Agency (BPS) shows that ownership telephone mobile in Indonesia continues increased , including in rural areas (Hasan., et al 2023). Conditions This show that access public to technology the more wide so that the world of education need adapt self with development said . Schools and teachers are required capable utilise technology as means supporters learning so that the learning process more relevant with need 21st century .

That matter in line with Constitution Number 14 of 2005 concerning Teachers and Lecturers Article 20 letter b states that teachers are obliged develop competence in a way sustainable in accordance development knowledge knowledge, technology, and art (Sylvia., et al 2021). In implementation Independent Curriculum , teachers are given freedom For choose appropriate learning strategies , methods and media with characteristics participant educate. Curriculum this also emphasizes importance development ability think level tall covering ability analyze, evaluate, and create (Sukiyanto , et al. 2024).

Ability think level tall need built since level school base through experience meaningful and contextual learning. According to theory development Piaget's cognitive , participants educate age school base be at the stage operational concrete , namely stage when child more easy understand draft through object real , visual, and experiential directly . Besides that , theory *Cone of Experience* from Edgar Dale confirms that learning will more meaningful if participant educate involved direct through visual and interactive media (Prana et al., 2020). Therefore that is , the use of concrete and interesting learning media very important For help participant educate understand draft at a time practice ability think level tall.

However , the reality on the ground show that Science learning at MI Roudlotul Ulum Jabalsari Sumbergempol, especially on the material system digestion human , still dominated use of conventional media like book packages, posters, and boards write. Method dominant lecture cause participant educate tend passive as well as experience difficulty understand draft abstract, such as the shape of the digestive organs , the location of the organs, and the digestive process food. Material system digestion man including materials that are needed visualization Because related with internal organs body that is not can observed in a way directly. If only explained verbally , participants educate tend only memorize organ name without understand connection structure, function, and work process. As a result, participants educate more Lots be at the cognitive level low , namely remember and understand, and Not yet trained For analyze and evaluate.

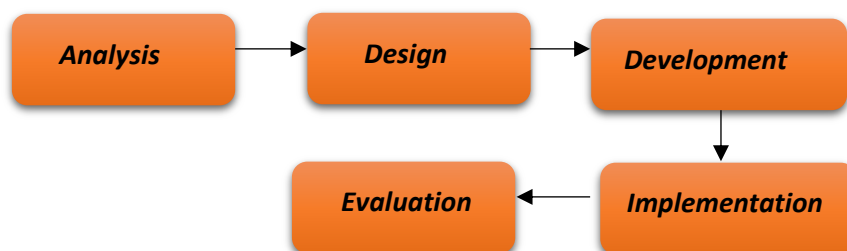
One of solutions that can implemented is use of media based Augmented Reality (AR). Augmented Reality is technology that combines virtual object two dimensions or three dimensions to in environment real in a way time real (Wibowo., et al 2020). Technology This allows participant educate see a model of the digestive organs in a way more real through device *smartphone* so that draft abstract become more concrete . AR media is also interactive Because participant educate can observe , rotate , enlarge , and explore object in a way independent.

According to Putri and Wiguna , the way For get accurate and comprehensive knowledge is *Augmented Reality Technology* this , students Possible will make more A little error conceptual moment understand material real lesson . Instructional Media more sophisticated that utilizes technology latest is profit others (Wiguna & Putri 2020). Study This aim to : (1) describe the process of developing KARISPENMA-AR media in class V science learning at MI Roudlotul Ulum Jabalsari Sumbergempol ; and (2) describe improvement ability think level tall participant educate after using KARISPENMA-AR media.

METHOD

Study This use type research and development (Research and Development) with the ADDIE model which consists of into five stages, namely Analysis, Design, Development , Implementation , and Evaluation (Zamsiswaya & Syawaluddin 2024). The ADDIE development model was chosen by the researcher Because the stages are sequential and directed. A valid product is results end from the review and revision process that accompanies it every steps . Besides that , the ADDIE model procedure for create product learning nature straightforward and not complicated . Here This is ADDIE development model chart (Waruwu , 2024).

Chart 1. ADDIE Development Model



Stage analysis done For identify need learning , characteristics participant education, curriculum , and problems with the material system digestion human. Stage design covering KARISPENMA-AR media design, compilation material, appearance cards, as well as instrument research . Stage development done with manufacturing media- based products Augmented Reality. Stage implementation done with validated by media experts and experts material furthermore through trial activities to participant educate Class V MI Roudlotul Ulum Jabalsari Sumbergempol . Stage evaluation done For know effectiveness product as well as media improvement based on trial results.

