Marker-Based Module using the SETS Approach (Science, Environment, Technology and Society) Learning Media Subject Educational Technology Study Program

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Abstract. Study This aim for: developing and testing the feasibility of digital marker-based media modules using the SETS approach (Science, Environment, Technology and Society) in the learning media course. This type of research uses the Research and Development (R&D) method from the Hannafin and Peck Model. The product is then validated based on stages: 1) Experts Reviews, 2) One-to-one Evaluation, 3) Small Group Evaluation and 4) Field Trial. The research subjects were students in Semester I of the Educational Technology Study Program at Ibn Khaldun University, Bogor, with learning media material odd semester TA. 2023/2024. Technique collection data form interview, questionnaire, sheet observation, And documentation. Results test eligibility model meet the requirements of feasibility and practicality. Based on the results of the Expert Review feasibility test, the mean results for instructional design experts were 3.8, material experts 3.28, media and IT experts 3.7 and language experts 3.5. The average class evaluation score from One to One was 3.37, Small Group 3.59, and Field Trial 4.89 in the good category. Based on these results, it can be concluded that digital- based marker-based media modules in learning media courses have been proven to improve student learning outcomes in the first semester of Educational Technology at Ibn Khaldun University, Bogor.

Keywords: Marker-based Encyclopedia, Digital, SETS, Learning Media Module.

1 Introduction

Currently the world is entering a new civilization called the Industrial Era 4.0, where technological developments are increasing more rapidly, resulting in global integration and unification in the exchange of information from all parts of the world which includes products, thoughts, views and other cultural aspects. In line with technological developments in the Industrial Era 4.0, educational institutions are starting to aggressively innovate Teaching and Learning Activities (KBM). Teaching and Learning activities in each educational unit are expected to be based on technology (Gatot S. Dewa, 2017). Society is required to carry out activities as effectively as

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possible, so that technology has its own role as a supporter of activities, especially in field of education. In line with the development of the Industrial Era 4.0 and the Independent Learning-Independent Campus Curriculum (MBKM) which is entering schools and universities, it requires educators and education staff to be able to carry out learning by utilizing a variety of varied learning methods and media.

The results of observations made by researchers at the Bachelor of Educational Technology Study Program at Ibn Khaldun University, Bogor, show that the curriculum currently being used is the Independent Learning-Independent Campus Program (MBKM). In accordance with the concepts summarized in the Curriculum Merdeka Belajar, namely intracurricular learning, must be maximized, where teachers are allowed to choose various teaching methods and tools according to their learning needs. So that the learning content is more optimal so that students have time to explore concepts, strengthen competencies, and develop soft skills and character, in accordance with the Pancasila Student Profile and 21st century learning. Another finding in the Learning Media course, lecturers still use conventional methods and limited media, causing the learning process in class to become less active and boring. Of course, the inactivity of the teaching and learning process in the classroom causes students' learning values to decrease so that it is necessary to increase the learning values. This is what researchers note about being able to provide varied and innovative learning by developing digital technology media based on Augmented Reality.

Augmented Reality (AR) is a metaverse technology that has penetrated the realm of education in accordance with 21st century learning. In its development, Augmented Reality has been widely used as a learning medium to convey information and provide interaction in the learning process [1]. Augmented Reality (AR) is a Metaverse technology that combines objects from the real world and virtual or virtual objects in real-time conditions that occur with appropriate technological support to produce 2D and 3D image displays (Atmajaya, 2017:228). Meanwhile, interactions can occur using certain devices including smartphones and tabs, marker-based modules and software applications. In the study of Educational Technology in the Learning Media course, Augmented Reality is used to explain material in 3D graphics in demonstrating types of media, their characters and functions in learning activities.

The use of appropriate media will be very effective if accompanied by an appropriate learning approach, especially in improving students' digital skills. The SETS (Science, Environment, Technology and Society) approach is closely related to digital learning and its application in the global environment. The NSTA Position Statement [2], SETS

is a focus on problems from the real world which has science and technology components from the learner's perspective in which there are concepts in real situations or in the context of human experience. The choice of the SETS approach is deemed appropriate to the Learning Media course material and of course can be integrated well using Marker-Based module teaching materials based on Augmented Reality. So this is the basis for researchers to develop teaching materials in the form of Marker-Based modules based on Augmented Reality to improve digital skills in Educational Technology students at Ibn Khaldun University, Bogor.

