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## **Gender Differences and Learning Outcomes Using the Ethno-PjBL Model**

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### **ABSTRACT**

**KEYWORDS:**

*PjBL,*

*Ethnoscience,*

*Gender*

Biology learning in the 21st century is a challenge for teaching staff in guiding students in developing their abilities in accordance with the 4Cs and will produce competent students. One learning model that integrates 4C is project-based learning (PjBL) which is oriented to ethnoscience. The aim of this research is to determine gender differences in the implementation of ethno-PjBL learning. The research method is descriptive quantitative. Data analysis uses the Rasch model to analyze the suitability of the items to the model used and the t-test to determine the difference in cognitive scores of male and female students. The research results show that there are differences in learning outcomes between men and women. The average score for male is 68 and female is 73.5. The Levene Test results show  $0.591 > 0.05$ , which indicates that the two gender groups have different learning outcomes. Male students complete assignments more quickly, tend to focus on content and are less interested in ethnoscience material, but their learning outcomes are no better than female students. Female students take longer to complete project assignments than male students. Female students are more interested in contextual learning presented through ethnoscience and structured design assignments through PjBL.

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## **1. INTRODUCTION**

21st century learning has characteristics which are usually referred to as the 4Cs which include creative thinking skills, critical thinking and problem solving, communicating and collaborating (Gunn & Hollingsworth, 2013). 21st century learning is a challenge for teaching staff in guiding students in developing their abilities in accordance with the 4Cs and will later produce competent students (Laal et al., 2012). One type of learning that is influenced by the 21st century is learning in the field of Biology. The demands of 21st century skills must be implemented in all fields, one of which is Biology learning (Fung et al., 2022).

Biology learning in the 21st century has experienced many significant developments along with advances in technology, new scientific discoveries, and changes in learning approaches or methods (Ligan & Tacadena, 2022). The learning model that is expected to help students have the ability to think creatively in the biology learning process is the Project-based Learning (PjBL) learning model (Elliott, 2020). The Project-Based Learning (PjBL) model is an innovative learning model which uses projects as a learning medium, the use of this project is expected to be able to actively involve students in learning and problem solving, students are also expected to be able to work in groups to produce useful products (Shuhailo & Derkach, 2021).

Project-based learning is easier for students to understand so that learning is linked to daily life according to the potential of their respective areas (Al Mulhim & Eldokhny, 2020). The potential possessed by each region includes natural resources, culture and local wisdom (Lavrillier & Gabyshev, 2021). There is a lot of Indonesian culture that can be applied in ethnoscience-based

learning, especially in biology subjects or what is usually called bioethnoscience (Suciyati et al., 2021).

Ethnoscience is an activity of transforming original knowledge into scientific knowledge (Abonyi et al., 2014). Efforts to use the environment as a learning resource in science learning are by integrating culture into society, known as ethnoscience learning (Moodie, 2019). Ethnoscience is currently one of the things studied in Indonesia because it can make students aware of rediscovering local intellectual values and integrating them into the learning process (Zidny et al., 2021).

Tanaka (2023) has investigated the influence of gender on PBL, and concluded that gender influences the way PBL students approach project work. Afriana et al., (2016) describe women's tendency toward context orientation in engineering design tasks, and note that female learners. The research results of Ali Samsudin et al., (2018) states that several factors influence the success of PjBL learning, including gender. Female students tend to be interested in structured design tasks and tend to undertake a broader range of engineering problems than males. However, the investigation carried out by Muspiroh, (2020) actually showed different results. Muspiroh stated that there is no influence of gender on the implementation of learning using PjBL. Therefore, research needs to be carried out to determine the influence of gender on PjBL by integrating an ethnoscience approach.

## **2. MATERIALS AND METHODS**

### *2.1. Research Design*

This type of research is quantitative descriptive research. Descriptive research is research with the aim of testing a hypothesis by describing the actual situation of a variable. Meanwhile, quantitative is research with data presented in the form of numbers from the start of data collection until the results obtained.

