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DIGITAL STUDENT WORKSHEET BASED ON PROJECT-BASED LEARNING INTEGRATED WITH NGADA LOCAL WISDOM FOR NATURAL SCIENCE MATERIAL IN JUNIOR HIGH SCHOOL

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Abstract

The problem in this study is that the learning process is generally still conventional, with the dominance of lecture methods and the use of printed Student Worksheet which is less interactive and has not been linked to existing local wisdom. This study aims to develop and test the feasibility of digital Student Worksheet based on Project Based Learning integrated with Ngada local wisdom on additive material for students of SMPS PGRI Bajawa. The method used is research and development or often called R&D (Research and Development) with the model developed is the ADDIE model. The research subjects were 20 students of class IX SMPS PGRI Bajawa. The data collection techniques used were interviews, questionnaires, and expert validation sheets. These data collection techniques allowed for comprehensive data collection to evaluate and develop digital student worksheets based on project-based learning integrated with local Ngada wisdom. in science learning at SMPS PGRI Bajawa. The data analysis techniques used by researchers in this study are qualitative and quantitative data used to obtain research data. Based on the scores the validity of the three experts was 3.94, which is in the very valid criteria. The practicality test for teacher responses was 97.91%, and student responses were 98.13%.

Keywords: Project-Based Learning, Ngada Local Wisdom, Science Education.

Abstrak: Permasalahan dalam penelitian ini adalah proses pembelajaran umumnya masih bersifat konvensional, dengan dominasi metode ceramah dan penggunaan LKPD cetak yang kurang interaktif serta belum dikaitkan dengan kearifan lokal yang ada. Penelitian ini bertujuan untuk mengembangkan dan menguji kelayakan LKPD digital berbasis *Project Based Learning* (PjBL) terintegrasi kearifan lokal Ngada pada materi zat aditif bagi siswa SMPS PGRI Bajawa. Metode yang digunakan adalah penelitian dan pengembangan atau yang sering disebut dengan R&D (*Research and Development*) dengan model yang dikembangkan adalah model ADDIE. Subjek penelitian adalah siswa kelas IX SMPS PGRI Bajawa yang berjumlah 20 siswa. Teknik pengumpulan data yang dilakukan adalah wawancara, angket atau kuesioner, dan lembar validasi ahli. Dengan menggunakan teknik pengumpulan tersebut dapat mengumpulkan data yang komprehensif untuk mengevaluasi dan mengembangkan LKPD Digital berbasis *PjBL* terintegrasi kearifan lokal ngada dalam pembelajaran IPA SMPS PGRI Bajawa. Teknik analisis data yang digunakan peneliti dalam penelitian ini adalah data kualitatif dan kuantitatif yang digunakan untuk memperoleh data peneltian. Berdasarkan skor validitas dari ketiga ahli adalah 3,94 berada dikriteria sangat valid. Uji kepraktisan respon guru 97,91%, dan respon siswa 98,13%.

Kata-kata Kunci: Pembelajaran Berbasis Proyek, Kearifan Lokal Ngada, dan Pendidikan IPA.

Background

Science learning at the junior high school level still faces various problems that affect students' learning outcomes, particularly in the topic of food additives. The learning process is still generally conventional, dominated by lecture methods and the use of printed Student Sheets that are less interactive and not connected to students' local context. As a result, students' engagement in learning activities remains low, and their understanding of food additives is still not optimal. Science learning should provide students with direct learning experiences that help them develop scientific thinking, critical thinking, and the ability to relate concepts to everyday life. However, in practice, students often only understand scientific concepts theoretically without being able to connect them with real situations around them. This condition is in line with previous research stating that science learning is still dominated by conventional methods, resulting in low student engagement and less optimal learning outcomes (Marasabessy, 2024). Science learning also emphasizes direct experience so that students can explore and understand the natural environment while developing better character (Dinatha & Kua, 2019). Therefore, the topic of food additives is highly relevant to students' daily lives, especially in relation to food consumption habits and the local wisdom of the Ngada community, which includes various traditional practices involving natural preservatives and dyes.