With the development of AR-based Marker-Based module teaching materials, students will be able to utilize Science and Technology (IPTEK) and the skills they have in the field. Apart from that, the digital skills obtained can shape students' character in terms of perspective, thinking, behaving and acting to be applied in real life as individuals, communities, members of organizations and citizens who are religious, nationalist, productive and innovativ

2 Method

This research uses the Research and Development method (R & D) or Research and Development, and applying the SETS (Science, Environment, Technology and Society) approach at the implementation stage. The instruments used in collecting and processing data used interview sheets, observations, questionnaires and documentation. The type of data obtained and managed is in the form of a mix method, namely qualitative and quantitative data. The research was carried out on 22 students in the first semester of the Educational Technology Study Program at Ibn Khaldun University, Bogor FY 2023/2024. The development model used by researchers refers to the Hannafin and Peck Model. According to Hanafin and Peck (1988:60), this Development Model is specifically for developing digital and multimedia-based media with stages consisting of three phases, namely 1) Needs Analysis, 2) Design, and 3) Development and Implementation with evaluation and revision at each stage. The model stages are explained in the following image:

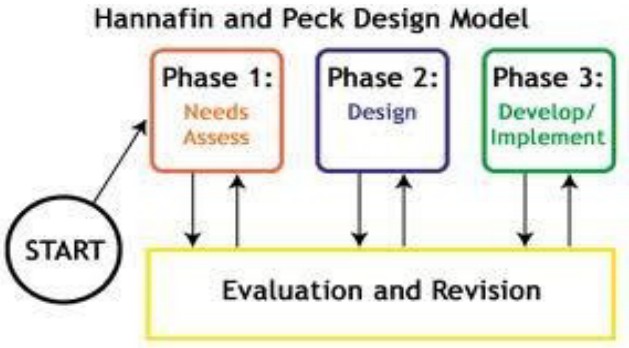

Fig. 1. Stages of The Hannafin and Peck Model

3 Result & Discussion

In the development stage, researchers applied the Hannafin and Peck model, while in the implementation stage they used the SETS approach (Science, Environment, Technology and Society). The stages of development of the Hannafin and Peck model are explained as follows:

3.1 Need Assesment

In the initial stage, the researcher carried out a needs analysis and curriculum analysis by conducting a preliminary study of the 1st semester class of the Educational Technology Study Program, namely to determine the environmental situation, curriculum, student character and the availability of media and teaching materials used to support the learning process. The instruments used were interview sheets for lecturers who taught learning media courses as well as representative 1st semester students and checklist questionnaires.

3.2 Design

In the second stage, researchers designed a digital-based Marker-Based module design and Learning Design using image, UX and UI designs in the SPADA AR application, flowcharts and Storyboard Modules. The module design is adapted to the curriculum contained in CPMK in the OBE-based RPS. The Marker-Based Module

3.3 Development & Implementation

In the development stage, researchers develop products based on the designs that have been created. This development was assisted by a teaching team from the IT scientific field to create software programs, barcodes and markers based on image objects. This Marker-Based module has a barcode scanning system which will later be scanned by an AR application called Quiver 3D Coloring App. When the module has been scanned for a barcode, an interactive 3D visual display will appear complete with audio and moving animations.

3.4 Evaluation & Revision

At each stage of the Hannafin and Peck model, evaluation and revision are carried out, especially when media is developed, it is first evaluated by an expert review by Media/IT experts, Learning Design Experts, Material Experts and Language Experts. The revised media is then implemented in the classroom in stages: 1) One to One Evaluation; 2) Small Group Evaluation; and 3) Field Trial. All data analysis processes carried out are to measure the level of validity, practicality and effectiveness of the product being developed. The stages of model development can be seen in the following picture:

