

Exploring the impact of homework assignments on achievement and attitudes in science education

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Abstract

The aim of this study is to review the effects of homework in science education studies in the electronic database. Moreover, journals published in the electronic database were searched using the same keyword. 21 studies were chosen related to the effects of homework in the science education context and analyzed by means of standards obtained from the related literature. A qualitative thematic review was used in this study. All articles were downloaded and read by the researchers. Each researcher studied together to determine themes. The themes were decided as students', teachers', and parents' views about homework assignments and the positive and negative effects of homework assignments on achievement, and attitudes. Results were reviewed in terms of the effects of a homework assignment in science education studies. Some implications of these results were proposed for determining and developing the effects of homework assignments in science education studies.

Keywords: effects of homework assignment, homework in science education

INTRODUCTION

A lot of memorization and conceptual understanding is needed in the study of science. Homework can aid students in reviewing what they have learned in class and improving their memory of it (Prabha, 2020). However, a student may suffer negative effects and become overburdened if they have too much homework. Right amount of homework must be given, and teachers must make sure it is not too monotonous or repetitive.

Homework can have both positive and negative effects on science education according to Cooper and Valentine (2001). On the positive side, homework can help students gain a deeper understanding of the material they are studying. It can also give them practice in applying what they have learned. On the negative side, homework can be a source of stress and frustration, especially if it is not well-designed or if it is given in excess. In addition, homework can take away from time

that could be spent on more enjoyable activities such as playing outside or spending time with family or friends.

While assigning homework can help students remember what they have learned in class, it can also be detrimental to their comprehension of science. Students may become discouraged and begin to dislike science if they are given too much or too challenging homework (Kryukova et al., 2022; Platonova et al., 2022). Due to this, they may have difficulty in class and ultimately give up on science. As students look for ways to complete work more quickly, having too much homework can also encourage cheating. When assigning homework, it's critical for teachers to strike a balance between time commitment and aptitude (Ellsworth & Buss, 2000).

According to Herreid and Schiller (2013), homework has been shown to have a positive effect on student achievement in science, especially when it comes to problem-solving and critical thinking skills and homework can also help students to learn how to manage their time and resources effectively.

Contribution to the literature

- This study can provide a comprehensive summary of the current research in the field of homework assignments including the main findings, key studies and important developments.
- This study can highlight the most important findings and developments in exploring the impact of homework assignments on achievement and attitudes in science education showing what is already known and what needs further investigation.

Homework generally refers to tasks given to pupils by their teachers to be completed outside regular class hours. There has been criticism of homework given in science education, with arguments that it increases the academic workload of pupils and detracts from science being seen as an enjoyable activity according to Ramdass and Zimmerman (2011). Homework in science education has been criticized for its potential to increase the academic workload of students and detract from the enjoyment of science. Some argue that homework can also lead to a better understanding of the material.

Homework is a widely used educational practice that has been shown to be effective in promoting students' learning and academic achievement in many subject areas including science (Cooper, 2010). However, the effects of homework in science education have been subject to debate among educators and researchers. A systematic review by Trautwein and Köller (2014) found that homework has a positive effect on students' academic achievement in science although the effect size was relatively small. They also found that the effectiveness of homework in science education depends on several factors including the type of homework assignment, the amount of homework assigned and the students' attitudes toward science and engagement.

Tamim et al. (2011) reviewed the effects of homework on students' academic achievement related to science education in elementary and middle school. Homework has a positive effect on students' science achievement particularly in middle school according to Tamim et al. (2011). However, it was also concluded that the effects of homework on science achievement were smaller than the effects on other subjects such as mathematics and language arts.

The aim of this study is to review the effects of homework in science education studies in the electronic database. The purpose of conducting a systematic review on the effects of homework in science education is to gather and synthesize existing research on this topic. The review aims to provide a comprehensive understanding of how homework assignments affect students' academic performance, conceptual understanding and attitudes towards science. Researchers can identify gaps in the literature and generate new research questions by analyzing the strengths and weaknesses of previous studies. Ultimately, the goal of this systematic review is to inform educators and policymakers about the role of homework

in science education and provide evidence-based recommendations for best practices in homework assignment design and implementation.