This problem was also found at SMPS PGRI Bajawa, particularly in the learning of food additives. The learning process still uses conventional printed Student Sheets that are less interactive and have not been able to actively engage students. Student participation in learning activities is still low because the learning process does not provide enough opportunities for exploration, collaboration, and contextual problem-solving. The topic of food additives is often presented abstractly and is not yet connected to the real-life experiences of students. This condition is consistent with the finding that suboptimal science learning directly affects students' low learning outcomes (Risnawati et al., 2024). In fact, food additives are

closely related to students' daily lives because students frequently encounter various natural and artificial additives in the food they consume. However, many students do not yet understand the functions, benefits, and possible impacts of these substances scientifically. Therefore, learning about food additives needs to be designed contextually so that students can connect scientific concepts with real experiences. A contextual learning approach can help improve students' conceptual understanding because students learn through situations that are close to their lives. Thus, the topic of food additives is appropriate to be developed through meaningful and relevant learning innovation.

One possible learning innovation is the development of a digital Student Sheet based on Project-Based Learning (PjBL). A digital Student Sheet can provide a more interactive, flexible, and accessible learning experience than a conventional printed Student Sheet. The use of digital learning media also supports students' digital literacy, namely the ability to use technology in the learning process to develop thinking and learning skills (Analinta et al., 2025). Meanwhile, Project-Based Learning encourages students to learn through project activities that involve problem-solving, creativity, collaboration, and independent investigation. Previous research shows that project-based and problem-based learning models can significantly improve student learning outcomes (Hildayanti et al., 2024). Therefore, the integration of a digital Student Sheet with the Project-Based Learning approach can be an alternative solution to improve student engagement and the quality of science learning.

In addition to digital learning media and Project-Based Learning, the integration of local wisdom is also important in science learning. Learning based on Ngada local wisdom has been proven effective and has received good results from expert assessments and student trials (Laksana & Widiastika, 2017). Education is also considered one of the most effective ways to maintain and preserve culture (Laksana, 2019). Therefore, culture needs to be integrated into education, both through learning models and learning media, so that students can achieve learning objectives while also recognizing and preserving their cultural identity (Endu et al., 2024). Ngada local wisdom contains many traditional practices that are closely related to food processing and preservation. One example is Hui wu'u, a traditional process of preserving pork by cutting it into small pieces, mixing it with salt and corn bran, storing it in bamboo for several days, and then keeping it in a shady and dry place (Lawa & Nggada, 2020). This practice has cultural, social, and scientific value because it reflects natural preservation principles that are relevant to the concept of preservative additives in science learning. Salt (NaCl) acts as a natural additive that inhibits the growth of microorganisms through osmosis by drawing water out of meat tissue and microbial cells. This creates conditions that are less suitable for bacterial growth. Corn bran helps absorb excess water and maintain humidity inside the bamboo so that the preserved food does not become too wet. In addition, corn bran

contains natural compounds such as phenols and organic acids in small amounts, which may contribute to the preservation process. The use of bamboo containers also helps maintain limited air circulation and reduce external contamination, making this traditional preservation process effective without modern technology.

The product developed in this study is a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom. This product has several advantages compared to conventional printed Student Sheets. It is designed to guide students in learning through real project activities that connect scientific concepts, particularly food additives, with everyday life and local cultural practices. Through the Project-Based Learning approach, students are encouraged to actively construct knowledge through direct experience, collaboration, critical thinking, and the creation of meaningful products (Widyastuti & Kurniawati, 2022). The integration of Ngada local wisdom also makes the learning process more contextual because students can understand scientific concepts through cultural practices that are close to their environment. Thus, the digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom has pedagogical, cultural, and technological value. It can support more meaningful and contextual science learning at SMPS PGRI Bajawa.

However, previous studies still show several limitations. First, the development of Student Sheets in science learning is still often dominated by printed and conventional formats, so it does not fully support interactive and flexible learning. Second, previous studies related to Project-Based Learning generally focus on improving learning outcomes, creativity, or collaboration, but have not sufficiently connected project activities with local cultural practices. Third, studies on local wisdom in science learning tend to emphasize cultural content separately, without integrating it into a structured project-based learning process. Fourth, previous studies have not widely developed digital Student Sheets that combine Project-Based Learning and Ngada local wisdom in one integrated product, especially for the topic of food additives. Therefore, the research gap lies in the limited availability of digital Student Sheets that comprehensively integrate Project-Based Learning, Ngada local wisdom, and science concepts in contextual learning.