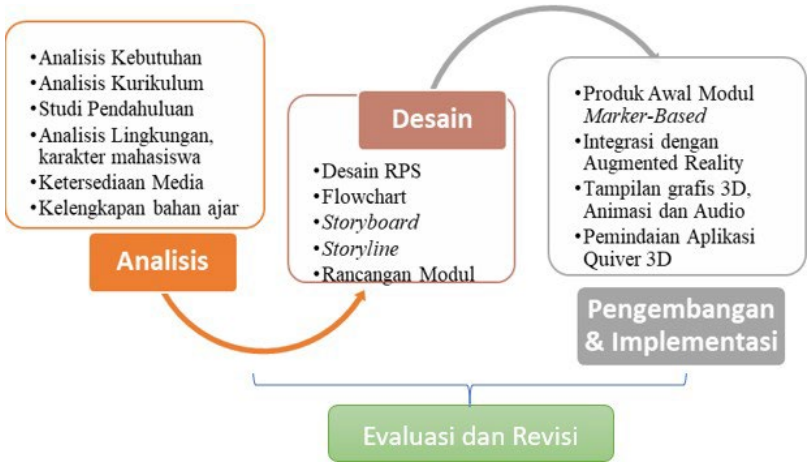

Fig. 2. Development Activity Stage

This is different from the syntax for implementing learning which is carried out using the SETS (Science, Environment, Technology and Society) approach, where the activity stages are: 1) Invitation, 2) Exploration, 3) Solution, 4) Application, 5) Concept Consolidation. The explanation can be seen in the following picture:

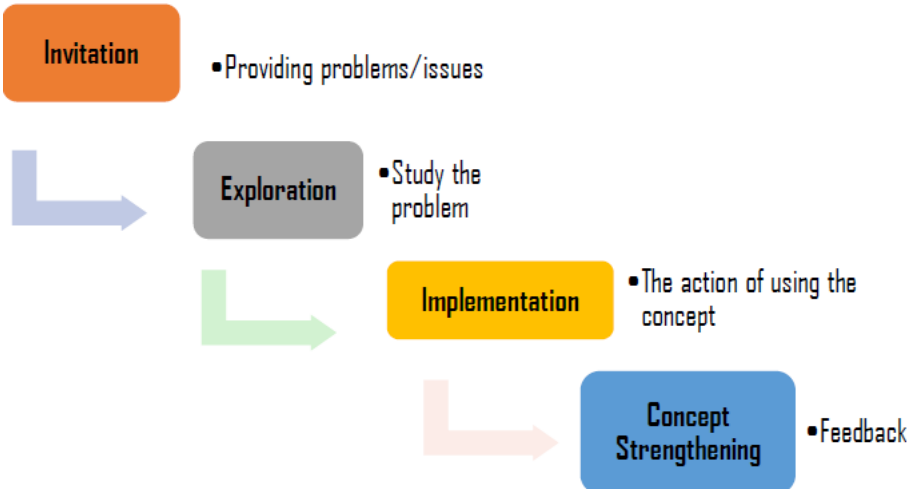

Fig. 3. Learning Syntax in SETS Approoach

SETS (Science, Environment, Technology and Society) is closely related to digital learning and its application in the global environment. NSTA Position Statement (Morrell, 2020), SETS is a center for problems from the real world that has a science and technology component from the student's perspective in which there are concepts in real situations or in the context of human experience. The choice of the SETS approach is considered to be in accordance with the Learning Media course material and of course

can be integrated well using digital marker-based module teaching materials. The SETS approach applied follows the following stages:

1) Invitation Stage
   At this stage the lecturer provides actual issues/problems that are developing in the surrounding community so that students can understand them and can stimulate students to overcome them. Lecturers can also explore opinions from students related to learning media material.
2) Exploration Stage
   Students through their own actions and reactions try to understand or learn about the problems given.
3) Solution Stage
   Students analyze and discuss how to solve the problem using the Inquiry learning method.
4) Application Stage
   Students are given the opportunity to use the concepts they have acquired. In this case, students take real action to overcome problems that arise at the invitation stage.
5) Stabilization Stage
   Concepts Lecturers provide feedback/reinforcement of the concepts obtained by students. In this way, the SETS approach can help students understand the Science and Technology (IPTEK) they use and can influence the environment and society

The results of the research that has been carried out are that researchers have completed developing printed teaching materials for modules in learning media courses that are integrated with Augmented Reality. This module is programmed on a marker- based tracking system with the Android-based SPADA AR application. The following displays the application/software that has been developed:

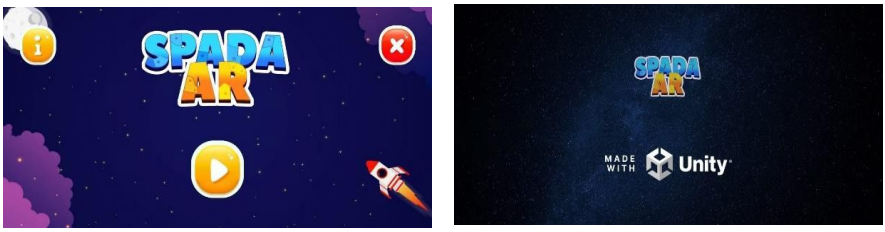

Fig. 4. SPADA AR Aplication Opening Screen

Fig. 5. Learning Media Material Menu on SPADA AR

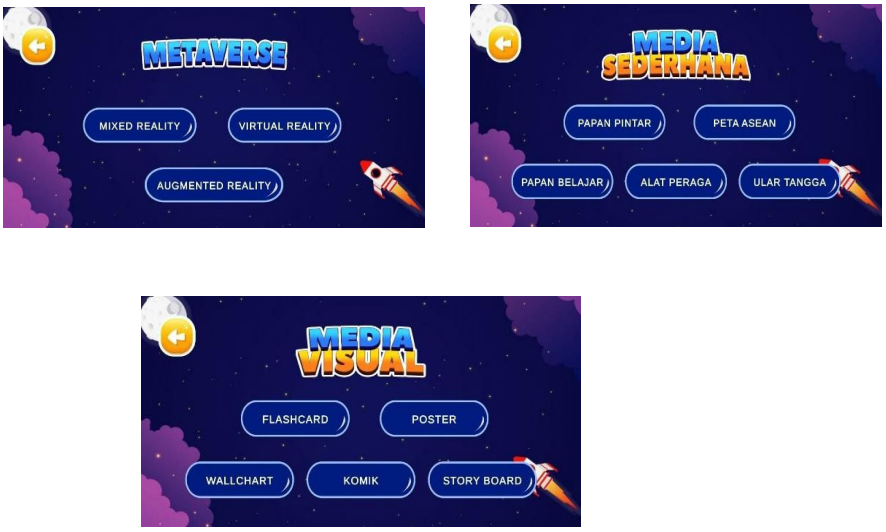

Fig. 6. Types of material in the SPADA AR application

The SPADA AR application is software developed by the IT team and has been validated by experts in the IT Media field. The aspects that are considered in testing feasibility are based on the assessment of the user interface design and the quality of the AR (Augmented Reality Usability) system. The SPADA AR application is then integrated with the Learning Media course module which has been given a barcode to match marker-based tracking in each material chapter. Here's what it looks:

Fig. 7. Display Marker-Based Module

The marker-based module that was developed was first validated by experts in the field, learning design experts, material experts, media experts and language experts. Then revised according to suggestions and improvement notes from experts. The media developed was considered feasible as measured using a Likert scale questionnaire. The media validation test results are explained in table 1 as follows:

Table 1. Expert Validation Recapitulation Results

No.	Expert	Average Score	Percentage %
1	Instructional design expert	3.53	88.3%
2	Materials Expert	3.35	83.7%
3	Media/IT Expert	3.56	89%
4	Language Expert	3.48	87%
Overall Average Score		**3.48**	
Category		**Worth using**	

The recapitulation results from experts or validators show a value of 3.48. By using a calculation method that refers to the conversion of quantitative values into qualitative data, the assessment results of each assessor group are in the good category and suitable for use in the learning process. The assessment graph of 4 experts is depicted in the figure as follows:

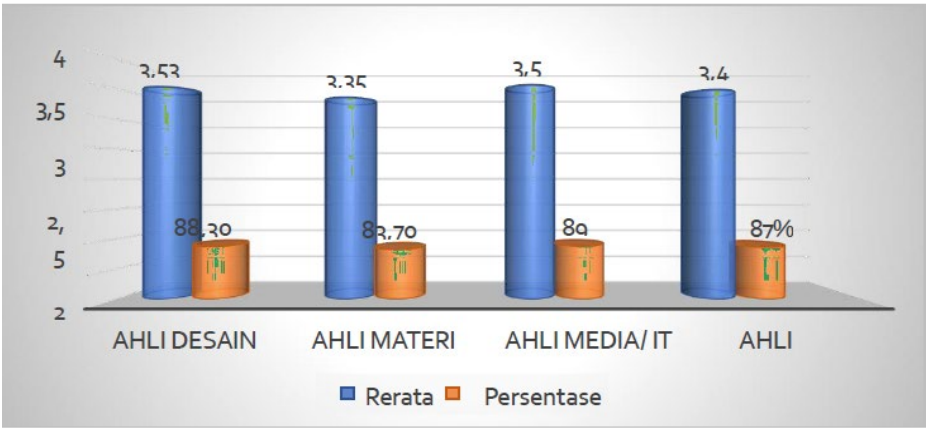

Fig. 8. Diagram of Expert Validation Results

The results of the diagram above show an average value with a limit range of 4, and the expert assessment score is between 3.3 and 3.5. Here also with a percentage of 87% to 89%. So it can be concluded that the level of suitability of the media being developed is in the good and feasible category.

3.5 One to One Evaluation

Media Marker-based module which has been developed and validated for its feasibility, can be implemented in the classroom with an initial one-to-one stage Evaluation. This evaluation is carried out in the odd semester of FY. 2023/ 2024 in semester 1 of the UIKA Bogor Educational Technology Study Program. This evaluation began by selecting three students who took the Learning Media course. The three students were taken from students high ability, medium ability and low ability. Then students are given learning media material using a marker-based module with the SETS approach (Science, Environment, Technology and Society). The implementation stage of SETS is by initiation/invitation; concept formation; application of concepts; concept stabilization; and evaluation.

In the SETS approach, students are invited to get to know technology, and analyze the positive and negative impacts of this technology. In the end, students are expected to be able to apply the technological concepts and knowledge they have acquired in their daily lives. After students were given learning materials on the first day, at the second meeting students were interviewed one by one to get their comments and input and were asked to provide assessments through a respondent questionnaire. The evaluation is intended to obtain input from students, either through interviews or questionnaires, regarding the type of learning media material using digital-based Marker-based module media. The assessment results obtained through the questionnaire are in table 2 as follows:

Table 2. Results One-to One Evaluation

Questionnaire item number	Respondent		
	1st (MH)	2nd (NS)	the 3rd (RMF)
1.	4	4	4
2.	4	4	4
3.	4	4	4
4.	4	4	4
5.	4	4	4
6.	4	4	4
7.	4	4	4
8.	3	3	3
9.	4	4	4
10	4	4	4
11	4	4	4
12	1	1	1
13	1	1	1
14	4	4	4
15	1	1	1
16	4	4	4
TOTAL	54	54	54
Overall Total Score		162	
Grand Total Average		$\frac{162}{16X3}$ = 3,37	
Overall Percentage		$\frac{162}{48X4}$=100%=84,3%	
Category		**Very Worthy**	

One to One Evaluation assessment results of 84.3% were in the very feasible category. So it can be concluded that the digital marker-based media module with the SETS approach is very well applied in the learning process. The results of the One-to One Evaluation of students based on the questionnaire showed an average score of 3.37 in the Good category, indicating that students considered the media developed to be very good. Based on interviews, the three students stated that learning media as a whole could be used in the learning process of learning media courses.

3.6 Small Group Evaluation

Small Group Evaluation carried out in the second week after the One-to-One evaluation, namely in September 2023. The evaluation process began by selecting 8 students from all semester 1 classes of the Educational Technology Study Program in the learning media course. The selection process was carried out by taking three students with high abilities, three students with medium abilities, and two students with low abilities.