The systematic review related to the effects of homework in science education aims to address several key problems related to this topic. One problem is the lack of consensus among educators and researchers about the effectiveness of homework in promoting students' learning, achievement and attitudes toward science. Another problem is the variability in the design and implementation of homework assignments in science education making it difficult to draw generalizable conclusions from previous studies. Additionally, previous reviews of the literature have been limited in scope or have focused on a specific aspect of homework in science education, such as homework frequency or type. This systematic review seeks to address these problems by providing a comprehensive and up-to-date analysis of the literature on the effects of homework in science education, identifying key factors that influence its effectiveness, and providing evidence-based recommendations for best practices in homework assignment design and implementation.

METHOD

This study is a systematic review related to the effects of homework in science education in the last ten years. Effects of the homework assignment and homework in science education were used as keywords through the ERIC electronic database. Keywords were searched and 268 articles were found by selecting full-text and peer-reviewed articles. Finally, 21 articles were selected after reviewing all articles according to their contents. These 21 articles were reviewed one by one in detail. A qualitative systematic review was used in this study. All articles were downloaded and read by the researchers. Each researcher studied together to determine themes. The themes were decided as students', teachers', and parents' views about homework assignments and the positive and negative effects of homework assignments on achievement, and attitudes.

Table 1 summarizes the authors of the articles, the profile of the participants, and the research design. **Table 1** shows that most of the data collection tools were quantitative tools such as the Likert test, survey, questionnaires, and scale. On the other hand, the interview was used extensively as a qualitative data collection tool. Both quantitative and qualitative tools

Table 1. Article authors, country, the profile of the participants, and data collection tools

Authors	Country	Profile of the participants	Research design
Batman et al. (2022)	Northern Cyprus	7 teachers	Qualitative
Chen et al. (2022)	Taiwan	18 teachers	Mixed
Deveci and Onder (2013)	Turkey	1,539 students	Quantitative
Deveci and Onder (2015)	Turkey	1,584 students	Quantitative
Deveci et al. (2013)	Turkey	764 parents	Quantitative
Dolean and Lervag (2022)	Norway	440 students	Quantitative
Duru and Cogman (2017)	Turkey	621 students	Quantitative
Fan et al. (2022)	China	1,349 students	Quantitative
Fatma (2014)	Turkey	705 students	Quantitative
Haq et al. (2020)	Pakistan	100 teachers	Quantitative
Kukliansky et al. (2016)	Israel	25 teachers	Mixed
Kurt and tas (2019)	Turkey	328 students	Quantitative
Maharaj-Sharma & Sharma (2016)	Australia	34 students	Mixed
Mešić et al. (2021)	Bosnia and Herzegovina	39 students	Quantitative
Ratniyom et al. (2016)	India	76 pre-service teachers	Quantitative
Salame & Hanna (2020)	USA	163 participants	Quantitative
Sayan and Mertoglu (2020)	Turkey	100 teachers	Mixed
Tas et al. (2014)	Turkey	168 teachers	Quantitative
Tas et al. (2016)	Turkey	618 students	Quantitative
Uanhoro & Young (2022)	Taiwan	162 students	Quantitative
Yildiz and Sahin (2017)	Turkey	669 students	Quantitative

were used in some of the studies. These studies were called “mixed” studies.

Table 2 summarizes aims of selected studies. These aims are related to the effects of homework assignments in science education and science education participants’ views and opinions about homework assignments.

THEME 1: STUDENTS’, TEACHERS’ & PARENTS’ VIEWS ABOUT HOMEWORK ASSIGNMENT

To evaluate positive or negative effects of homework in science education, it is first necessary to examine stakeholders’ ideas and opinions about homework. For this purpose, as the first theme, the opinions and thoughts of all participants in literature on homework in science education were addressed in detail.

Most of the studies showed that students’, teachers’, and parents’ views about homework assignments were multidimensional with respect to some variables. For example, Deveci and Onder (2015) found that female students’ function scores were higher than those of male students when the scores for the function, attitude, and behavior subscales were investigated by gender. Besides this, students who allotted more time for reading, homework, and research scored higher on each subscale than those who did not. The behavior of students who spent more time watching TV, playing computer games, or taking private classes was worse than that of students who spent less time engaging in these activities. Also, Deveci and Onder (2013) concluded that by completing these homework assignments, students can comprehend subject matter better, develop their research, reading, observation, experimentation, and writing skills, learn

about natural phenomena and living things, finish tests more quickly, and gain knowledge of current events.