### *2.2. Population, sample and sampling*

#### *2.2.1. Population*

The research population is class IX students in the second semester at SMPN 3 Babakancikao, Purwakarta, West-Java, Indonesia, in the 2023/2024 academic year with a total of 66 students.

#### *2.2.2. Sample*

The sample in this study was all students in class XI Science semester II, totaling 66 students.

#### *2.2.3. Sampling*

The sampling method used is total sampling. total sampling is a sample selection technique carried out on all members of the population. In this research, samples were taken from the entire existing population.

### *2.3. Data analysis*

#### *2.3.1. Item Analysis Using Rasch Model*

The approach taken in Rasch modeling is different. The main goal of Rasch modeling is to create a measurement scale with equal intervals. Because raw scores do not have interval properties, they are not used directly to provide an interpretation of student abilities. Rasch modeling jointly uses score data based on each person and score data per item. These two scores

are the basis for estimating the true score which shows the level of individual ability and the level of item difficulty.

### 2.3.2. *T-test*

The t-test is an inferential statistic used to determine whether there is a significant difference between the means of two groups and their patterns of association. The t test was carried out using SPSS 16 software.

## 3. RESULTS AND DISCUSSION

### 3.1. *Item Analysis*

Fit items mean that the item behaves consistently with what is expected by the model (Sumintono, 2018). If it is found that the questions do not fit, this is an indication that there are misconceptions among students regarding the questions. Some of the fit indices provided in Rasch analysis are Person Infit ZSTD, Person Outfit ZSTD, Person Infit MNSQ, Person Outfit MNSQ, Item Infit ZSTD, Item Outfit ZSTD, Item Infit MNSQ, and Item Outfit MNSQ (Boonee et al., 2014).

Person	66	INPUT	66	MEASURED	INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	17.6	25.0	1.04	.53	1.00	.1	1.00	.1
P.SD	2.3	.0	.61	.07	.17	.8	.58	.7
REAL RMSE	.54	TRUE SD	.29	SEPARATION	.54	Person	RELIABILITY	.22

Item	25	INPUT	25	MEASURED	INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	46.5	66.0	-.36	.47	1.00	.1	1.00	.1
P.SD	13.8	.0	1.74	.43	.08	.9	.23	1.1
REAL RMSE	.64	TRUE SD	1.62	SEPARATION	2.54	Item	RELIABILITY	.87

**Figure 1. Results of Item Analysis**

The MNSQ value is always positive and moves from zero (0) to infinity ( $\infty$ ). In this case, the MNSQ value is used to monitor the suitability of the data to the model. The expected value is 1 (one). The mean square infit or outfit value is less than 1, indicating that the observed data has 22% less variation than predicted. The research results show that the z value is -1 and the standard deviation is 1.1, which means that the observed data is in accordance with the model. Meanwhile, a negative value indicates that there is not much variation in the answers. The responses were fairly regular and predictable.

The results of the analysis carried out obtained an MNSQ value of 1.00 and a ZSTD of -1, which means that the question items are good and can be used, even though the variation in answers is not too high. The level of suitability of this item is greatly influenced by the size of the sample. Errors in answer keys, many individuals who are careless in working on questions, and questions that have low differentiation power can reduce the appropriateness value of items (Bambang Sumintono. & Wahyu Widhiarso., 2013).

### 3.2. *Gender Differences in Learning*

Cognitive scores are obtained through a posttest in the form of multiple choice questions. These values are analyzed to determine the highest value, lowest value, mode, average, standard deviation, standard error for both types of gender. The results of the analysis are presented in table 1.

**Table 1. Cognitive Learning Outcomes by Gender**

Cognitive	Gender	
	Male	Female
N	36	32
Max	68	92
Min	48	52
Mode	64	84
Mean	68	73.5
Standart deviasi	8.504901	8.9861
Standart. Error Mean	1.438	1.614

Table 1 shows that the maximum value, minimum value, mode and mean of female students are better than male students. This value was obtained from the posttest questions in the form of 25 multiple choice questions which were completed at the end of the ethnoscience-based project learning. Even though the post-test results obtained show significant differences between the two gender groups, it is necessary to carry out a t test further to see the significance of the differences between the two. T test results are presented in table 2.