Research and development This done all over participant educate VB MI Roudlotul class Ulum Jabalsari Sumbergempol, meanwhile For know response participant educate class V as test subjects. Instruments research used covering guidelines interview, sheet observation , questionnaire validation expert , questionnaire response participant educate , and question *pretest* and *posttest* For measure ability think level tall. Data collection techniques were carried out through interviews, observations, tests, and questionnaires. The data obtained analyzed use analysis descriptive quantitative and qualitative, including analysis media validity , analysis response participant educate, and analysis improvement results *pretest* and *posttest* ability think level tall participant educate.

RESULTS AND DISCUSSION

A. Learning Media Development Process Card System Digestion Man Based on Augmented Reality (KARISPENMA-AR)

1. Stage Analysis

Stage analysis done through observation , interviews , and studies documentation For know need learning. Observation results show that science learning material system digestion man Still dominated method lectures, use board write, and LKS books. Conditions This show that the learning process Still teacher -centered so that participant educate not enough involved active in build understanding. As a result , participants educate experience difficulty understand organ shape, organ function, as well the digestive process flow is abstract.

Interview results with the teacher strengthening findings that , that ability think level tall participant educate Not yet develop optimally. Participants educate tend only remembering and understanding material without capable analyze and evaluate problem. This is indicates that learning strategies and media used Not yet capable facilitate skills think level high (HOTS), because learning Still be at the cognitive level low.

Temporary that , the result interview with participant educate show that they more likes visual media three dimensions Because considered more interesting and easy understood. Preferences This show that participant educate need experience learn more concrete and interactive . With Thus, the problem main No only on abstract material , but also on inconsistencies between characteristics materials, needs participant education, and the learning media used.

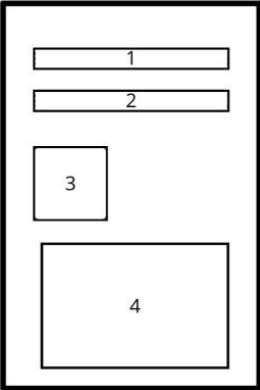
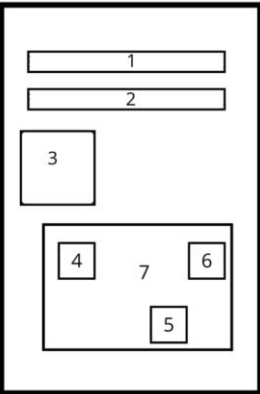
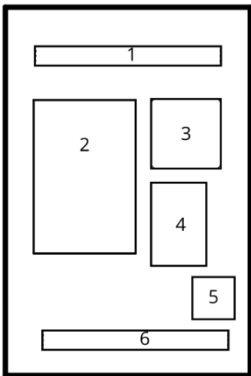
Findings the can interpreted that learning media own role important in bridge draft abstract become more concrete . This is in line with opinion Azhar Arsyad who stated that learning media can clarify presentation information so that improve processes and results Study (Fadilah , et al 2023). Besides that , according to theory development cognitive Jean Piaget, participant educate ages 7–11 years be at the stage operational concrete , so that need visual aids and objects real For understand draft optimally (Nainggolan, 2021). Therefore that , the use of media that is abstract - verbal without adequate visual support become not enough effective.

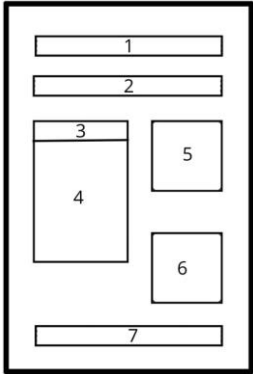
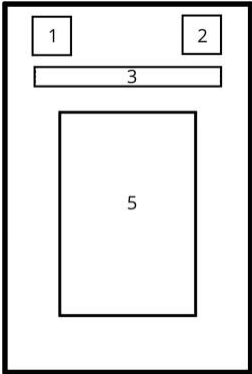
Based on analysis mentioned, the use of Augmented Reality technology becomes relevant solutions Because capable visualize object three dimensions in a way real so that make it easier participant educate understand concept . This is in line with opinion Hafifah that AR can also push ability think level high , especially analysis and evaluation (Hafifah & Marlina , 2025). With Thus, the selection of AR media is not only practical, but also strategic For bridge gap between characteristics materials, needs participant education, and HOTS development.