On the other hand, Sayan and Mertoglu (2020) stated that most teachers believe that assigning homework is necessary and do not support its prohibition. For repetition and reinforcement, teachers frequently give homework assignments. The most frequently assigned types of homework are project assignments and research presentation assignments. Teachers assign homework, which students can complete primarily at home while spending zero-one hour with their friends. For reinforcement, repetition, and learning, teachers claim that homework is the most beneficial. Most of the teachers in the study were found to not be using portfolios. Concentration, reluctance, and a lack of knowledge, according to the study’s participating teachers, are the main factors that influence student motivation. In another study, Fatma (2014) discovered that students’ opinions on homework did not significantly differ, but they did vary according to class levels in terms of factors like gender or parents’ educational backgrounds. Additionally, a sizeable portion of students thinks that science homework does not develop their critical thinking and creativity skills. The students also mentioned that they were more careful and gave their homework more time because it would help them do well on the high school entrance exam. According to Tas et al. (2014), teachers assigned homework for several reasons, such as knowledge acquisition, skill development, and updating parents on their children’s progress. According to structural equation modeling, small class sizes made teachers more likely to value homework; these teachers were also more

Table 2. The aims of the studies

Article	Aims
Batman et al. (2022)	The primary goals of this study are to identify the types of homework given in the fifth-grade Science and Technology classes at public primary schools in Northern Cyprus and to ascertain the opinions of the teachers regarding homework policies.
Chen et al. (2022)	The study aimed to offer all of the students with “daily extracurricular reading for pleasure” and observe how intrinsic motivation interacts with the reading experience.
Deveci and Onder (2013)	The purpose of this study is to investigate the students’ perspectives on the assigned homework in science and technology courses through a qualitative search.
Deveci and Onder (2015)	Inquiring into the opinions of the students on the homework given in science classes was the goal of the current study.
Deveci et al. (2013)	The purpose of this study was to learn what parents thought about the homework that was assigned in science and technology courses.
Dolean and Lervag (2022)	The aim of this study is to demonstrate whether and how much different homework loads affect elementary school students’ academic performance.
Duru and Cogman (2017)	The aim of this study is to look into how primary and secondary school students and their parents feel about homework as well as the issues that arise when completing it from their perspective as parents.
Fan et al. (2022)	The purpose of this study is to get a deeper understanding of homework creativity.
Fatma (2014)	The purpose of current study was to learn what middle school students’ (n=705) opinions were regarding homework. Also, it investigated to see if these opinions vary on a number of factors, including gender, social class, & parental education.
Haq et al. (2020)	The goal of the current study was to determine how homework affected secondary students’ academic performance in Gilgit Baltistan.
Kukliansky et al. (2016)	The present study aims to partially fill this void by broadening our understanding of what middle-school science teachers know about, their attitudes toward and beliefs about, and their classroom practices involving homework.
Kurt and Tas (2019)	The purpose of this study is to investigate how students’ deep learning and time management techniques during homework are predicted by parents’ support for their children’s science assignments and by students’ goal orientation.
Maharaj-Sharma & Sharma (2016)	The purpose of this research is to reveal secondary school science students’ views about class-assigned homework by exploring the factors and/or experiences that, they believe, have influenced their views.
Mešić et al. (2021)	The purpose of it was to design such a minds-on simulation-based approach to physics homework and to compare its effectiveness to traditional physics homework.
Ratniyom et al. (2016)	This research was performed in order to investigate the use of online homework affecting the performance of first-year pre-service science teacher students studying introductory organic chemistry chapters.
Salame & Hanna (2020)	This essay aims to investigate how students view the value of online homework, its contribution to the development of students’ problem-solving abilities and study habits, and its influence on students’ attitudes and academic performance
Sayan and Mertoglu (2020)	The aim is to look into how science teachers feel about giving students homework.
Tas et al. (2014)	This study looks into how Turkish middle school science teachers handle homework, how much importance they place on it, and how they interact with parents about it.
Tas et al. (2016)	The objective of this study was to create and validate the Science Homework Scale (SHS), a tool that measures middle school students’ perceptions of homework policies and self-regulation in science assignments.
Uanhoro & Young (2022)	The goal of this study focused on developing a digital badge system and how such a system might impact learning in general physics.
Yildiz and Sahin (2017)	The aim is to ascertain how private middle school students feel about doing science homework online. Additionally, the association between these students’ perceptions of online homework and their academic outcomes in science lessons was looked at.

likely to communicate with parents about homework, which helped students complete their assignments.

