Student and Teacher Collaboration in Developing STEM-Based Learning Modules and Pancasila Student Profiles

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ABSTRAK

Pelaksanaan kurikulum merdeka di Indonesia mendesak guru untuk menyusun modul ajar. Namun, kondisi di sekolah dasar menunjukkan bahwa guru belum mendapatkan pelatihan terkait penyusunan modul ajar yang sesuai dengan kurikulum merdeka. Oleh karena itu, penelitian ini bertujuan mengembangkan produk berupa modul pembelajaran berbasis STEM dan Profil Pelajar Pancasila yang valid dan efektif. Jenis penelitian adalah Research & Development (R&D) dengan mengacu pada model pengembangan Analysis, Design, Development, Implementation, Evaluation (ADDIE). Produk yang dikembangkan diujicoba pada siswa kelas IV pada salah satu jenjang sekolah dasar. Hasil penilaian kualitas produk ditinjau dari penilaian ahli materi, bahasa, media, dan praktisi. Modul pembelajaran yang dikembangkan memperoleh nilai rata-rata skor 94,5% yang dikategorikan sangat layak. Hasil responsif siswa terhadap modul pembelajaran diperoleh nilai rata-rata 85,5% dengan kategori sangat tertarik. Modul pembelajaran berhasil mengefektifkan hasil belajar dan pembentukan karakter siswa. Selama implementasi modul pembelajaran berhasil mencerminkan pembentukan karakter Profil Pelajar Pancasila pada dimensi bernalar kritis, mandiri dan bergotong royong. Dengan demikian disimpulkan bahwa pada jenjang sekolah dasar diperlukannya pembelajaran yang berorientasi pada model konsep STEM dan usaha dalam pembentukan karakter Profil Pelajar Pancasila. Sehingga modul yang disusun dianggap dapat digunakan dalam pembelajaran siswa kelas IV sekolah dasar.

ABSTRACT

Implementing an independent curriculum in Indonesia urges teachers to develop learning modules. However, conditions in elementary schools indicate that teachers still need to receive training related to teaching modules following the independent curriculum. Therefore, this study aims to develop a product in the form of a valid and effective STEM-based learning module and Pancasila Student Profile. The type of research is Research & Development (R&D) regarding the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) development model. The developed product was tested on fourth-grade students at one of the elementary school levels. The results of product quality materials are assessed from expert judgment, language, media, and practitioners. The learning module developed obtained an average score of 94.5%, categorized as very feasible. The results of student responsiveness to the learning module obtained an average of 85.5% with an exciting category. The learning module has succeeded in streamlining learning outcomes and student character formation. The implementation of the learning module successfully reflects the character formation of the Pancasila Student Profile in critical reasoning, independence, and cooperation. Thus, in elementary schools, learning is needed that is oriented to the STEM model and efforts in forming the character of the Pancasila Student Profile so that the compiled modules are considered to be used in the learning of fourth-grade elementary school students.

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1. INTRODUCTION

Indonesia has an education system that prioritizes the quality of human resources in character education through efforts to support the achievement of the Pancasila Student Profile. The Pancasila Student Profile is one of the efforts to improve the quality of education in Indonesia that emphasizes character building (Kurniawaty, I., & Faiz, 2022; Rusnaini et al., 2021). The main goal to achieve the Pancasila student profile is developed following the vision and mission of the Ministry of Education and Culture as stated in the Minister of Education and Culture Regulation Number 22 of 2020 concerning the Strategic Plan of Education and Culture for 2020-2024. There are six profiles of Pancasila students according to the Ministry of Education which are the core competencies in the driving teacher program, namely: 1) have faith, fear God, and have noble character; 2) independent; 3) critical reasoning; 4) creative; 5) cooperation; 6) global diversity (Pamungkas & Sudigdo, 2022; Rachmawati et al., 2022).
The results of the research by previous study show that the Pancasila Student Profile is one of the policies that support the realization of national education goals and the continuation of the character-strengthening program (Irawati et al., 2022). The Pancasila Student Profile is a character and competence that must be possessed by Indonesian students both when they are learning and when they are involved in society. Then, the research results of other study show that strengthening character education in realizing Pancasila students is encouraging the birth of good humans who have the main characteristics of the Pancasila Student Profile in the hope that students can independently improve, use their knowledge, study, and internalize and personalize values (Ismail et al., 2020). Character values and noble character can be realized in daily behavior.