2. Stage Design

After carrying out observation, interviews, analysis material, characteristics participant educate and analyze curriculum, researchers continue to stage design. At this stage this, researcher designing product in the form of Card System Digestion Man based *Augmented Reality* (KARISPENMA-AR) is appropriate need learning that has been found at the stage previously. Media designed measuring 9 x 12 cm because easy brought and enough proportional For display text, images, and Augmented Reality markers clear. The materials used is 150 gsm art paper so that the results print sharp and attractive, then laminated For increase Power media resistant to water, dust, and folds . Researchers also compiled a storyboard as reference development product as following :

Table 1. KARISPENMA-AR Media *Storyboard*

Order Card	Appearance	Information
Card First		1. Media name 2. Full name media name 3. Animated images explorer 4. Objective learning
Card Second		1. Media name 2. Full name media name 3. Animated images explorer 4. Image of <i>smartphone scanning barcode</i> 5. AR view image after <i>barcode scan</i> 6. Participant images educate observing AR 7. Instruction use
Card Third		1. Writing (<i>Adventures in the Land of Digestion</i>) 2. System image digestion in a way intact 3. Column <i>barcode scan</i> 4. Adventure map explorer system digestion and 5. Explorer image

		6. Narration short about journey exciting explorer
Card Fourth Card eighth		1. The writing "Adventure in the Land of Digestion" 2. Point a must-do trip passed explorer 3. digestive organs 4. digestive organs 5. Column <i>barcode scan</i> 6. Animated images explorer 7. Narration short journey explorer in accordance organ sequence
Card Ninth- Card Tenth		1. Number 1 and 2 Animated images explorer 2. Writing card question 3. Question

In a way conceptual , designing this media refers to Edgar Dale 's Cone of Experience theory which emphasizes that learning will more meaningful if participant educate get experience direct through visualization and interaction (Bisaroh & Faruq, 2026) . Therefore that , the use of Augmented Reality is interpreted as effort For concretize draft abstract system digestion so that more easy understood .

Besides that , integration question HOTS -based in media shows that KARISPENMA-AR does not only functioning as tool transmitter material , but also as means development ability think level high. This is in line with Anderson and Krathwohl's revised Bloom's taxonomy emphasizes

importance ability analyze , evaluate , and create in learning (Talib, 2021). With Thus , this media design in a way theoretical has accommodate need learning the 21st century that is not only understanding - oriented concept , but also on development skills think critical.

Findings This is also supported by research Mustaqim who stated that the use of Augmented Reality is capable of visualize draft abstract so that make things easier understanding participant educate educate (Mustaqim , 2016). With thus , it can interpreted that KARISPENMA-AR design is step strategic that is not only answer need practical in the field, but also harmonious with runway theoretical in learning

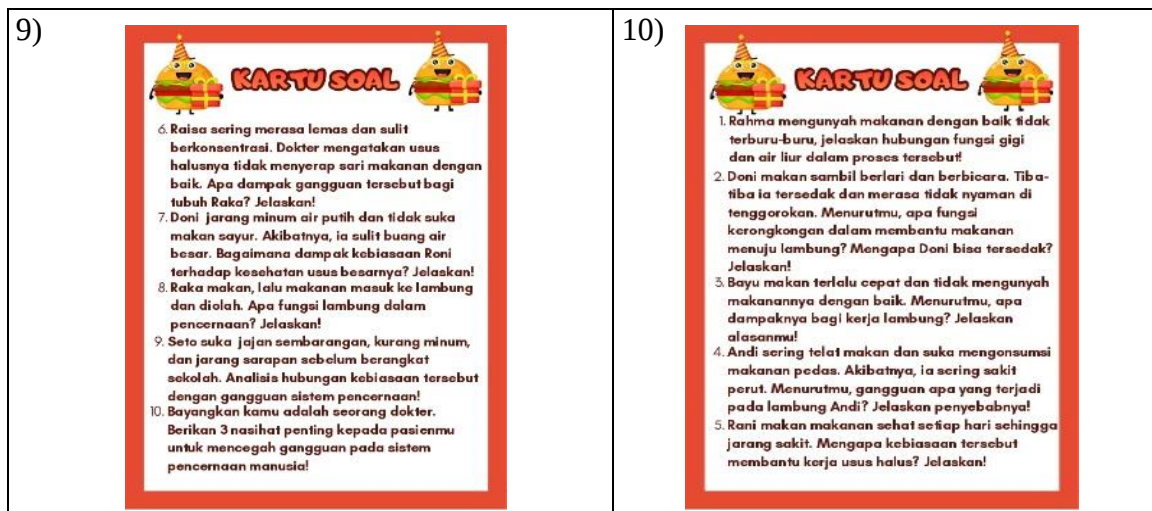
3. Stage Development

At the stage development , researchers realize design *storyboard* become product real in the form of Card System Digestion Man based *Augmented Reality* (KARISPENMA-AR). Design card made use Canva application , while AR features developed through Assembler Edu. Resulting media consists of top 10 cards , following is results end of KARISPENMA-AR media.