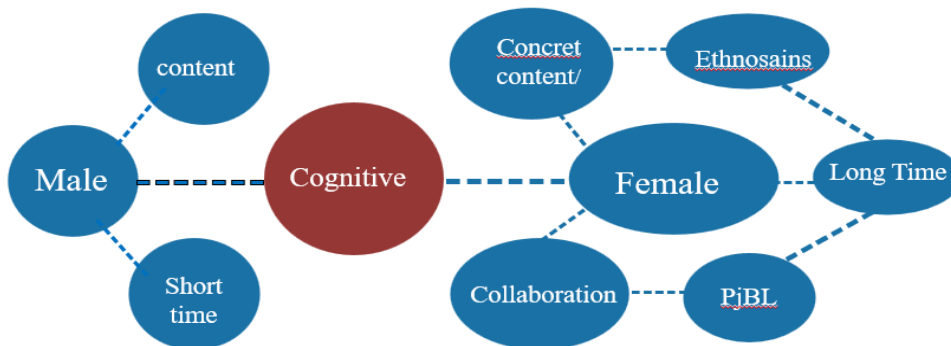
**Table 2. T-test Results of Cognitive Scores Based on Gender**

	Independent Samples Test								
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower Upper	
Equal variances assumed	.291	.591	-2.399	66	.019	-5.167	2.154	-9.467	-.866
Equal variances not assumed			-2.390	64.014	.020	-5.167	2.161	-9.484	-.849

Based on the t-test that has been carried out, it is known that the Levene's Test results are  $0.591 > 0.05$ , so the data used is Equal variances assumed data with a significance result of  $0.019 < 0.05$ , which indicates that there is a significant difference between the cognitive scores of male and female students use the ethnoscience-based PjBL learning model. Through the t-test, it is known that the two gender groups show different learning outcomes.

The term gender is defined as a socio-cultural phenomenon, a social consciousness, and as a concept for analysis. Gender is a cultural concept used to differentiate the roles, behavior, mentality and emotional characteristics of men and women that develop in society. Gender in education is not differentiated. Every student, both male and female, has the same opportunities in the learning process. Male and female students have the same opportunity to achieve maximum cognitive achievement.

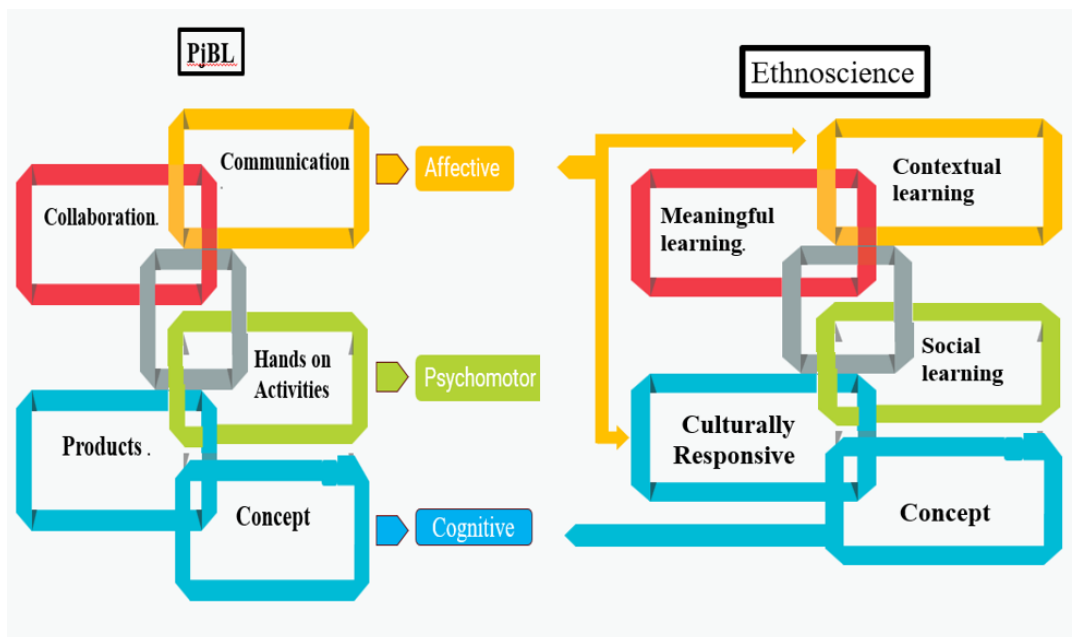
Based on the research that has been conducted, it appears that overall the cognitive scores of female students are higher than those of male students. Through ethnoscience-based project learning, female students obtained better results than male students, but showed different patterns. Male students tend to focus more on the core of the material being studied, regardless of whether there is assistance in the form of an ethnoscience approach or not. Because male students focus more on the material, they tend to be faster in completing project assignments. Although male students excel in terms of speed of completing tasks, they do not show the same results in terms of cognitive tests.