The role of value and character education is needed to foster a balance between technological development and human development. Pancasila's student profile is designed to answer one big question: What competencies does the Indonesian education system want to produce? These competencies have character and also behave according to the values of Pancasila (Nggano et al., 2022; Susilawati et al., 2021; Utari & Afendi, 2022). Research results from previous study show that the Pancasila Student Profile contains characters that refer to Pancasila, which can have implications for students' resilience, where the Pancasila Student Profile directs students to become individuals with the character following Pancasila (Rusnaini et al., 2021). Therefore, achieving the Pancasila Student Profile needs to be a concern to support the values and characters expected to appear in students. One way to bring up the Pancasila Student Profile can be through implementing projects in learning in education units, both at the elementary, junior high, and high school/vocational levels (Dasmana et al., 2022; Nurhayati, 2022; Utari & Afendi, 2022).

Projects outlined in learning can be part of the teaching materials used to improve students' creativity, knowledge, and experience in learning, namely modules (Tjiptiany et al., 2016). Modules are printed teaching materials that are presented systematically using language that students can understand according to the age level and knowledge of students consisting of materials, methods, and evaluations that can be used to support learning either in schools as teaching materials for teachers or used by students, independently which can be applied to the prototype curriculum (Hamzah & Uno, 2022; Syafi'i, 2022). Providing modules with projects in them can increase student effectiveness in learning, so it is necessary to determine an overall learning approach that can focus students in the process. Project-based learning can be through the application of the Science, Technology, Engineering, and Mathematics (STEM) approach. Using the STEM approach is very relevant to achieving the Pancasila Student Profile because it requires collaboration, critical reasoning, creative thinking, and training children to think independently to solve problems (Oktavian Fajar & Harry, 2019; Tjiptiany et al., 2016). STEM education, in its application, is not only focused on cognitive development but also the affective domain because STEM education provides space for students to play an active role in learning by cooperating, disciplined, and helping each other in unifying various experiences in the lives of students so that STEM education is suitable in the development and formation of the cognitive, affective, and psychomotor aspects of students (Conradty & Bogner, 2020; Zubaidah, 2019). Applying STEM-based learning will motivate students to excel and get the best grades and can motivate students to be more active in discussions. In addition, the application of STEM-based learning can have a good influence on the learning outcomes of elementary school students (Rahmi et al., 2022; Wahyuni, 2019).

STEM education provides opportunities for teachers to show students the concepts, principles, and techniques of STEM that are integrated with the development of products, processes, and systems used in their daily lives. Through STEM, students can connect the lessons learned in school with their daily lives, developing STEM learning that enables them to compete in a knowledge-based global era (Pebriani et al., 2022; Sartika, 2019; Selsabila & Pramudiani, 2022). Based on the explanation above, no research focuses on STEM learning to see the Pancasila Student Profile. Therefore, this study aims to specifically develop a STEM-based learning module and the Pancasila Student Profile through collaboration between students and teachers.

