

# Development of 21st Century Learning Tools Through a Scientific Approach Based on HOTS and TPACK in Elementary Schools

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## Abstract

The study aims to generate a 21st century learning device design (Lesson Plan, Teaching Material, and Learning Evaluation) through a scientific approach based on HOTS (Higher Order Thinking Skill) and PCK (pedagogical content knowledge) in elementary schools. At the same time, this present study applies a Research and Development method based on the development research model of Saputro, which adopts modifications from Borg and Gall and Sugiono, namely preliminary studies, model development/design, and testing. Meanwhile, this study is only up to the model design phase.

The finding of the device design based on the validation of experts and users depict that the learning set has highly feasible criteria, with the obtained score for a lesson plan is 96%, teaching material is 95%, and evaluation is 95%. Therefore, the learning set is included in the most feasible criteria. Accordingly, it can be used in learning and enhance the quality of learning since it can improve students' learning outcomes and motivation as well as provide a more exciting and valuable learning experience.

## 1. INTRODUCTION

Law no. 20 of 2003 concerning the National Education System defines the curriculum as a set of plans and arrangements regarding objectives, content and learning materials that are used as guidelines for implementing learning activities to achieve certain educational goals. Mudlofir (in Shobirin, 2016: 14), said that the curriculum in terms of language comes from the Greek word curir which means a place to race in a race that is passed by competitors. The consequence is that each participant is obliged to comply with the rules of the game in the competition.

Talking about the curriculum, in Indonesia itself it has undergone several changes. It is recorded that the educational curriculum has been changed 10 times. First, there is the 1947 curriculum (1947 Lesson Plan), in this curriculum learning focuses on character education and awareness in the nation and state with the lesson material taken focusing on events in everyday life. Not only that, in this curriculum physical education and the arts are given great attention. Second, the 1952 curriculum (1952 Decomposed Lesson Plan), this curriculum is a refinement of the previous curriculum.

The change that occurred was very big, namely that one subject was taught by one teacher with the material still referring to everyday life. Third, the 1964 curriculum (1964 Education Plan), this curriculum focuses on the Pancawardhana program.

Pancawardhana itself is a program that includes skills (parigelan), emotional, physical, intelligence and moral development. Fourth, the 1968 curriculum, this curriculum has differences with the previous curriculum. In the 1968 curriculum the material was theoretical so it was not very relevant to events that occurred in everyday life. The aim of this curriculum is to form true Pancasila people.

Fifth, the 1975 curriculum, this curriculum was influenced by MBO (Management by Objective), which is a concept in the field of management. This curriculum was previously known as "Study Units" which means lesson plans for each unit of study. Then each lesson contains General Instructional Objectives (TIU), Specific Instructional Objectives (ICT), lesson materials, learning tools, teaching and learning activities and learning evaluation. Sixth, namely the 1984 curriculum which is called the enhanced 1975 curriculum. This curriculum uses the method initiated by Prof. Dr. Conny R. Semiawan, namely, the CBSA learning method which stands for Active Student Learning Method, so that students can carry out various activities such as discussing, grouping and reporting their learning results. Seventh, namely the 1994 curriculum and the 1999 curriculum supplement. In this curriculum a very significant change occurred from the semester system to a quarterly system which is expected to ensure that students receive more lessons, from local to national. However, this curriculum was deemed unsuccessful because it was too burdensome for students.

Eighth, the Competency Based Curriculum (KBK) or the 2004 curriculum is a curriculum that must have 3 main mandatory elements, namely the specification of evaluation indicators to determine the success of competency achievement, selection of appropriate competencies and learning development. Ninth, namely the Learning Unit Level Curriculum (KTSP) or the 2006 curriculum, which is a curriculum that aims to maintain the characteristics of national education in each region. KTSP is prepared by the National Education Standards Agency (BNSP) and approved by the Minister of National Education. In KTSP, the central government only determines competency standards and basic competencies, then teachers in each school are required to be able to develop syllabi and assessments in accordance with school conditions in their area. Ninth, namely the 2013 Curriculum which is still being implemented. There are 4 aspects of assessment in this curriculum, namely attitudes, behavior, skills and knowledge. This curriculum refinement has been linked to intelligent predictions about the present and the trends that may occur in 21st century life. Future trends require various skills, including life and career skills, learning and innovation skills, and technology and information media skills. These future trends are taken into consideration in determining curriculum design, especially curriculum components in the aspects of objectives, content/materials, and learning processes.