Based on this gap, this study offers novelty by developing a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom for the topic of food additives. The developed product is expected to increase student activeness, develop critical thinking skills, support collaboration, and create contextual and meaningful science learning. This study aims to develop and test the feasibility of a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom for students of SMPS PGRI Bajawa.

Method

This study used a research and development method, commonly known as R&D. The purpose of this research was to develop a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom for science learning on the topic of food additives.

The development process used the adapted ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The ADDIE model was selected because it provides a systematic framework for designing and developing learning products. In this study, the implementation stage was limited to a small-scale trial, while the evaluation stage was conducted formatively throughout the development process.

The development of the digital Student Worksheet applied the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The analysis stage identified learning problems, student characteristics, curriculum needs, and the relevance of Ngada local wisdom to the topic of food additives, revealing the need for contextual, interactive, and project-based learning materials. In the design stage, the researcher prepared learning objectives, project activities, content organization, and research instruments, including validation sheets and response questionnaires. The development stage focused on producing the digital Student Sheet and validating it through material, media, and language experts who assessed content quality, design, language, and the integration of Project-Based Learning and Ngada local wisdom. The implementation stage involved a limited trial with ninth-grade students at SMPS PGRI Bajawa to evaluate practicality and user responses. Finally, formative evaluation was conducted throughout the process to revise and improve the product's validity, practicality, and suitability for science learning.

This research was conducted at SMPS PGRI Bajawa. The research subjects were ninth-grade students who participated in the limited trial of the digital Student Sheet. The sample was selected using purposive sampling because the students were chosen based on specific considerations, namely their involvement in science learning on the topic of food additives and their suitability as users of the developed product.

The limited trial involved 20 students from class IX of SMPS PGRI Bajawa. In addition, one science teacher was involved as a respondent in the practicality assessment and as a source of information related to the learning process. Expert validators were also involved to assess the quality of the developed product, consisting of a material expert, a media expert, and a language expert.

The data in this study were collected using interviews, validation sheets, and questionnaires. Interviews were used to obtain information about learning needs, classroom problems, and the relevance of the developed product to the learning context. Validation sheets were used to assess the validity of the digital Student Sheet based on expert judgment.

Meanwhile, teacher and student response questionnaires were used to determine the practicality of the product after the limited trial.

The validation sheet covered several aspects, including content suitability, presentation, language, media design, Project-Based Learning components, and the integration of Ngada local wisdom. The practicality questionnaire focused on ease of use, clarity of instructions, attractiveness of display, usefulness of project activities, and students' engagement in learning.

The validity of the instruments was examined through expert judgment. The validation sheets, interview guidelines, and response questionnaires were reviewed by experts to ensure that each item was relevant, clear, and appropriate for the research objectives. The expert validation process was used to check whether the instruments were suitable for measuring the validity and practicality of the digital Student Sheet.

Instrument reliability was considered through the consistency of assessment indicators and the use of clear scoring rubrics. The validation rubrics were arranged using a Likert scale to help validators assess each aspect consistently. The teacher and student response questionnaires were also structured using clear and measurable indicators so that the responses could reflect the practicality of the product more accurately.

The data were analyzed using qualitative and quantitative descriptive analysis. Qualitative data were obtained from interviews, comments, and suggestions from validators, teachers, and students. These data were used as the basis for revising and improving the digital Student Sheet.

Quantitative data were obtained from expert validation sheets and teacher and student response questionnaires. The validation results were used to determine the validity level of the product, while the questionnaire results were used to determine its practicality. The results were then interpreted based on predetermined criteria, such as very valid, valid, practical, or very practical. The analysis focused on describing the feasibility and practicality of the developed digital Student Sheet rather than presenting complex statistical calculations.