2. METHOD

This study aims to develop a STEM-based learning module and Pancasila Student Profile. Research & Development (R&D) is the research method used in developing the learning module. The Research & Development (R&D) model refers to the design procedure of the Analyze, Design, Development, Implementation, and Evaluation (ADDIE) model (Gustiani, 2019; Laws et al., 2013). This model was chosen because the ADDIE model design procedure was based on a practical systems approach and a continuous process. The learning module is implemented for students in grade IV at the elementary school level as the subject of this research. The number of students in grade IV elementary school who became the subject of this study was 28 people. Gender consisted of 10 students and 18 students. The instrument used to collect data in this study is an instrument that is adapted to the needs of the research procedure. The research instruments in the preliminary study were interview guidelines and questionnaires. The research instruments in the implementation of the research are the validation rubric, student response questionnaires to the developed product, interview sheets to teachers, observation sheets to students, student learning outcomes test instruments, and assessment rubrics. The design and flow of research and development is described through the five stages of ADDIE, the five stages are shown in Figure 1.
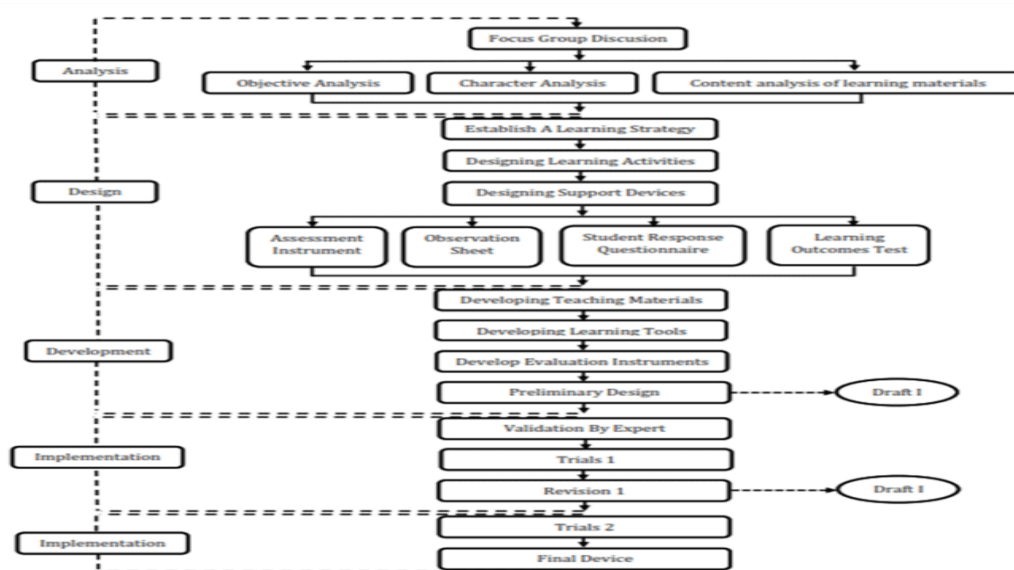

Figure 1. Chart Development Of Learning Devices ADDIE Model

The Analyze stage consists of several activities to determine the primary problems for fourth-grade students. This activity involves interviews with the homeroom teacher, class observations, and the distribution of learning style questionnaire assessments. This is done to determine the characteristics and needs of students to be achieved in a lesson. The Design phase consists of; researchers doing the design in the form of; a) Designing learning module design concepts, b) Mapping of Core Competencies (KI), Basic Competencies (KD), and Indicators, c) Preparation of materials, d) Preparation of expert validation sheets, e) Preparation of student response questionnaire sheets, f) Preparation of learning completeness test.

The Development phase is carried out by developing a module framework in the form of a prototype STEM-based learning module and the Pancasila Student Profile. The prototype of the teaching module consists of; a cover, teaching module instructions, STEM-based learning, Pancasila Student Profile, learning objectives, table of contents, activity 1, activity 2, activity 3, assessment, and attachments. The prototype module and test instrument (expert assessment questionnaire) were submitted to the expert validator and then assessed. The expert validators consist of material, language, media, and practitioner validators. The Implementation phase is carried out by conducting a test of the teaching module in two stages, namely the limited trial stage and the field trial stage in class IV. Limited trials were conducted on as many as 50% of randomly selected students. Furthermore, field trials were conducted on all fourth-grade students. After the two stages of the trial were carried out, the student response questionnaire was also distributed. The Evaluation stage is carried out by collecting data from student response questionnaires and student learning mastery results through a cognitive learning mastery test which includes the level of knowledge, understanding, application, and analysis of the learning objectives to be achieved. The type of research data instrument used consists of two instruments: test and non-test. Data

analysis techniques consist of two types: descriptive qualitative and descriptive quantitative. The types of test instruments were analyzed using quantitative descriptive techniques, while the non-test instruments used qualitative descriptive techniques. The results of the expert validation assessment are recapitulated, analyzed, and determined through the eligibility criteria in Table 1.

Table 1. Assessment Criteria

No	Percentage (%)	Criteria
1	0-20%	Very Less Feasible
2	21%-40%	Less Feasible
3	41%-60%	Enough
4	61%-80%	Feasible
5	81%-100%	Very Feasible

The results of the student response questionnaire assessment for limited trials and field trials were analyzed and determined through the criteria of interest is show in Table 2.