Lastly is the Independent Curriculum. As explained on the official website of the Ministry of Education and Culture, Research and Technology, the Independent

Curriculum or often called the Independent Learning Curriculum is a curriculum with diverse intracurricular learning, where the content presented to students will be more optimal with the aim that students can have enough time to deepen concepts and strengthen competence. In the Independent Curriculum, teachers have the freedom to choose various teaching tools, so that learning can be tailored to the learning needs and interests of students.

One of the essences that is taken into consideration in the 21st century curriculum is the achievement of higher order thinking skills (Higher Order Thinking Skills) and the application of technology in learning (Technological Pedagogical Content Knowledge), to solve problems by thinking critically, innovatively, creatively, for the sake of human life together. with peace and harmony (to live together in peace and harmony). By implementing HOTS and TPACK in learning, positive things can be increased such as courage to face difficult questions, the formation of good cooperation between students, interaction between students and students and higher teachers, better learning activities, and good student character in terms of discipline, perseverance, responsibility, thoroughness and open attitude. This directly or indirectly shows that the application of HOTS and TPACK learning is able to improve the quality of learning while improving student learning outcomes in both cognitive, psychomotor and affective aspects.

The 21st Century curriculum is the 2013 curriculum and the independent curriculum under development Learning tools are required to be oriented towards Higher Order Thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPACK). The development of learning oriented towards Higher Order Thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPACK) is a government program developed as a ministry and cultural effort through the Directorate General of Teachers and Education Personnel (Ditjen GTK) in an effort to improve the quality of learning and improve the quality of graduates.

Curriculum changes in Indonesia are carried out so that the Indonesian education curriculum is not left behind by developments in society, including science and technology, but with the changes to the curriculum, many teachers are still confused about implementing learning in this curriculum. Researchers took samples during the Introduction to Schooling Field (PLP) and Pioneer Teaching Campus (KMP) activities in several schools, namely SDN 28 Kota Selatan and SDN 2 Bukal. The results of an unstructured interview with one of the teachers at SDN 28 Kota Selatan during the PLP 1 activity, admitted that the learning devices used during teaching were produced by purchasing, (W/GR/16/3/2020). and according to the results of observations at SDN 2 Bukal, the procurement of learning devices was provided or facilitated by the school operator, (O/23/11/2020). On the other hand, the learning tools used are not yet oriented towards 21st century learning, namely tools oriented towards Higher Order Thinking Skills (HOTS) and Technological Pedagogical Content Knowledge (TPACK), (O/PP/30/11/2020).

The development of learning tools cannot be separated from the use of models. In this research, researchers hope that students can think critically, be active, collaborate, concentrate and can also create a learning atmosphere that is interesting and not boring for students.

Based on this, researchers are encouraged to make efforts to develop 21st century learning tools through a scientific approach based on HOTS and TPACK. The researcher limited this research to Theme 3 Healthy Food, Subtheme 1 How does the Body Process Food?, Learning 2. Development of learning tools in elementary schools is a series of activities or processes created to produce a learning tool based on pre-existing development theories.

Developing learning tools that are oriented towards 21st century skills, namely higher order thinking skills (HOTS) and Technological Pedagogical Content Knowledge (TPACK) with the Cooperative Learning model, can improve the quality of learning and improve the quality of graduates. Apart from that, developing this learning tool will make it easier for teachers to teach the material clearly to students and attract students' interest in learning the lesson material presented.

## 2. METHODS

The type of research used in this research is research and development (R&D). The Research and Development method is a research and development method commonly used by students. The Research and Development method is a research method that produces products (can be in the form of models or modules and so on), and there is an effectiveness of the product (Saputro, 2017: 7). According to Sugiyono (in Saputro, 2017: 8) the Research and Development method is a research method used to produce a particular product and test the effectiveness of the product. However, this research focuses on producing products.