Table 2. Final Results of KARISPENMA-AR Media

1) 	2) 
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3) Petualangan di Negeri Pencernaan SCAN Peta Petualangan Gerni Seorang penjelajah kecil bernama Gerni (Burger Mini) memulai perjalanan seru di sebuah negeri ajaib di dalam tubuh manusia.	4) Petualangan di Negeri Pencernaan Gerbang Kunyah MULUT SCAN ME Di Gerbang Kunyah, Gerni dihanutkan oleh penjaga kuat dan di siram air aialb agar lembut dan siap melanjutkan perjalanan.
5) Petualangan di Negeri Pencernaan Lorong Meluncur KERONGKONGAN SCAN ME Gerni meluncur di lorong panjang yang mendorongnya perlahan ke tempat berikutnya.	6) Petualangan di Negeri Pencernaan Dapur Ajaib LAMBUNG SCAN ME Di Dapur Ajaib, Gerni diaduk dan dimasak hingga menjadi bubur halus.
7) Petualangan di Negeri Pencernaan Taman Penyerapan USUS HALUS SCAN ME Di taman ini, bagian-bagian bergizi dari Gerni diserap dan dibagikan ke seluruh tubuh.	8) Petualangan di Negeri Pencernaan Padang Pengerang dan Gerbang Akhir USUS BESAR SCAN ME Sisa Gerni melewati padang ini. Air diserap kembali sehingga sisa makanan menjadi padat. Kemudian, gerni keluar melalui gerbang akhir.



Development of this media No only combine text and images , but in a way conceptual utilise principle multimedia learning from Richard E. Mayer stated that that combination of visual and verbal capable increase understanding participant education. Integration card physical, narrative, images, and 3D visualizations on KARISPENMA-AR show that presentation information designed For maximize cognitive processes participant educate , so that material No only understood in a way surface but more deep (Rahayu , Marmoah , and Budiharto , 2024) .

Besides that, the use of AR -based media can interpreted as implementation theory Jean Piaget's constructivism, in which participants educate build knowledge through experience direct (Nurhayati et al., 2025). Through interaction with virtual objects , participants educate No Again nature passive, but active explore, observe with method zoom in and out object , rotate 360 degree objects and connect draft from various corner view. This is show that the KARISPENMA-AR media does not only functioning as visual aids , but also as means of encouraging involvement active and construction knowledge in a way independent.

4. Stage Implementation

At the stage implementation, KARISPENMA-AR media was validated by media experts and experts material from UIN Sayyid Ali Rahmatullah Tulungagung For evaluate suitability, appearance , and suitability material . Validation results media experts obtain percentage of 93.3% with category very valid, whereas expert material get 100% with category very valid. The height

results validation This No only show that the media is worthy used , but also indicates that media design has in accordance with principle development learning , good from visual aspects, interactivity , and accuracy content. This is in accordance theory Plomp that validation expert is part evaluation formative For perfect product before used more wide (Plomp & Nieveen , 2021).

Suggestions for improvement from the validator, such as adjustment font size and addition of main barcode, shows that aspect readability and ease access is factor important in media effectiveness . This in line with theory Plomp stating that validation expert is part from evaluation formative For perfect product to be more optimal before used in a way area . After revision , the media was tested try to participant Educate. Questionnaire results response show percentage of 85% with category good. Response positive This can interpreted that the KARISPENMA-AR media is capable increase interest and involvement participant educate in learning. Interactive and visual media are proven more capable interesting attention compared to conventional media , so that support creation more learning active.

Next, the test results field show improvement The average score increased from 53% in the pretest to 81% in the posttest. The increase This No only show existence repair results learning , but also indicates development ability think level tall participant educate. Before media use, participants educate tend be at the cognitive level low , namely understand draft basic . After using the media, participants educate start capable analyze the digestive process, evaluate organ function, as well as give more answers logical and structured .

In a way theoretical , improvement the can explained through Brookhart's stated opinion that think level tall covers ability analyze , evaluate , and solve problem (Rochman & Hartoyo , 2018). The use of AR media allows participant educate get experience learn more concrete and interactive , so simplify the analysis and evaluation process . In addition that , the findings this is also in line with study Fitri Sylvia et al . who showed that effective use of Augmented Reality in improve participants' Higher Order Thinking Skills educated (Sylvia, Ramdhan , and Windyariani , et al. 2021).