At the first meeting, 8 students as samples applied learning using the SETS approach using digital marker -based modules. Students form groups of 4-5 people. each, then use their respective smartphones or Androids to track the barcodes on the module. At the second meeting, students were given a respondent questionnaire to provide assessments and fill out the questionnaire individually, in order to provide input and comments on the learning media being developed. The assessment results obtained through the questionnaire are in table 3 as follows:

Table 3. Small Group Evaluation Results

Question Number	Respondent							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Positive Statements								
1.	4	4	4	3	4	3	4	3
2.	3	4	4	4	4	4	3	4
3.	4	4	4	3	4	4	4	3
4.	3	4	4	3	4	3	4	3
5.	4	4	3	3	3	4	3	4
6.	3	4	4	4	4	4	3	4
7.	4	4	4	4	4	4	4	4
8.	4	4	4	3	4	4	4	4
9.	4	4	4	3	4	4	4	3
10.	4	4	4	3	4	3	3	4
11.	4	4	4	4	4	4	4	4
12.	3	4	4	3	4	3	4	4
13.	4	4	4	4	4	4	3	4
14.	4	4	4	4	4	4	3	4
Negative Statements								
1.	3	4	2	2	4	4	4	3
2.	3	4	4	4	4	4	4	4
3.	4	4	3	3	3	4	3	3
4.	4	4	3	3	3	2	4	2
5.	3	4	4	3	3	4	4	3
6.	4	4	4	4	4	4	4	3
7.	3	4	4	3	3	3	3	3
8.	3	4	2	3	3	4	2	3
9.	2	4	2	4	3	2	2	3
10.	2	4	4	4	4	4	4	3
11.	4	4	4	4	4	3	3	3
Total	87	100	91	85	93	90	87	85

No.	Questionnaire Questions	Score	Means	Percentage	Category
1	Positive Statements Questionnaire	420	= **3.75**	× 100% = **93.7%**	
2	Negative Statements Questionnaire	298	= **3.38**	× 100% = **84.6%**	
	Overall Total Score			**718**	
	Grand Total Average			$\frac{718}{25\times8}$ = **3.59**	
	Overall Percentage			$\frac{718}{200\times4}$ × 100% = **89.7%**	**Very Valid**

Small Group Evaluation results table an average score of 3.59 was obtained and a total score of 718 with a percentage of 89.7%. With the Small Group Evaluationassessment the category is very valid. So it can be concluded that digital marker-basedmedia modules with the SETS approach can be used in the learning process.

Table 4. Recapitulation of Average Class Assessment Results

NO	Assessment Group	Average Score	Criteria
1.	One-to-One Evaluation	3.37	Very Valid
2	Small Group Evaluation	3.59	Very Valid
3	Field Trials	4.89	Very Effective
	Average Score	**3.95**	**Very Valid**

Small Group Evaluation Results showed an average score of 3.95. By using acalculation method that refers to the conversion of quantitative values into qualitative data, the assessment results of each group of assessors are in the very good category and very suitable for use in the learning process.

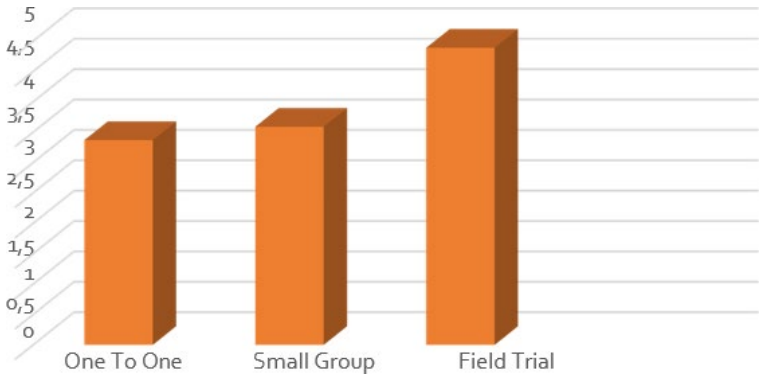

Fig. 9. Class Average Evaluation

4 Conclusion

The digital marker-based module was developed using Research and Development (R&D) research methods. In the R & D method, the research steps use the Hannafin and Peck model with the following stages: 1) Need Assessment, 2) Design, 3) Development and Implementation, 4) Evaluation and Revision.

In this development research, the results of the expert assessment show that the learning media developed received an assessment from 4 experts (Expert Review), namely learning design experts, material experts, media/IT experts and language experts of 3.57 in the good category, so it is suitable for implementation. Student assessment results during One-to-One Evaluation, Small Group Evaluation and Field Trial obtained an average score of 3.95 with very good criteria. So that in students' assessment of the learning model developed it is suitable to be applied.

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Acknowledgments. A third level heading in 9-point font size at the end of the paper is used for general acknowledgments, for example: This study was funded by X (grant number Y).

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