Table 2. Assessment Criteria

| No	Percentage (%)	Criteria
1	0-20%	Very Less Feasible
2	21%-40%	Less Feasible
3	41%-60%	Enough
4	61%-80%	Feasible
5	81%-100%	Very Feasible

3. RESULT AND DISCUSSION

Result

The results of this research and development were obtained through 5 stages of ADDIE. The final product of this research and development is a STEM-based learning module and the Pancasila Student Profile, which has gone through the product quality assessment results in expert validators. To produce an effective product to improve student learning outcomes and provide positive results in implementing learning. The Analyze Phase (analysis) consists of several activities: interviews with the homeroom teacher, class observations, and the distribution of learning style questionnaires. So that the results obtained that the fourth-grade students at SDN 043 Tarakan experienced 1) difficulties in understanding and mastering learning materials to the maximum, 2) lack of teaching materials, the sources of teaching materials used were only in student handbooks, 3) learning centered on theory and questions and lack of practice make it difficult for students to understand learning. The results of the Design Phase and Development Phase, namely STEM-based learning modules and Pancasila Student Profiles, can be seen in Figures 2 and Figure 3.

Figure 2. Module Cover
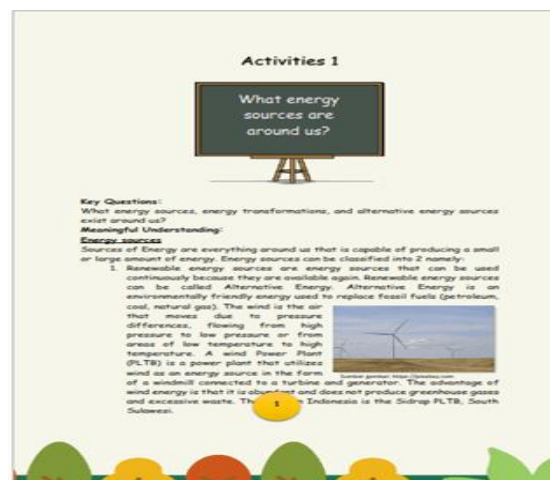
Figure 3. Module Content

Then the researchers combined the results of the module design concept into a prototype of the STEM-based learning module and the Pancasila Student Profile. The module prototype is then assessed by expert validators consisting of material, language, media, and practitioner validators. So the results can be seen in Table 3 .

Table 3. Expert Validator Recapitulation Score

No.	Validator	Score Percentage (%)	Criteria
1	Material Validator	92%	Very Feasible
2	Language Validator	94%	Very Feasible
3	Media Validator	94%	Very Feasible
4	Practitioner Validator	98%	Very Feasible
	Average	**94,5%**	**Very Feasible**

Based on Table 3 show the recapitulation of expert validators, an average percentage of 94.5% was obtained, categorized as very feasible. This consists of the value of the material validator acquisition of 92%, which states that the product is very feasible. This is also based on the value of the acquisition of language validators of 94%, which states that the product is very feasible. Furthermore, it is also based on the value of the media validator of 94%, which states that the product is very feasible. It was also stated that 98% of practitioner validators stated that the product was very feasible. The product was then tested on fourth-grade students at SDN 043 Tarakan. This implementation phase is where researchers conduct product trials on fourth-grade students. Product trials were carried out twice, namely limited trials and field trials. The implementation of this trial can be seen in Figures 4 and Figure 5.

Figure 4. Limited Trial Activities

Figure 5. Field Trial Activities

Figures 4 and Figure 5 are an activity where the researcher conducted a test of the teaching module, which was carried out twice, namely a limited trial and a field trial. A limited trial was conducted in class IV of 14 students or three study groups that had been randomly selected. Furthermore, field trials were carried out in class IV with 29 students or six study groups. The results of the analysis of the Student Response Questionnaire Data for Limited Trials and Field Trials and the Data on the Recapitulation of Student Response Questionnaires can be seen in Tables 4, and Table 5.