Based on the expert's understanding above, it can be concluded that the Research and Development (R&D) method is a research method that produces a certain product and is effective. As stated by Creswell (in Fahrurrozi and Mohzana, 2020: 9), the aim of this research is to increase knowledge in the field of education, improve learning practices and inform public policy issues. So, researchers developed research entitled "Development of 21st Century Learning Tools Using a Scientific Approach Based on HOTS and TPACK in Elementary Schools". The researcher limited the research only to class V. The reason the researcher took class V was because the material content in class V was very interesting and the age of children in class 4, as Piaget said (in Mu'min, 2013: 94), is the age at which students have the ability to think better. good and able to solve concrete problems in a logical mode.

The research development procedure produces a final product design in the form of a learning tool. This research was designed using a model adopting modifications from Borg and Gall and Sugiyono. Saputro modified it into 3 stages, namely: Preliminary study, Model development/design, and testing. (Saputro, 2017: 9). However, in this

research, researchers only limited it to 2 stages, namely preliminary study and model development/design.

### 3. RESULTS AND DISCUSSION

#### Results

##### Lesson plan

The results of the design of this tool are in the form of a Learning Implementation Plan (RPP) prepared based on the results of curriculum analysis and the school environment. Researchers limit the development of tools, namely lesson plans for class V, theme 3: healthy food, sub-theme 2: how does the body process food?, learning 2. In preparing the Learning Implementation Plan (RPP) it refers to the 2013 curriculum based on a scientific approach.

One of the learning methods used is 4C (Critical thinking, Creativity, Communication, Collaboration). In preparing the Learning Implementation Plan (RPP) tool, it is also oriented towards HOTS (Higher Order Thinking Skills) and TPACK (Technological Pedagogical Content Knowledge), with a Cooperative Learning model.

In the design of this Learning Implementation Plan (RPP) tool, researchers hope that this tool can be a reference for teachers in designing learning tools so that students can learn at a level of thinking in stages C4, C5 to C6, and can maximize mastery of technology in order to provide provisions for improving their abilities. to students. The results of the complete Learning Implementation Plan (RPP) design are attached

In accordance with the development stages, the devices that have been prepared will be validated by experts and users to determine the suitability of the learning devices created. This RPP tool has been validated by 1 RPP expert and 3 grade 5 teachers from various elementary schools in the city of Gorontalo. The results of the device validation in the form of a complete Learning Implementation Plan (RPP) are attached

The following is the accumulated calculation of the results of the validation of the Learning Implementation Plan (RPP) by several validators in their respective fields, as follows.

Table 1 Accumulated RPP Validation Results

N	Aspects assessed	Exp ert	Use r 1	Use r 2	Use r 3	Sco re mak es
1	The systematics of preparing the RPP is clear	4	4	4	3	4
2	Systematic preparation of RPP according to general rules	4	4	4	3	4
3	The appearance of the lesson plan is neat and attractive	4	4	4	4	4
4	Contains lesson plan identity	4	4	4	4	4
5	Contains core competencies	4	4	4	3	4
6	Contains basic competencies	4	4	4	3	4

No	Aspects assessed	Expert	Use r 1	Use r 2	Use r 3	Scores
7	Contains learning indicators	4	4	4	3	4
8	Contains learning objectives	4	4	4	3	4
9	Coverage of material in accordance with time allocation	4	4	4	2	4
10	Teacher activities in each learning stage are clearly stated	4	4	4	3	4
11	Teacher activities in each learning stage are clearly stated	4	4	4	3	4
12	Student activities in each learning stage are clearly stated	4	3	4	3	4
13	Stages of the game are carried out according to the allocated time	4	4	4	3	4
14	Contain clear evaluations periodically	4	4	4	3	4
15	Contains collaborative activities (group work)	4	4	4	3	4
16	Contains learning motivation	4	4	4	4	4
17	Include reflection at the end of learning	4	4	4	4	4
18	Student activities are more active than teachers	4	3	4	4	4
19	Contains praise and appreciation for students	4	4	4	4	4
20	Contains learning steps that use a scientific approach (5M)	4	4	4	4	4
21	Contains activities that can develop student character	4	4	4	4	4
22	Contains activities that can develop student character	4	4	4	4	4
23	The language used is in accordance with Indonesian language rules	4	4	4	4	4
24	The language used is easy to understand	4	4	4	4	4
Total scores		96	94	96	82	96

$$P = (\text{total scores obtained}) / (\text{total scores}) \times 100\%$$

Percentage of feasibility by experts:

$$= 96/96 \times 100\%$$

$$= 100 \%$$

Percentage of eligibility by user 1:

$$= 94/96 \times 100\%$$

$$= 98\%$$

Percentage of eligibility by user 2:

$$= 96/96 \times 100\%$$

$$= 100 \%$$

Percentage of eligibility by user 3:

$$= 82/96 \times 100\%$$

$$= 85 \%$$

So if you average the validation results from several validators above, it is 96% or a very feasible interpretation. With the following calculations.