Result and Discussion

Result

The analysis phase was conducted to identify the need for digital student worksheet development. Based on interviews with science teachers at SMPS PGRI Bajawa, it was found that students still experience difficulties in understanding the differences between natural and artificial additives and have misconceptions regarding the dangers of additives. The learning process is still conventional and less engaging because it is limited to the use of textbooks and lecture methods. From a curriculum perspective, learning has referred to Learning Outcomes

(CP) and Learning Objective Flow (ATP), but has not been optimal in developing students' critical thinking skills. In terms of characteristics, students prefer visual, interactive, and activity-based learning. In addition, learning has not utilized the potential of Ngada local wisdom, such as the processing of traditional Hui Wu'u food that is relevant to the concept of additives. Therefore, it is necessary to develop digital student worksheets based on Project Based Learning (PjBL) integrated with local wisdom.

Design stage; The design stage is carried out after the analysis stage to design the product to be developed. At this stage, researchers drafted a digital Student Worksheet based on Project Based Learning (PjBL) adapted to the results of the needs analysis, student characteristics, curriculum, and the local context in the Ngada area. In addition, at this stage, an assessment instrument was also developed to assess the feasibility of the product being developed. The developed instrument covered important aspects in the development of learning media, namely material feasibility, media feasibility, language feasibility, and practicality of product use. These instruments were then used in the next stage, namely the development stage, to carry out a validation process by experts and trials with teachers and students. With a systematic assessment instrument, researchers were able to obtain more accurate data in assessing the quality and feasibility of the digital Student Worksheet based on Project Based Learning integrated with Ngada local wisdom. The development results can be seen in the image below:

Figure 1. Digital Student Worksheet Based on Project-Based Learning (PjBL) Integrated with Ngada Local Wisdom

Table 1. Analysis Results at the Design Stage

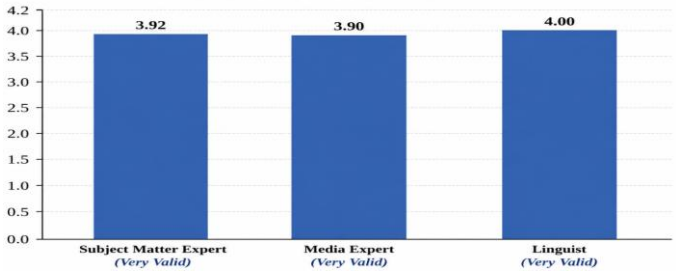
No	Design Components	Analysis Results
1	Digital Student Worksheet Structure	The Student Worksheet is designed with a systematic structure consisting of a cover, user instructions, CP and ATP, learning materials, project activities, practice questions, and reflections. The Student Worksheet structure is systematic to make it easier for students to follow the learning flow.
2	Learning model	The learning model used is *Project Based Learning* (PjBL). The Student Worksheet is designed to include project activity steps that encourage students to be active in learning.
3	Presentation of Material	The material is presented simply and linked to examples from everyday life. It is structured contextually to make it easier for students to understand.
4	Integration of Local Wisdom	The additive material is linked to the traditional Hui Wu'u food preservation process. The integration of local wisdom is carried out to increase the relevance of learning to the students' environment.
5	Supporting Media	Digital student worksheets are equipped with images and learning videos. This media is used to help improve students' understanding of the material.
6	Assessment Instrument	Validation instruments were developed by material experts, media experts, and language experts, as well as teacher and student response questionnaires. These instruments were used to assess the product's validity and practicality.

Development Stage: The development stage is carried out to determine the feasibility level of the Digital Student Worksheet based on Project Based Learning (PjBL) that has been designed in the previous stage. At this stage, the researcher validates the product by three validators, namely a material expert validator, a media expert validator, and a language expert validator. The validation process is carried out by providing the digital Student Worksheet file along with the assessment instrument to each validator to obtain assessments, input, and suggestions for improvements to the product being developed. The assessment results from the validators are then analyzed using an average formula to determine the level of product validity. The analysis is carried out on the material, media, and language aspects contained in the digital Student Worksheet.

Table 2. Validation Results from the Three Experts

No	Validation Aspects	Average Score	Category
1	Subject Matter Expert	3.92	Very Valid
2	Media Expert	3.90	Very Valid
3	Linguist	4.00	Very Valid
	Average	3.94	Very Valid

The graph of the validation results can be seen in the following figure.