Table 4. Limited Trial Student Response Questionnaires Data

No	Observed Aspect	Score Total	Score Percentage (%)	Criteria
1	Ease of understanding the material using STEM-based learning modules and Pancasila Student Profile	55	78%	Interested
2	Ease of working on worksheets in the STEM-based learning module and Pancasila Student Profile	62	88%	Very Interested
3	Ease of studying STEM-based learning modules and Pancasila Student Profiles at home	52	74%	Interested
4	Ease of understanding the contents of the STEM-based learning module and the Pancasila Student Profile	50	71%	Interested
5	Availability of theme 9 material on STEM-based learning modules and Pancasila Student Profile	55	78%	Interested
6	Ease of doing activities on STEM-based learning modules and Pancasila Student Profile	49	70%	Interested
7	The project steps on the STEM-based learning module and the Pancasila Student Profile are clear to follow	47	67%	Interested
8	Enjoy learning by using STEM-based learning modules and Pancasila Student Profile	58	82%	Very Interested
9	It is easy to work on worksheets on STEM-based learning modules and Pancasila Student Profiles because there are pictures	48	68%	Interested
	Average		**75%**	**Interested**

Table 5. Field Trial Student Response Questionnaire Data

No	Observed Aspect	Total Score	Score Percentage (%)	Criteria
1	Ease of understanding the material using STEM-based learning modules and Pancasila Student Profile	68	97%	Very Interested
2	Ease of working on worksheets in the STEM-based learning module and Pancasila Student Profile	68	97%	Very Interested
3	Ease of studying STEM-based learning modules and Pancasila Student Profiles at home	66	94%	Very Interested
4	Ease of understanding the contents of the STEM-based learning module and the Pancasila Student Profile	67	96%	Very Interested
5	Availability of theme 9 material on STEM-based learning modules and Pancasila Student Profile	66	94%	Very Interested
6	Ease of doing activities on STEM-based learning modules and Pancasila Student Profile	68	97%	Very Interested
7	The project steps on the STEM-based learning module and the Pancasila Student Profile are clear to follow	66	94%	Very Interested
8	Enjoy learning by using STEM-based learning modules and Pancasila Student Profile	70	100%	Very Interested

9	It is easy to work on worksheets on STEM-based learning modules and Pancasila Student Profiles because there are pictures	66	94%	Very Interested
	Average		**96%**	**Very Interested**

Base on the result in Table 4, and Table 5 the results of the teaching module test activities were obtained in the form of student response questionnaire data. The average teaching module test data obtained a percentage of 85.5%, with the information that fourth-grade students are very interested in using the product. The limited trial student response questionnaire obtained an average percentage of 75% who were categorized as interested. Furthermore, the results of the student response questionnaire field trials obtained an average percentage of 96%, categorized as very interested.

Discussion

Students are required to master all fields of study and have the ability to solve problems in education in elementary schools. In addition, student learning in elementary schools focuses on not only cognitive aspects but also affective and psychomotor aspects (Arum & Wahyudi, 2016; Maghfiroh, Y., & Hardini, 2021). These affective and psychomotor aspects are related to the cultivation of student character. The development of STEM-based learning modules and the Pancasila Student Profile has positively impacted students' cognitive, affective, and psychomotor aspects (Harris et al., 2020; Wahyuningtyas & Suastika, 2016). The positive impact on the cognitive aspect is marked by increased science and mathematics learning outcomes. Students' scientific knowledge increases, especially concerning changes in energy forms that look better. Furthermore, the impact that students have felt on mathematical knowledge is the ability to solve a problem or problem solving very well (Asih & Ramdhani, 2019; Imam et al., 2018). This learning module has helped students get used to analyzing and finding the best solution to a problem. Problem-solving is a multi-step process where one can solve or solve problems by finding relationships between past and current problems, then giving action as a goal for completion (Florentina Turnip & Karyono, 2021; Staddon, 2022). Before this research was conducted, the problem in mathematics lessons experienced by students was a need for more interest in the learning process. According to students, mathematics lessons taught by teachers are difficult to understand. However, after this learning module was implemented in students, it got the appropriate results.

Factors that influence the learning process in learning activities are influenced by several factors, both from the individual and outside the individual. The most influencing factor in learning activities is individual factors in the form of motivation. After all the learning media used in learning activities, students will only be able to accept the learning media if they can motivate student learning. In line with previous study who concluded the results of their research that there is an effect of using learning media on student learning motivation (Putri, 2017; Setyaningsih et al., 2020). The factor of using learning modules is important because modules can present complex information, use systematic learning sequences, and the learning process can adjust in time; that is, it takes place slowly or very quickly. In addition, the development of learning modules is also a factor that influences the learning process because it develops a learning system that creates conditions where students can interact so that they can follow the learning process properly. This is in line with previous research, which states that using printed modules effectively supports 21st-century skills (Puspitasari, 2019). In addition, learning modules can also improve learning outcomes, learning motivation, and also students' critical thinking skills (Dwiyanti et al., 2021; Pratama et al., 2017; Ramadhani, R., & Amudi, 2020).