$$\text{Average} = (100\%+98\%+100\%+85\%)/4 = 96\%$$

The suggestions given by the validators will be used to improve or revise the Learning Implementation Plan (RPP) tools in this research. Complete results of improvements or revisions are attached. The following are the suggestions/comments given by the validator to improve the tool being developed, namely, it would be better to simplify the learning objectives and reduce the use of repetitive words in core activities.

Teaching materials

The second device design is technology-based teaching materials or what are called interactive teaching materials. This interactive teaching material contains thematic material for class V, theme 3: healthy food, sub-theme 2: how does the body process food?, learning 2. This teaching material was created using Microsoft Office Power Point with pictures, writing and an attractive appearance for students.

This interactive teaching material contains instructions for using teaching materials, complete with student attendance, material content, and quizzes. The researchers hope that this teaching material can make learning more effective and efficient and can be used as a reference for improving and evaluating the quality of education and attracting students' attention in following and understanding the material in the learning carried out by the teacher. The complete design results of teaching materials are attached.

In the development stage, the tools that have been prepared will be validated by experts and users to determine the suitability of the learning tools that have been created. This set of interactive teaching materials has been validated by 1 RPP expert and 3 grade 5 teachers from various elementary schools in the city of Gorontalo. The results of the device validation in the form of complete interactive teaching materials are attached.

The following is an accumulation of calculations from the validation results of interactive teaching materials by several validators in their respective fields, as follows.

Table 2 Accumulated Teaching Material Validation Results

No	Aspects assessed	Expert	Use r 1	Use r 2	Use r 3	Scores
1	Systematic preparation of teaching materials according to general rules	4	4	4	4	4
2	The display of teaching materials is clear and attractive	3	4	4	4	4
3	Proportional text and image layout	3	4	4	3	4
4	Display of visual friendly teaching materials	3	4	4	4	4
5	Contains the identity of teaching materials	4	4	4	4	4
6	Contains learning objectives	4	4	4	4	4
7	Coverage of material according to the objectives to be achieved	4	4	4	3	4
8	Reliability (reliability of teaching materials)	4	4	4	3	4
9	Can be used anywhere, easy to carry, and not easily damaged	4	4	4	3	4
10	Contains evaluation	4	4	4	3	4
11	Contains instructions for use	4	4	4	3	4
12	Load images that match the material	4	4	4	4	4
13	Contextual and actuality	4	3	4	3	4
14	There is material development (additional material)	4	4	4	3	4
15	Complexity of the material presented	4	4	4	3	4
16	Material appropriate to student age level (student cognitive)	4	4	4	3	4
17	The language used is in accordance with Indonesian language rules	4	4	4	4	4
18	The language used is easy to understand (communicative)	4	4	4	4	4
Total scores		96	94	96	82	96

$$P = (\text{total scores obtained}) / (\text{total scores}) \times 100\%$$



Percentage of feasibility by experts:

$$= 69/72 \times 100\%$$

$$= 96 \%$$

Percentage of eligibility by user 1:

$$= 71/72 \times 100\%$$

$$= 98\%$$

Percentage of eligibility by user 2:

$$= 72/72 \times 100\%$$

$$= 100 \%$$

Percentage of eligibility by user 3:

$$= 62/72 \times 100\%$$

$$= 86 \%$$

So if you average the validation results from several validators above, it is 95% or a very feasible interpretation. With the following calculations.

$$\text{Average} = (96\% + 98\% + 100\% + 86\%) / 4 = 95\%$$

The suggestions given by the validators will be used to improve or revise the interactive teaching material tools in this research. The following are the suggestions/comments given by the validator to improve the device being developed, namely: color contractions need to be paid attention to so that the writing and display are clearer and the layout of the images and writing is adjusted so that they are interesting to read and look at.