Batman et al. (2022) showed that homework assignments were designed to help students review and retain the material they had learned in class. They did not give the students any homework that could be

considered extension work or work that would help them develop higher-order thinking skills. All the teachers agreed that homework helps with grades and the college entrance exam, which is a requirement to enroll in secondary school in Northern Cyprus, in addition to the fact that homework helps students succeed. Both primary and secondary school students

reported that they prefer task-based homework, such as projects or designing something, over longer-duration assignments like reading and writing according to Duru and Cogmen (2017). Students in primary schools enjoy math homework the most, while those in secondary schools prefer science assignments. When asked which types of homework they like or dislike, students cited emotional factors (liking/disliking, boring/enjoyable, feelings about the teacher, feeling qualified or unqualified). The homework was given out for practice, according to the parents. For primary school students, not wanting to do their homework, and for secondary school students, unclear tasks, they claimed is the most common issue. Moreover, Maharaj-Sharma and Sharma (2016) stated that teachers are inconsistent about collecting and marking homework and that sometimes the homework tasks are either regurgitation, irrelevant to the current class topic, or overly challenging and thus go beyond what is covered in classroom learning. Most students perceived homework as an unnecessary chore from which no meaningful learning emerged. Furthermore, Devenci et al. (2013) found that civil servants in the occupational category had lower function scores than self-employed, farmers, workers, artisans, and retired people. In the category of the level of education, university graduates were found to have lower function scores than primary school, secondary school, and high school grads. It was also discovered that high earners in each related group had function scores that were lower than those of other members in the monthly income group. In another study, Tas et al. (2016) showed that students' perceptions of the quality of their homework and the feedback they received were related to aspects of homework self-regulation that were, in turn, related to science achievement. The objective of this study was to create and validate science homework scale, a tool that measures middle school students' perceptions of homework policies and self-regulation in science assignments.

THEME 2: POSITIVE & NEGATIVE EFFECTS OF HOMEWORK ASSIGNMENTS ON ACHIEVEMENT & ATTITUDES

Based on the idea that homework assignments in science education can have significant effects on academic achievement, attitude, motivation, and other perceptions, studies related to the effects of homework assignments on some variables in the literature were examined. Firstly, the findings of Yildiz and Sahin's (2017) study showed that the students' attitudes toward completing online homework for science lessons were favorable. According to Haq et al. (2020), homework has a significant impact on student's achievement and varies depending on the age of the students. Moreover, Fan et al. (2022) demonstrated that the eight-item version of the

homework creativity behaviors scale had acceptable validity and reliability; homework creativity explained less variation in academic achievement than homework completion and homework time and homework creativity explained more variation in general creativity than homework completion and homework time. Contrary to popular belief, completing homework and having creative homework has a positive impact on students' overall creativity. Similarly, Dolean and Lervag (2022) revealed a notable immediate effect of homework quantity on writing proficiency (but not on math proficiency). Only for the group that had dedicated a reasonable amount of homework to practicing writing skills were the effects of writing homework still evident four months later. This study supports giving elementary school students a moderate amount of writing homework by demonstrating that the extra opportunities for practice provided by homework can have different short- and medium-term effects on their academic achievement. According to Salame and Hanna (2020) students' perceptions, attitudes, learning experiences, comprehension, and learning outcomes were all positively impacted by online homework. Additionally, it gave students more time to complete tasks, which benefited their achievement, engagement with the subject matter, and meaningful learning. Finally, according to data, online homework helped students improve their active participation in class, study skills, and comprehension. Furthermore, Ratniyom et al. (2016) showed that the implemented treatment had a significant positive impact on the performance of pre-service science teachers and that the online homework was a useful tool for boosting students' understanding of basic organic chemistry. Investigations were made into the relationships between the grade on the online homework and the different course components. Between the students' online homework grades and the normalized gain as well as between the online homework grade and their post-test results, there were moderate and statistically significant correlations. As a result, the online homework score results were used to predict student test scores. Their performance in the introductory organic chemistry chapter and their overall grades were found to be statistically significantly correlated. This implied that students' learning behaviors improved when they finished their online homework.