Fifure 2. Validation Results

The value indicates that the digital Student Worksheet based on Project Based Learning (PjBL) developed has met the eligibility criteria from various aspects, namely the content aspect, media design, and language use such as the product developed is in accordance with the curriculum, has an attractive and communicative appearance, and uses language that is easy for students to understand. Thus, the digital Student Worksheet is worthy of being tested at the implementation stage. Based on the results of the analysis from the three validators, it can be concluded that the digital Student Worksheet based on Project Based Learning developed has met the eligibility criteria as a learning medium. The average score of 3.94 indicates that the product developed is in the very valid category, so it is worthy of being used in the learning process after going through several improvements according to the suggestions from the validators.

Implementation stage: this stage is the stage to test the use of the Digital Student Worksheet product based on Project Based Learning (PjBL) which has been developed and revised based on input from the validators in the previous stage. At this stage the researcher implemented the digital Student Worksheet to prospective product users, namely teachers and students at SMPS PGRI Bajawa. The trial was carried out on February 23–25, 2026. The purpose of this implementation stage is to determine the level of practicality of the digital Student Worksheet when used in the learning process. Data at this stage was collected using the teacher response questionnaire instrument and the student response questionnaire that had been prepared in the previous stage. The practical results of the digital Student Worksheet are presented in Table 5 below.

Table 3. Practical Results of Digital Student Worksheet

No	Respondents	Percentage	Category
1	Students (5 people)	98.13%	Very Practical
2	Teacher	97.91%	Very Practical

Based on Table 5, student and teacher responses to the digital worksheets (Student Worksheet) were categorized as very practical. This indicates that the Student Worksheets are easy to use, engaging, and facilitate the learning process. This means that digital Student

Worksheets can increase student engagement in learning, facilitate understanding of the material, and support more active and contextual learning. This limited trial also demonstrated that the product can be used effectively in real-world classroom settings.

Evaluation stage. In this stage, the author revised other inputs obtained from experts, including: improving the visual appearance, refining the material to be more contextual, and adjusting the language to be simpler and more communicative. In addition, the researcher also improved the user manual to be clearer and added illustrations that were more relevant to students' lives. This evaluation aims to ensure that the digital Student Worksheet is truly suitable for use in science learning. The purpose of this stage is that the digital Student Worksheet product based on Project Based Learning is truly suitable for use in the science learning process, especially on the material on Additives. Thus, the final product in the form of a digital Student Worksheet based on Project Based Learning (PjBL) integrated with Ngada local wisdom is declared very valid and very practical, so it is suitable for use as a learning medium for the material on additives in junior high schools. The following is a link to the product that has been validated by the three experts: https://sites.google.com/view/lkpd-digital-z a t-aditif-pengaw/pembuka

Discussion

Based on the results of the study, the development of a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom on food additives was carried out through the ADDIE stages, namely analysis, design, development, implementation, and evaluation. Each stage contributed to the quality of the final product, resulting in a digital Student Sheet that was valid, practical, and suitable for use in science learning.

In the analysis stage, the findings showed that science learning on food additives still used limited and less interactive teaching materials. Students had difficulty understanding concepts and were not fully able to connect the material with real-life situations. The lack of digital learning media also reduced student engagement in the learning process. These findings are in line with Nurdyansyah (2020), who stated that conventional teaching materials can reduce students' interest and learning activity, so interactive and technology-based teaching materials are needed. This condition shows that the development of a digital Student Sheet is relevant to support more active and contextual science learning.

In the design stage, the digital Student Sheet was arranged by integrating the Project-Based Learning model and Ngada local wisdom. The learning activities were designed in the form of projects that encouraged students to observe problems, discuss ideas, collect information, and produce learning outputs related to the topic of food additives. This finding is similar to the study by Sari et al. (2021), which found that Project-Based Learning can increase

student engagement and help students relate learning material to real-life contexts. However, this study provides a more specific contribution because the project activities are not only connected to daily life, but also linked to Ngada local wisdom, especially traditional food preservation practices.