### **Evaluation**

The third learning tool design is evaluation. The evaluation developed by researchers is an evaluation used to measure students' cognitive domain. In implementing this evaluation using an application called Kahoot.

Kahoot is a game-based learning platform. Kahoot is also a quiz with various forms of questions created by users which can be accessed via web browsing or the Kahoot application.

The quiz in the Kahoot application is oriented towards HOTS (Higher Order Thinking Skills) and TPACK (Technological Pedagogical Content Knowledge), and is based on material in class V, theme 3: healthy food, subtheme 2: how does the body process food? learning 2. This evaluation given to students at the end of the lesson to measure students' understanding after following the lesson.

Researchers in developing evaluation tools hope that this evaluation can increase the achievement of goals or targets that teachers want to achieve, identify components that are successful or unsuccessful, increase interest and support the learning styles of the digital generation. The complete evaluation design results are attached.

In the development stage, the tools that have been prepared will be validated by experts and users to determine the suitability of the learning tools that have been created. This evaluation tool has been validated by 1 RPP expert and 3 grade 5 teachers from various elementary schools in the city of Gorontalo. The results of the device validation in the form of a complete evaluation are attached.

The following is an accumulation of calculations of evaluation validation results by several validators in their respective fields, as follows.

Table 3 Accumulated Evaluation Validation Results

<b>No</b>	<b>Aspects assessed</b>	<b>Expert</b>	<b>Use r 1</b>	<b>Use r 2</b>	<b>Use r 3</b>	<b>Scores</b>
1	The material asked is in accordance with competency	4	4	4	3	4
2	Homogeneous and logical answer choices	4	4	4	3	4
3	There is only one answer key	3	4	4	2	4
4	Includes one indicator of HOTS questions, namely analyzing (C4). evaluate (C5) and create (C6)	4	4	4	3	4
5	The main question is formulated briefly, clearly and firmly	4	4	4	3	4
6	The main question does not provide clues to the answer key	4	4	4	3	4
7	Answer choices are homogeneous and logical in terms of material	4	4	4	3	4
8	Pictures, graphs, tables, diagrams, or similar are clear and functional	4	4	4	3	4
9	The length of the answer choices is relatively the same	4	4	4	3	4
10	Answer choices do not use the statement "all the answers above are wrong/right"	4	4	4	3	4
11	The main formulation of the question and answer choices are only necessary statements	4	4	4	3	4
12	Question items do not depend on the answers to previous questions	4	3	4	3	4
13	Giving questions using an electronic application (TPACK)	4	4	4	4	4
14	Can measure higher level thinking abilities	4	4	4	4	4
15	The language used is in accordance with Indonesian language rules	4	4	4	4	4
16	The language used is easy to understand (communicative)	4	4	4	4	4

N	Aspects assessed	Exp	Use	Use	Use	Sco
o		ert	r 1	r 2	r 3	re
						mak
						s
	Total scores	96	94	96	82	96

$$P = (\text{total scores obtained})/(\text{total scores}) \times 100\%$$

Percentage of feasibility by experts:

$$= 64/64 \times 100\%$$

$$= 100 \%$$

Percentage of eligibility by user 1:

$$= 63/64 \times 100\%$$

$$= 98\%$$

Percentage of eligibility by user 2:

$$= 64/64 \times 100\%$$

$$= 100 \%$$

Percentage of eligibility by user 3:

$$= 51/64 \times 100\%$$

$$= 80 \%$$

So if you average the validation results from several validators above, it is 95% or a very feasible interpretation. With the following calculations.

$$\text{Average} = (100\%+98\%+100\%+80\%)/4 = 95\%$$

### Discussion

The products produced in this research are learning tools which are important components in learning, such as Learning Implementation Plans (RPP), interactive teaching materials, and evaluation. This research uses the method adopted by Saputro by limiting it to only 2 stages, namely preliminary study and model development/design.

In accordance with the steps in the development stages, researchers carry out validation to assess the feasibility of a product being developed. In order to perfect the learning tools, the researchers revised them again according to suggestions and moments given by several validators who are experts in their respective fields.