In another study, Uanhoro and Young (2022) found that students had a favorable opinion of badges based on a questionnaire that was distributed to study participants near the end of the investigation. These results support earlier research by other researchers who found that badges can be used to encourage student behaviors with only minor course structure changes. The discovery that badges may not be particularly helpful to motivate students toward difficult tasks, however, further supports earlier research. In a previous study of

this course in a previous academic year, it was discovered that students valued the online homework system. It appears from this study that the main purpose of badges within the system is to improve the experience of students and to encourage prompt engagement with assignments. Besides this, Mešić et al. (2021) demonstrated through covariance analysis that the hands-on simulation-based homework was significantly more successful than conventional homework in helping students develop their understanding of gas laws. Students in the experimental group thought the simulation-based homework was interesting, difficult, and helpful. Likewise, Chen et al. (2022) showed that after using this notebook, these 7th and 8th grade students significantly improved their epistemic understandings of the source and the (un)certainly of scientific knowledge. Individual student interests in science and reading were linked to their epistemic perspectives on the development of science and scientific justification techniques. Particularly, Kurt and Tas (2019) discovered that only the mastery goal orientation among the goal orientations accurately predicted the deep learning strategy, and the relationship was positive. 61% of the variance in the management of homework and 53% of the variance in the deep learning strategy were explained by parental support for homework and students' goal orientation in homework.

On the other hand, Kukliansky et al. (2016) showed that teachers have a wide range of attitudes, beliefs, and actions and that they simultaneously hold both positive and negative views. Additionally, there were discrepancies between the opinions expressed in the interviews and the teacher's actual classroom behavior for some categories and agreement for others.

CONCLUSION & RECOMMENDATIONS

When the studies are analyzed, it is seen that homework has many complex and multidimensional effects on science education. In addition, the opinions, thoughts, and perspectives of the participants about homework also shape these effects.

This review study examined previous research on the effects of science homework assignments in science education. In some of the studies, the opinions of all stakeholders (students, parents, and teachers) about homework in science education were examined and it was concluded that many variables could affect these opinions (Batman et al., 2022; Deveci & Onder, 2013, 2015; Deveci et al., 2013; Duru & Cogmen, 2017; Fatma, 2014; Maharaj-Sharma & Sharma, 2016; Sayan & Mertoglu, 2020; Sorakin et al., 2022; Tas et al., 2014, 2016).

On the other hand, some studies focused on the positive or negative effects of homework on science education and provide explanations about the sources of these effects (Chen et al., 2022; Dolean & Lervag, 2022; Fan et al., 2022; Haq et al., 2020; Kukliansky et al., 2016;

Kurt & Tas, 2019; Mešić et al., 2021; Oschepkov et al., 2022; Qarkaxhja et al., 2021; Ratniyom et al. 2016; Salame & Hanna, 2020; Uanhoro & Young, 2022; Yildiz & Sahin, 2017; Zhdanov et al., 2022).

Through homework, teachers should encourage students to develop necessary skills such as the ability to understand and read different representations, as well as how to translate between them. As a result of using homework in such a manner, teachers may be able to strengthen the link between homework and the learning of science by using homework in this manner. Therefore, it was suggested further research to develop and evaluate an intervention program aimed at enriching science teachers' perspectives on homework.

When designing homework assignments in science classes, it can be helpful to consider variables such as gender, grade level, and time spent on different activities. The metacognitive abilities of self-regulation, critical thinking, creativity, and time management can all be enhanced by science homework assignments. Teachers need to exercise caution when it comes to both the quantity and quality of science homework. The results of this review could also have some useful applications. For example, there should be creativity in homework and homework creativity may simultaneously contribute to academic success and general creativity, making it a valuable learning objective.

This study is limited to Eric's database. Given the limitations of this work, more academic databases and search engines such as Scopus, Web of Science, and Google Scholar should be explored. This was done to conduct a broader and more detailed background search for relevant literature related to the effects of homework in science education. The study was also limited to 21 articles for review. Several articles can be reviewed in return and systematically reviewed to answer the developed research questions.

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REFERENCES

- Batman, K. A., Beidoglu, M., & Koklu, S. (2022). Homework assignments for the science and technology course in 5th grade in Northern Cyprus.