Figure 1. Participants educate using KARISPENMA-AR media

5. Stage Evaluation

Evaluation in study This covering evaluation formative and summative purposes For ensure quality at a time effectiveness of KARISPENMA-AR media. Evaluation formative done through validation expert For perfect product before used . Validation results media experts at 93.3% and experts material by 100% shows that the media has fulfil criteria eligibility Good from aspect appearance and content. Suggestions for improvement like adjustment font size and addition of material barcode indicates that aspect readability and ease access become factor important in support optimal use of media . This show that improvement product No only nature technical , but also influential to comfort and effectiveness Study participant educate.

After going through revision , media tested try and get response positive from participant educate. This is can interpreted that the KARISPENMA-AR media is capable increase interest and involvement participant educate in learning , which is prerequisite important in a meaningful learning process.

Next , evaluate summative through field tests show improvement results Study from 53% in the pretest to 81% in the posttest. The increase This No only reflect success in aspect cognitive, but also indicative development ability think level tall participant educate. In a way conceptual , thing This happen because AR media is capable serve draft abstract in a way more concrete and interactive, so make it easier participant educate in do analysis , evaluation , and problem solving problem. With Thus , the results evaluation This show that KARISPENMA-AR does not only worthy used , but also effective as a supporting learning medium development ability think level tall .

B. Improvement Ability Participants' Higher-Order Thinking Educate In Use of Card Media System Digestion man Based on Augmented Reality (KARISPENMA-AR)

On trial group big or field test , participants educate become four group small , every group consists of on four participant educate . Division group small This aim For increase environment learn , improve involvement students , and make it easier management activity learning.

Table 3. Pretest and Posttest Results

	Member's name Group	Pretest	Posttest
	Group 1		
	Wiji	60	96
	Harun	30	94
	Bagus	54	68
	Andi	54	74
	Group 2		
	Danis	26	54
	Wildan	28	54
	Bilqis	84	96
	Rafa	36	82
	Group 3		
	Kamila	70	96
	Daffa	32	74
	Nuril	30	72
	Isma	80	98
	Group 4		
	Khaira	36	68
	Anggun	84	98
	Fais	70	82
	Daffa Ade	80	96
	Amount	854	1302
	Average	53.3	81.3
	Presentation	53%	81%

Improvement ability think level tall indicated by the increase The average score increased from 53% in the pretest to 81% in the posttest. The increase This No just show repair results learn , but indicates existence changes at the cognitive level participant educate. Before media use , participants educate Still be at the

stage understanding basic , marked with limited ability to recognize draft without capable connecting , explaining processes, and give reason logical.

After using KARISPENMA-AR, participants educate start show ability think level high , such as analyze the digestive process , evaluate organ function , identifying disturbances , as well as give solution to problems . Changes This show that Augmented Reality based media is not only help visualization concepts , but also encourages a more in-depth thinking process . complex through interaction direct with object learning. In a way theoretical, findings This in line with Anderson and Krathwohl's revised Bloom's Taxonomy emphasizes that HOTS capabilities include analyze (C4), evaluate (C5), and create (C6). Besides that , the increase can also be explained through Vygotsky's theory of the Zone of Proximal Development (ZPD), which states that participant educate can reach level greater understanding tall with appropriate media assistance or scaffolding (Anjani & Setiana , 2025).

In matter In this , KARISPENMA-AR plays a role as tools that facilitate participant educate For beyond ability initially . However Thus , the results study This nature contextual Because only conducted on participants educate VB class at MI Roudlotul Ulum . Therefore that , the findings This Not yet can generalized in a way wide , but can become reference beginning in development of learning media based technology For increase ability think level high in school base.

CONCLUSION

Based on results research , KARISPENMA-AR media developed through the ADDIE model successfully become a suitable , interesting and appropriate learning media need participant educate school basic . This media capable help understand material system digestion human nature abstract through more Augmented Reality visualizations concrete and interactive . The use of KARISPENMA-AR media is also capable of increase ability think level tall participant learners . Participants educate No only understand material , but also capable analyze , evaluate , and solve problem related system digestion human . With Thus , the KARISPENMA-AR media has the potential developed on other materials as innovation digital learning in schools elementary school expected support use of learning media based technology For increase quality learning . Teachers are advised utilizing KARISPENMA-AR media so that learning more interactive and interesting . Researchers furthermore expected can develop similar media on other materials with range more subjects wide.

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