During the development stage, the digital Student Sheet was validated by subject matter, media, and language experts. The validation results showed an average score of 3.94, which was categorized as very valid. This result indicates that the developed digital Student Sheet met the criteria of content feasibility, media design, language clarity, and learning presentation. This finding is in line with Putri and Wulandari (2022), who stated that digital worksheets developed through expert validation can be categorized as valid and suitable for learning. Compared with similar studies, the strength of this research lies in the integration of three important aspects in one product: digital learning media, Project-Based Learning, and local wisdom.

The implementation stage showed that the digital Student Sheet received very positive responses from both teachers and students. The teacher response reached 97.91%, while the student response reached 98.13%, and both were categorized as very practical. These results indicate that the digital Student Sheet was easy to use, interesting, and helpful in supporting learning activities. Students were more involved in discussions, group work, and project completion. This finding supports Rahmawati et al. (2023), who found that PjBL-based digital worksheets can increase student interaction and activeness in learning. Similar findings were also reported by Hidayat et al. (2021), who stated that Project-Based Learning can improve collaboration, motivation, and critical thinking skills.

The integration of Ngada local wisdom also made the learning process more meaningful. Students were able to understand the concept of food additives through examples that were close to their cultural environment. This finding is consistent with Fitriani and Nurhayati (2021), who stated that teaching materials based on local wisdom can improve conceptual understanding because learning becomes more contextual. Pratama and Santoso (2023) also explained that local wisdom-based learning can improve scientific literacy and strengthen the relevance of science material to everyday life. Therefore, this study supports previous findings that local wisdom can be used as an effective context in science learning.

Compared with previous studies, this research has a distinctive contribution. Previous studies on Project-Based Learning generally focused on improving student activity, collaboration, or learning outcomes. Meanwhile, studies on local wisdom often emphasized cultural content as a learning context. However, not many studies have combined Project-Based Learning, digital Student Sheets, and Ngada local wisdom in one integrated science

learning product. Therefore, this study fills the gap by developing a digital Student Sheet that combines project activities with local cultural practices, especially in the topic of food additives.

The evaluation stage was carried out based on input from validators, teachers, and students. The revisions mainly focused on improving the appearance, language, clarity of instructions, and learning presentation. This shows that the product had already met the main feasibility criteria, while the revisions were made to make the product clearer and easier to use. This finding is in line with Wahyuni et al. (2022), who stated that evaluation in teaching material development is important to refine the product and ensure that it meets user needs.

However, this study also has several limitations. First, the implementation was conducted only in a limited trial, so the results cannot yet be generalized to a wider student population. Second, the study was conducted in one school, namely SMPS PGRI Bajawa, so the practicality results may be influenced by the specific learning conditions of that school. Third, this study focused only on the topic of food additives, so the digital Student Sheet still needs to be tested on other science topics. Fourth, the study only measured validity and practicality, while the effectiveness of the product in improving learning outcomes, critical thinking skills, or scientific literacy was not examined in depth. Therefore, further research is needed to test the effectiveness of the digital Student Sheet using a wider sample, different schools, and more varied science topics.

Overall, the results of this study indicate that the digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom is very valid and very practical for use in science learning. The product can help students learn science more actively, contextually, and meaningfully. In addition, this study strengthens previous findings that Project-Based Learning and local wisdom can support student engagement and conceptual understanding. The novelty of this study lies in the integrated development of a digital Student Sheet that combines Project-Based Learning, Ngada local wisdom, and the science concept of food additives into one learning product.

Conclusion

Based on the results and discussion, this study successfully developed a digital Student Sheet based on Project-Based Learning integrated with Ngada local wisdom for science learning on the topic of food additives. The product, developed using the ADDIE model, was found to be very valid and very practical because it met the criteria for content suitability, media design, language use, ease of use, clarity, and attractiveness. The main contribution of this study is the integration of digital learning media, project-based activities, and Ngada local wisdom into one contextual science learning product. Through this digital Student Sheet, students are encouraged to learn actively, collaborate with peers, and connect

scientific concepts with local cultural practices that are close to their daily lives. Therefore, the developed digital Student Sheet is suitable for use as a supporting medium in junior high school science learning. Future research is recommended to test the effectiveness of this product on students' learning outcomes, critical thinking skills, scientific literacy, and collaboration skills by involving larger samples, different schools, and other science topics.

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