#### Preliminary studies

Starting this research process, the researcher obtained facts or data in the field, in this case when the researcher conducted an Introduction to School Field (PLP 1) in semester 4 at SDN 29 Kota Selatan. Researchers conducted an unstructured interview with one of the teachers. He stated that he was overwhelmed by the curriculum which at that time had just changed to the 2013 curriculum. So, when preparing the learning tools, the teacher admitted that he had received the tools from other people.

The researcher again conducted initial research at the school where the researcher participated in one of the programs from the Ministry of Education and Culture, namely the pioneer teaching campus program. Researchers found one of the schools

in Kab. Buol is SDN 2 Bukal. The surprising fact was that after researchers conducted observations at the school, there were several teachers whose learning devices were provided by the school operator.

This encourages researchers to develop learning tools that refer to the 2013 curriculum as well as the demands of government programs to improve the quality of education, tools in the 21st century must be HOTS (Higher Order Thinking Skills) and TPACK (Technological Pedagogical Content Knowledge) oriented. With the development of this device, it is hoped that it can help the current learning process.

### **Model Development**

The types of tools developed by researchers are Learning Implementation Plans (RPP), interactive teaching materials, and evaluation. This tool refers to the demands of the 2013 curriculum and government programs to achieve graduates with the best quality. This is in line with the opinion expressed by Hilda Taba in Suhendra (2019:13-14), namely "A curriculum is a plan for learning therefore, what is known about the learning process and the development of the individual has bearing on the shaping of a curriculum" (curriculum is learning planning related to the learning process and individual development, including in the form of a curriculum. Curriculum as learning program planning is also in line with the curriculum formulation in Law No. 20 of 2003 concerning the national education system, namely a set of plans and arrangements regarding objectives, content and learning materials as well as methods used as guidelines for organizing learning activities to achieve a certain goal. The researchers developed this tool using a scientific approach, namely the approach used in accordance with the 2013 curriculum, then oriented towards HOTS (Higher Order Thinking Skills) and TPACK (Technological Pedagogical Content Knowledge) and the Cooperative Learning model.

Widodo and Srikadarwati (in Sofyatiningrum, et al, 2018:3) stated that future trends are a consideration in determining curriculum design, especially curriculum components in the aspects of objectives, content/materials, and learning processes. One of the essences that is taken into consideration in K-2013 is the achievement of high-level thinking competencies (High Order Thinking Skills, HOTS) to solve problems by thinking critically, innovatively, creatively, for the sake of living together in peace and harmony (to live together in peace). and harmony). By implementing HOTS in learning, positive things can be increased, such as courage to face difficult questions, the formation of good cooperation between students, higher levels of interaction between students and students and teachers, better learning activities, and good student character in terms of discipline. perseverance, responsibility, thoroughness and open attitude.

According to Ariani, (in Aviyanti, 2020:7-8) TPACK is a description of how teachers integrate technology, methods and content into a harmonious whole. The components of technological knowledge, pedagogy and content are three complete combinations in TPACK which aim to grow basic knowledge about technology, increase students' learning opportunities and experiences and improve the content in learning.

According to Suhardini, (2021:113) TPACK emphasizes the use of technology in learning media to improve the quality of learning activities.

HOTS is defined as a person's ability to think at a high level. Meanwhile, TPACK is learning that uses a combined application of an education system that prioritizes technology and certain applications (content) in learning.

#### 4. SUMMARY

In an effort to implement a quality education system in the 21st century in order to form competitive human resources, the 2006 Curriculum (K-2006) has been refined into the 2013 Curriculum (K-2013). This curriculum refinement has been linked to intelligent predictions about the present and the trends that may occur in 21st century life. Future trends require various skills, including life and career skills, learning and innovation skills, and technology and information media skills. One thing that must be done is to develop learning tools that are 21st Century oriented.

The learning tools developed are lesson plans, interactive teaching materials and learning evaluation using the 2013 curriculum approach, namely the scientific approach (5M) which is HOTS and TPACK oriented and the Cooperative Learning model. The development of this device was carried out as a refinement of learning tools in elementary schools that can be used as a reference by teachers. The device developed has been tested and validated by experts and users with very feasible results.

Thus, the development of 21st century learning tools through a scientific approach based on HOTS and TPACK in elementary schools is believed to be able to improve the quality of learning because it can improve student learning outcomes and motivation, as well as provide a more interesting and useful learning experience.

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