- Cogent Education*, 9(1), 2149227. <https://doi.org/10.1080/2331186X.2022.2149227>
- Chen, S. Y., Chen, C. H., & Liu, S. Y. (2022). History of science reading materials as everyday homework to improve middle school students' epistemological beliefs about science. *International Journal of Science and Mathematics Education*, 20, 69-92. <https://doi.org/10.1007/s10763-022-10285-3>
- Cooper, H. (2010). Homework research and policy: A review of the literature. *Educational Researcher*, 39(2), 93-109.
- Cooper, H., & Valentine, J. C. (2001). Using research to answer practical questions about homework. *Educational Psychologist*, 36(3), 143-153. https://doi.org/10.1207/S15326985EP3603_1
- Deveci, I., & Onder, I. (2013). The students' views related to the given homeworks in the science and technology courses: A qualitative study. *US-China Education Review A*, 3(1), 1-9.
- Deveci, I., & Onder, I. (2015). Views of middle school students on homework assignments in science courses. *Science Education International*, 26(4), 539-556.
- Deveci, I., Onder, I., & Cepni, S. (2013). Parents' views regarding homeworks given in science courses. *Journal of Baltic Science Education*, 12(4), 497-508. <https://doi.org/10.33225/jbse/13.12.497>
- Dolean, D. D., & Lervag, A. (2022). Variations of homework amount assigned in elementary school can impact academic achievement. *The Journal of Experimental Education*, 90(2), 280-296. <https://doi.org/10.1080/00220973.2020.1861422>
- Duru, S., & Cogmen, S. (2017). Views of primary and secondary school students and their parents on homework. *Elementary Education Online*, 16(1), 354-365.
- Ellsworth, J. Z., & Buss, A. (2000). Autobiographical stories from preservice elementary mathematics and science students: Implications for K-16 teaching. *School Science and Mathematics*, 100(7), 355-364. <https://doi.org/10.1111/j.1949-8594.2000.tb18177.x>
- Fan, H., Ma, Y., Xu, J., Chang, Y., & Guo, S. (2022). Effects of homework creativity on academic achievement and creativity disposition: Evidence from comparisons with homework time and completion based on two independent Chinese samples. *Frontiers in Psychology*, 13, 923882. <https://doi.org/10.3389/fpsyg.2022.923882>
- Fatma, T. E. (2014). Elementary school students' views on the homework given in science courses. *Educational Research and Reviews*, 9(17), 594-605. <https://doi.org/10.5897/ERR2014.1809>
- Haq, M. N. U., Shakil, A. F., & Din, M. N. U. (2020). Impact of homework on the student academic performance at secondary school level. *Global Social Sciences Review*, 1, 586-595. [https://doi.org/10.31703/gssr.2020\(V-I\).59](https://doi.org/10.31703/gssr.2020(V-I).59)
- Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching*, 42(5), 62-66.
- Kryukova, N. I., Chistyakov, A. A., Shulga, T. I., Omarova, L. B., Tkachenko, T. V., Malakhovsky, A. K., & Babieva, N. S. (2022). Adaptation of higher education students' digital skills survey to Russian universities. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(11), em2183. <https://doi.org/10.29333/ejmste/12558>
- Kukliansky, I., Shosberger, I., & Eshach, H. (2016). Science teachers' voice on homework: Beliefs, attitudes, and behaviors. *International Journal of Science and Mathematics Education*, 14(1), 229-250. <https://doi.org/10.1007/s10763-014-9555-8>
- Kurt, U., & Tas, Y. (2019). Öğrencilerin fen bilimleri ödevlerinde kullandıkları stratejilerin aile desteği ve öğrencilerin hedef yönelimleri yardımıyla yordanması [Prediction of students' strategies for doing science homework by parental support and students' goal orientation]. *PEGEM Journal of Education and Instruction*, 9(2), 585-604. <https://doi.org/10.14527/pegegog.2019.019>
- Maharaj-Sharma, R., & Sharma, A. (2016). What students say about homework-views from a secondary school science classroom in Trinidad and Tobago. *Australian Journal of Teacher Education*, 41(7), 146-157. <https://doi.org/10.14221/ajte.2016v41n7.9>
- Mešić, V., Jusko, A., Beatović, B., & Fetahović-Hrvat, A. (2021). Improving the effectiveness of physics homework: A minds-on simulation-based approach. *European Journal of Science and Mathematics Education*, 10(1), 34-49. <https://doi.org/10.30935/scimath/11383>
- Oschepkov, A. A., Kidinov, A. V., Babieva, N. S., Vrublevskiy, A. S., Egorova, E. V., & Zhdanov, S. P. (2022). STEM technology-based model helps create an educational environment for developing students' technical and creative thinking. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(5), em2110. <https://doi.org/10.29333/ejmste/12033>
- Platonova, R. I., Khuziakhmetov, A. N., Prokopyev, A. I., Rastorgueva, N. E., Rushina, M. A., & Chistyakov, A. A. (2022). Knowledge in digital environments: A systematic review of literature. *Frontiers in Education*, 7, 1060455. <https://doi.org/10.3389/educ.2022.1060455>
- Prabha, S. (2020). Students' views on difficulties in conceptual understanding of science at secondary stage. In *Proceedings of the EURASIA Educational and Social Sciences* (pp. 1-10).