**Figure 2. Ethno-PjBL learning patterns for male and female students**

The use of ethnoscience-based project learning for female students has had a positive impact. Project-based learning builds collaboration patterns between students. The integration of ethnoscience has an impact on the material being studied to become more concrete. The process of transforming local science into modern science requires additional time. Through learning using this model, female students take longer to complete ethnoscience-based project assignments, but they show much better cognitive achievement results than male students.

Small group activities play an important role in project-based learning for cooperative decision making and problem solving among team members (Torres et al., 2019). Sometimes it is very easy for students to develop individual plans for a project, but it is necessary to determine the best solution through agreement and negotiation within the team. This will always be a challenge for lecturers (Guo et al., 2020). Collaborative learning is essential, and students can learn real-world skills naturally through project-based learning (Lin et al., 2021). Project-based learning is defined as a learning technique that allows students to carry out meaningful (Castro-Vargas et al., 2020). Project-based learning is a method where students learn problem solving through activities that involve in-depth work on assigned projects. Project-based learning is characterized by meaningful activities, learning, collaborative decision making, and problem solving through the use of digital videos, and changes in the role of lecturers (Huysken et al., 2019).



**Figure 3. Interaction in PjBL and Ethnoscience Learning**

Ethnoscience learning can transform teacher-centered learning into student-centered learning in the form of contextual and meaningful learning (Croce, 2019). Students can not only understand the material but also apply it in everyday life (Yustina et al., 2020). This makes students more interested in studying natural science and applying it to the living environment (Bohensky & Maru, 2011). The activities are ethnoscience-based, including relating material to the culture in the surrounding environment and context. The implementation of learning activities is adapted to local situations and always connects national knowledge with related topics. In other words, the application of an ethnoscience-based science learning approach only applies to certain material that can be linked to an ethnoscience approach (Zidny et al., 2020). Ethnoscience-based learning can be applied using student-centered learning methods, namely, methods of observation, questioning, classification, prediction, problem solving and drawing conclusions (Croce, 2020).

The use of the ethno-PjBL model in this research shows that most male students joke more or disturb their friends who are doing their assignments. Many male students are less motivated to participate in learning, and do not do the assignments or exercises given optimally. In general, female students are more diligent in studying and obey school rules. This is one of the factors that on average, female students have better academic achievement.

The above findings are confirmed by the results of Agustri & Rindrayani (2016) research which states that female students tend to care more about studies and they work harder than male students. Boys are more interested in technology than girls because they are always exploring computers and playing video games and they rely on technology more than girls. There are definitely solutions that can keep both genders on the same academic level such as including more technology in learning and including more practical work in academics.

Several types of research have been conducted on the topic of comparison between the performance of male students and female students. Female students are found to do better in class than male students. Female students are claimed to have better learning skills compared to boys (Ali Samsudin et al., 2018). Female students (regardless of educational background) were found to be more active in academics than male students (Afriana et al., 2016). It is a fact that male students have a lot of knowledge about the technical world and their intelligence level is completely different from that of girls but still, the difference between the values is the same and still in place. Grades in the academic field (whether students come from one educational institution or some other educational stage) have created a typical pattern that female students are better than male students (Noviyana et al., 2016.).