There are several advantages of modules in the learning process, including allowing students to be able to measure their learning outcomes, encouraging students to learn more actively, and getting students used to believing in themselves, and The teacher can act as a guide not just fixated as a teacher (Wahyudi, 2019; Yolantia et al., 2021). In addition, in STEM-based modules and the Pancasila Student Profile, there is a learning evaluation so that teachers and students can find out the students' success in understanding the material content of the learning module. The weaknesses of this learning module are that several students need assistance and direction from the teacher in learning, and difficulties in preparing materials that require much money, as well as in doing learning modules, and their development takes a long time.

In validating STEM-based learning modules and material experts' profiles of Pancasila students, they get a score percentage of 92% with a very decent category. This is supported by the opinion of in terms of module content, the module developed must be able to increase student motivation in learning and also be effective in achieving the expected learning competencies (Wati et al., 2017). This is in line with opinion that an orderly and structured arrangement of modules can increase understanding in a

topic and can learn with a variety of fun activities (Tamrin, 2021). The results of the validation assessment of linguists with a percentage score of 94%, which is a very feasible category. This is supported by the opinion that a module must be readable and follow the grammatical aspects (Musfiroh et al., 2012; Rahman et al., 2019). This is in line with Arum & Wahyudi, (2016) opinion that the language used in the module must be adapted to the language of elementary school students (Arum & Wahyudi, 2016). In the validation of media experts, they get a percentage score of 94%, so it can be categorized as very feasible. This shows that the developed module meets the components so that it can be used. This is in line with researcher state that modules must have three main components, namely introduction, learning, and evaluation (Tamrin, 2021). The expert practitioner validation assessment results by the practitioner validator have a score of 98% in the very feasible category. This shows that the module developed has the practicality of using a suitable module so that students can use this module to study independently. This is supported by other study that state modules are very useful for students to have the opportunity to train themselves to learn independently (Aditia & Novianti, 2013). This is in line with previous study that explaining the practical aspects of a learning media belonging to the media group, which is closely related to the design, material, and language of the learning media (Yulianti & Tutianingsih, 2020).

Student responses to the product developed in the trial of using learning modules obtained a presentation of 85.5% with an exciting category which can be concluded that the use of teaching modules can make students interested and can foster student interest in learning (Thuneberg et al., 2018; Trismayanti, 2018). Student learning outcomes after using STEM-based learning modules and Pancasila student profiles based on the analysis of student learning completeness scores obtained data, namely as many as 24 students or 92% who experienced complete learning and two students or 8% who did not experience learning mastery. From this, it can be concluded that the use of STEM-based learning modules and the profile of Pancasila students can be said to be successful and feasible in learning at school. The implication of this study is providing overview related to ways to integrate the principles of Pancasila, such as social justice and equality, into STEM education to enhance the learning experience and prepare students to become responsible citizens. It would be helpful to have more information about the research methods and data analysis techniques used to develop the STEM-based learning modules and Pancasila student profiles. The limitation of this research lies in the limited research subjects. Therefore, it is hoped that future research will be able to deepen and broaden research by considering other aspects in developing Pancasila learning modules.

4. CONCLUSION

This research and development have gone through the ADDIE stage and the collaboration of students and teachers in developing STEM-based learning modules and the Pancasila Student Profile. Based on research data and analysis results, as well as products that have been validated, it can be concluded that the results of the product quality assessment, in terms of expert judgment from practitioners, materials, media, and language, concluded that the STEM Pancasila-based learning module. Student Profile is very feasible to use. The results of student responses to STEM-based learning modules can help the learning process become meaningful, fun, and engaging to improve student understanding. This condition can be seen in student learning outcomes after using STEM-based learning modules and Pancasila Student Profiles, which can positively impact student learning outcomes. In addition, the use of learning modules can also attract students' attention, interest, and motivation to learn

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