- Qarkaxhja, Y., Kryukova, N. I., Cherezova, Y. A., Rozhnov, S. N., Khairullina, E. R., & Bayanova, A. R. (2021). Digital transformation in education: Teacher candidate views on mobile learning. *International Journal of Emerging Technologies in Learning*, 16(19), 81-93. <https://doi.org/10.3991/ijet.v16i19.26033>
- Ramdass, D., & Zimmerman, B. J. (2011). Developing self-regulation skills: The important role of homework. *Journal of Advanced Academics*, 22(2), 194-218. <https://doi.org/10.1177/1932202X1102200202>
- Ratniyom, J., Boonphadung, S., & Unnanantn, T. (2016). The effects of online homework on first year pre-service science teachers' learning achievements of introductory organic chemistry. *International Journal of Environmental and Science Education*, 11(15), 8088-8099.
- Salame, I. I., & Hanna, E. (2020). Studying the impact of online homework on the perceptions, attitudes, study habits, and learning experiences of chemistry students. *Interdisciplinary Journal of Environmental and Science Education*, 16(4), e2221. <https://doi.org/10.29333/ijese/8543>
- Sayan, H., & Mertoglu, H. (2020). Investigation of the opinions of science teachers about homework. *Journal of Education and Learning*, 9(2), 232-241. <https://doi.org/10.5539/jel.v9n2p232>
- Sorakin, Y., Akarturk, H., Oznacar, B., Prokopyev, A. I., Burkhanova, I. Y., Musin, O. A., Shaleeva, E. F., & Krivonozhkina, E. G. (2022). Educational reflections on the coronavirus pandemic in three different countries. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(11), em2180. <https://doi.org/10.29333/ejmste/12514>
- Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, 81(1), 4-28. <https://doi.org/10.3102/0034654310393361>
- Tas, Y., Sungur, S., & Oztekin, C. (2016). Development and validation of science homework scale for middle-school students. *International Journal of Science and Mathematics Education*, 14(3), 417-444. <https://doi.org/10.1007/s10763-014-9582-5>
- Tas, Y., Vural, S. S., & Oztekin, C. (2014). A study of science teachers' homework practices. *Research in Education*, 91(1), 45-64. <https://doi.org/10.7227/RIE.91.1.5>
- Trautwein, U., & Köller, O. (2003). The relationship between homework and achievement—still much of a mystery. *Educational Psychology Review*, 15, 115-145. <https://doi.org/10.1023/A:1023460414243>
- Uanhoro, J., & Young, S. S. C. (2022). Investigation of the effect of badges in the online homework system for undergraduate general physics course. *Education Sciences*, 12(3), 217. <https://doi.org/10.3390/educsci12030217>
- Yildiz, N. M., & Sahin, E. (2017). Middle school students' attitudes toward online homework in science education: A case from a private school. *İstanbul Aydın Üniversitesi Eğitim Fakültesi Dergisi [Journal of Istanbul Aydın University Faculty of Education]*, 3(2), 1-12.
- Zhdanov, S. P., Baranova, K. M., Udina, N., Terpugov, A. E., Lobanova, E. V., & Zakharova, O. V. (2022). Analysis of learning losses of students during the COVID-19 pandemic. *Contemporary Educational Technology*, 14(3), ep369. <https://doi.org/10.30935/cedtech/11812>

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