#### **4. CONCLUSIONS**

The use of the ethnoscience-based PjBL model shows that female students achieve higher cognitive scores than male students. Female students tend to be actively involved in group projects even though they take longer to complete assignments. The integration of ethnoscience in learning provides contextual effects for female students. However, there are still many other factors (research limitations) that must be considered for further research such as students' psychological conditions, parental background, parental education, number of siblings, and ethnicity.

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## 6. REFERENCES

- Abonyi, O. S., Achimugu, L., & Ijok Adibe, M. (2014). Innovations in Science and Technology Education: A Case for Ethnoscience Based Science Classrooms. *International Journal of Scientific & Engineering Research*, 5(1). <http://www.ijser.org> .
- Afriana, J., Permanasari, A., & Fitriani, A. (2016). Penerapan project based learning terintegrasi STEM untuk meningkatkan literasi sains siswa ditinjau dari gender. *Jurnal Inovasi Pendidikan IPA*, 2(2), 202. <https://doi.org/10.21831/jipi.v2i2.8561> .
- Agustrin, N. R., & Rindrayani, S. R. (2016). *Pengaruh Gender Dan Model Pembelajaran Berbasis Proyek Terhadap Kemampuan Berfikir Kreatif Siswa Pada Mata Pelajaran Ekonomi Kelas Xi Ips Di Sma Negeri 1 Pakel, Tulungagung*.
- Al Mulhim, E. N., & Eldokhny, A. A. (2020). The impact of collaborative group size on students' achievement and product quality in project-based learning environments. *International Journal of Emerging Technologies in Learning*, 15(10), 157–174. <https://doi.org/10.3991/ijet.v15i10.12913>.
- Ali Samsudin, M., Nurulazam Md Zain, A., Mahboobeh Jamali, S., & Ale Ebrahim, N. (2018). Physics Achievement in STEM PjBL: A Gender Study. In *Physics Achievement in STEM PjBL: A Gender Study. The Asia Pacific Journal of Educators and Education* (Vol. 32). <https://hal.science/hal-02105683> .
- Bambang Sumintono., & Wahyu Widhiarso. (2013). *Aplikasi model rasch : untuk penelitian ilmu-ilmu sosial*. Trim Komunikata Publishing House.
- Bohensky, E. L., & Maru, Y. (2011). Indigenous knowledge, science, and resilience: What have we learned from a decade of international literature on “integration”? *Ecology and Society*, 16(4). <https://doi.org/10.5751/ES-04342-160406> .
- Boonee-, W. J., Staver, J. R., & Yale, M. S. (n.d.). *Rasch Analysis in the Human Sciences*.
- Castro-Vargas, C., Cabana-Caceres, M., & Andrade-Arenas, L. (2020). Impact of Project-Based Learning on Networking and Communications Competences. In *IJACSA International Journal of Advanced Computer Science and Applications* (Vol. 11, Issue 9). [www.ijacsa.thesai.org](http://www.ijacsa.thesai.org) .
- Croce, F. (2019). Indigenous entrepreneurship, society, and the dimensions of diversity: An overview of the canadian national context. *Advanced Series in Management*, 21, 359–371. <https://doi.org/10.1108/S1877-636120190000021017> .
- Croce, F. (2020). Indigenous women entrepreneurship: analysis of a promising research theme at the intersection of indigenous entrepreneurship and women entrepreneurship. *Ethnic and Racial Studies*, 43(6), 1013–1031. <https://doi.org/10.1080/01419870.2019.1630659>
- Elliott, S. J. (2020). *Experiences of Teachers of the Deaf Using Project-Based Learning to Build Higher Order Thinking Skills*.
- Fung, C. H., Poon, K. K., & Ng, S. P. (2022). Fostering student teachers' 21st century skills by using flipped learning by teaching in STEM education. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(12). <https://doi.org/10.29333/EJMSTE/12728> .
- Gunn, T. M., & Hollingsworth, M. (2013). The implementation and assessment of a shared 21st century learning vision: A district-based approach. *Journal of Research on Technology in Education*, 45(3), 201–228. <https://doi.org/10.1080/15391523.2013.10782603> .
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102. <https://doi.org/10.1016/j.ijer.2020.101586> .
- Huysken, K., Olivey, H., McElmurry, K., Gao, M., & Avis, P. (2019). Assessing Collaborative, Project-based Learning Models in Introductory Science Courses. *Journal of the Scholarship of Teaching and Learning*, 19(1). <https://doi.org/10.14434/josotl.v19i1.26777> .
- Laal, M., Laal, M., & Kermanshahi, Z. K. (2012). 21st Century Learning; Learning in Collaboration. *Procedia - Social and Behavioral Sciences*, 47, 1696–1701. <https://doi.org/10.1016/j.sbspro.2012.06.885> .
- Lavrillier, A., & Gabyshev, S. (2021). An Indigenous science of the climate change impacts on landscape topography in Siberia. *Ambio*, 50(11), 1910–1925. <https://doi.org/10.1007/s13280-020-01467-w> .
- Ligan, H. C., & Tacadena, J. E. (2022). Teaching styles in relation to 21st century learning and innovation skills of students. *International Journal of Research Studies in Education*, 11(8). <https://doi.org/10.5861/ijrse.2022.316>
- Lin, J. W., Tsai, C. W., Hsu, C. C., & Chang, L. C. (2021). Peer assessment with group awareness tools and effects on project-based learning. *Interactive Learning Environments*, 29(4), 583–599. <https://doi.org/10.1080/10494820.2019.1593198> .
- Moodie, N. (2019). Learning about knowledge: threshold concepts for Indigenous studies in education. *Australian Educational Researcher*, 46(5), 735–749. <https://doi.org/10.1007/s13384-019-00309-3> .
- Muspiroh, N. (2020). *Perbedaan Hasil Belajar Peserta Didik Berdasarkan Gender Pada Mata Pelajaran Biologi* (Vol. 2, Issue 1). <http://syekhnhurjati.ac.id/jurnal/index.php/equalita/article/view/6441> .
- Noviyana, H., Sugianti, D., PGRI, S., & Lampung, B. (2016). Literasi Matematis Pada Project Based Learning ditinjau Dari Gender. *Jurnal Edumath*, 10(1), 47–57.

