Solar Infrastructure: MBKM Village Community Service Program, Narotama University, Surabaya, Indonesia, Connected MBKM, Village and Renewable Energy for Better Village Environment

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Abstract

This study aims to determine the involvement and benefits that can be obtained by students when participating in MBKM. The MKBM discussed was the MBKM Village Community Service Program, Narotama University, in particular the MBKM program which contributes to Renewable Energy for Better Village Environment. The research uses a quantitative approach. The populations in this study were all active Narotama University students, which amounted to 1633 students. Data was collected using a questionnaire. Data analysis was performed using descriptive and crosstab analysis. Crosstab is an analytical method that presents two different variables into one matrix. Crosstab research shows tabulations that include rows and columns. The results showed that Narotama University students had actively participated in the MBKM Building a Village activity. Student interest in this program is high and students are willing to recommend the MBKM program to other fellow students. The MBKM activities that have been followed have been able to improve the competencies and skills needed by students later when they graduate and enter the world of work. This MBKM activity can be a solution to reduce the gap that exists between university graduates and industry needs.

Keywords
Village community service program, renewable energy, solar power, energy for a better life, infrastructure

1. Introduction

Indonesia has the potential for renewable energy sources in large quantities. Some of them can be immediately applied in the country, such as bioethanol as a substitute for gasoline, biodiesel as a substitute for diesel, geothermal power, micro-hydro, solar power, wind power, and even garbage/waste can be used to generate electricity. Almost all of these energy sources have been tried to be applied on a small scale in the country (IESR, 2019).
Indonesia has a target for implementing renewable energy sources up to 2025 and 2050. The data can be seen in Table 1.

Table 1 New renewable energy power plant development target

Generator Type	Target 2025 (MW)	Target 2050 (MW)
Geothermal	7.241	17.546
Water & Microhydro	20.960	45.379
Bioenergy	5.532	26.123
Solar	6.379	45.000
Wind	1.807	28.607
Other renewable energy	3.128	6.383

Source: (IESR, 2017)

Indonesia has a target of using NRE in the national energy mix of 23% in 2025 and 31% in 2050. This target is equivalent to 45.2 GW of NRE power generations in 2025, the rest is contributed by biofuel, biomass, biogas, and coal bed, methane. In the electricity sector, Indonesia has big challenges. As of March 2019, the installed capacity of new NRE power plants was 8.80 GW, only 2% of the 443 GW of total NRE potential in Indonesia.

The Indonesian government continues to strive for the implementation of NRE in all fields, one of which is by cooperating with universities. The Minister of Education and Culture established the Merdeka Learning - Merdeka Campus (MBKM) policy in 2020 to improve the quality and relevance of undergraduate program graduates. Then, on August 5, 2020, the Ministry of Education and Culture issued Decree Number 754/P/2020 concerning Main Performance Indicators (IKU) of State Universities and Higher Education Service Institutions within the Ministry of Education and Culture in 2020. There are eight leading performance indicators to improve the quality of higher education graduates, lecturers, curriculum quality, and learning. The policy provides opportunities for students to gain broader learning experiences and new competencies through student exchanges, internships/work practices, research, independent projects, entrepreneurship, humanitarian projects, teaching in schools, and village projects/thematic community service programs. In addition, students have the freedom to participate in learning activities outside their study program in the same university with a specific credit weight. The lecturers guide all these activities with a cooperation agreement with parties outside the study program. Universities must make a more tangible contribution to economic development and progress through genuine impact innovations located downstream of the research and community service stream. Indonesia has a vast and complex higher education system with more than 4,500 universities, with 3,044 private universities (PTS).

This study aims to determine the involvement and benefits that can be obtained by students when participating in MBKM. The MKBM discussed was the MBKM Village Community Service Program, Narotama University, in particular the MBKM program which contributes to Renewable Energy for Better Village Environment.

2. Literature Review

The title of the article is Illuminant intersections: Injustice and inequality of electricity and water infrastructures of the Gujarat Solar Park, India. This research was written based on the discriminatory treatment of caste and sex differences in renewable electricity, which was built to increase the electricity supply. On the other side, its construction would jeopardize the food supply because it uses fertile soil, impacting the poor (Stock, 2021).

The second: Reconfiguring participants and infrastructure in renewable energy transitions: A regional perspective. The decentralization of renewable electricity supply makes local governments a vital player because there is an economic relationship between one city and its neighbors. Existing research suggests that collaboration between civilians is a determining factor. Future research can be carried out to figure out the role of institutions in producing side effects that occur in social and economic conditions due to the emergence of a lot of cooperation between cities (Hoicka et al., 2021).

The next one is Essential infrastructures and relevant policies for renewable energy developments in oil-rich developing countries: A Case of Iran. The study involved fifty people, including senior leaders and experts, collecting data using a census and a questionnaire. Quantitative data shows that government support for foreign investors, purchase agreements, and taxes positively affect 0.74, 0.52, and 0.68, respectively. This research improves the structure and supply of renewable energy and can be utilized by other countries with similar conditions (Ghorashi & Maranlou, 2021).