- Shuhailo, Y. V., & Derkach, T. M. (2021). Project-based learning for undergraduate engineering students minoring in textile technology and design. *Journal of Physics: Conference Series*, 1840(1). <https://doi.org/10.1088/1742-6596/1840/1/012042>.
- Suciyati, A., Suryadarma, I. G. P., & Paidi, P. (2021). Integration of ethnoscience in problem-based learning to improve contextuality and meaning of biology learning. *Biosfer*, 14(2), 201–215. <https://doi.org/10.21009/biosferjpb.18424>.
- Sumintono, B. (2018). *Rasch Model Measurements as Tools in Assessment for Learning*.
- Tanaka, M. (2023). Motivation, self-construal, and gender in project-based learning. *Innovation in Language Learning and Teaching*, 17(2), 306–320. <https://doi.org/10.1080/17501229.2022.2043870>.
- Torres, A. S., Sriraman, V., & Ortiz, A. M. (2019). Implementing Project Based Learning Pedagogy in Concrete Industry Project Management. *International Journal of Construction Education and Research*, 15(1), 62–79. <https://doi.org/10.1080/15578771.2017.1393475>.
- Yustina, Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking skills through online learning in the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia*, 9(3), 408–420. <https://doi.org/10.15294/jpii.v9i3.24706>
- Zidny, R., Sjöström, J., & Eilks, I. (2020). A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability. *Science and Education*, 29(1), 145–185. <https://doi.org/10.1007/s11191-019-00100-x>.
- Zidny, R., Solfarina, S., Aisyah, R. S. S., & Eilks, I. (2021). Exploring indigenous science to identify contents and contexts for science learning in order to promote education for sustainable development. *Education Sciences*, 11(3). <https://doi.org/10.3390/educsci11030114>.