The next read is Sustainable energy planning for remote islands and the waste legacy from renewable energy infrastructure deployment. The structure makes it easy to exchange multiple indicators to adjust their plans based on the information received. It can be used to find a better renewable energy plan for isolated islands in the future. Role of grid and bulk storage in integrating variable renewable energy resources: Framework for optimal operation-driven

multi-period infrastructure planning. The excellent and more straightforward European version determines the quality of deployment and storage of renewable electricity from several existing plans. The results show market share, investment size, average electricity price, and carbon emission target (Kouloumpis & Yan, 2021).
Infrastructural coupling of the electricity and gas distribution grid to reduce renewable energy curtailment. Medium-sized power plants that combine gas and electricity distribution networks have a high economical potential. The research carried out provides new insights on how to use existing gas distribution systems to control electricity supply, reduce the likelihood of generator breakdowns, and also reduce carbon effects.
The following review is Climate-resilient interconnected infrastructure: Co-optimization of energy systems and urban morphology. Harsh weather conditions will add to power needs by 20%, which will lead to a hike in the Levelized price of energy infrastructure by 40%. Finally, it is shown that co-optimization of municipal morphology and power systems will ensure the climate elasticity of city power systems with the lowest investment (Perera, Javanroodi, & Nik, 2021).
The literature is on the clean energy transition of heating and cooling in touristic infrastructures using shallow geothermal energy in the Canary Islands. This article demonstrates the capabilities of cheap and environmentally friendly SGE technology on volcanic islands where electricity demand is high due to tourism. It also applies to the heating production sector, which faces carbon reduction requirements.
The paper is optimal planning of hybrid renewable energy infrastructure for urban sustainability: Green Vancouver. The research can assist decision-makers in writing robust policies and mechanisms to promote the consolidation of hybrid renewable power systems in urban areas.
The last one is Innovation and legacy in energy knowledge infrastructures. The concept of knowledge infrastructures improves energy social science. They are the basis of our capability to study and expand extensible energy technologies, which is a key to defining probable energy futures (Eslami et al., 2021; Gassar & Cha, 2021; Kumar, 2021; Lan et al., 2021; Lazaroiu et al., 2022; Perera, Javanroodi, Wang, et al., 2021; Shi et al., 2021; Silverman et al., 2020; van Leeuwen et al., 2021; Zwickl-Bernhard & Auer, 2021).

3. Methods

The research uses a quantitative approach. The populations in this study were all active Narotama University students, which amounted to 1633 students. Data was collected using a questionnaire. Data analysis was performed using descriptive and crosstab analysis. Crosstab is an analytical method that presents two different variables into one matrix. Crosstab research shows tabulations that include rows and columns. Thus, the characteristic is that two or more variables have a descriptive relationship. The data are qualitative, especially on a nominal scale. The variables analyzed are variables that have a nominal scale. It is the easiest way to see associations in several data with percentage calculations and one of the most valuable tools because the results are easy to communicate. Furthermore, it provides input or insight into the nature of the relationship because adding one or more variables to a two-way cross-qualification analysis is the same as keeping each variable constant.

4. Results and Discussion

4.1 Result

This study aims to determine the involvement and benefits felt by students who take part in MBKM activities. This study involved eight departments at Narotama University Surabaya, namely the management department, the law department, the civil engineering department, the accounting department, the information systems department, the information engineering department, and the early childhood education department.

Table 2 The level of importance of the MBKM program in preparing for post-campus life

Answer		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	1,211	74.2	74.2	74.2
	Important	384	23.5	23.5	97.7
	Quite important	37	2.3	2.3	99.9
	Not important	1	0.1	0.1	100.0
	Total	1,633	100.0	100.0	

Table 2 shows students' perceptions of the importance of the MBKM program to prepare for post-campus life. The results show that the majority of Narotama University students (1,211 respondents) stated that MBKM activities are

very important to prepare for life after campus life. Only 1 person stated that MBKM activities were not important to prepare for life after campus life.

Table 3 MBKM activities can meet the needs of graduates in the future

Answer		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Suitable	1,326	81.2	81.2	81.2
	Suitable	307	18.8	18.8	100.0
	Total	1,633	100.0	100.0	

Table 3 shows the research respondents' assessment of MBKM activities. MBKM activities are prepared so that students are more available when entering the world of work. The majority of research respondents (1326) stated that this MBKM activity can meet the needs of graduates in the future. MBKM activities are designed so that students have additional skills, both hard skills, and soft skills, and are better prepared to enter the world of work. Students who are involved in MBKM activities feel that this activity can provide provisions for students when students enter the world of work.

Table 4 Interested in joining the MBKM Program

Answer		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very interested	1,572	96.3	96.3	96.3
	Ordinary	61	3.7	3.7	100.0
	Total	1,633	100.0	100.0	

Table 4 shows the level of interest of Narotama University Surabaya students to join the MBKM program organized by the University. The available data shows that the majority of the research respondents are very interested (1,572 people) to join the existing MBKM activities. While the rest, as many as 61 people feel normal with the MBKM program organized by Narotama University Surabaya.

Table 5 Desire to recommend MBKM Program to friends

Answer		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very interested	1,560	95.5	95.5	95.5
	Ordinary	73	4.5	4.5	100.0
	Total	1,633	100.0	100.0	

Table 4 shows the willingness of research respondents to recommend the MBKM program to friends. Existing data shows that the majority of research respondents, Narotama University Surabaya students will recommend the MBKM program to friends. The number reached 1,560 people, equivalent to 95.5% of the total research respondents. The rest, namely 73 research respondents are neutral towards the MBKM program held by Narotama University.

Table 6 Choice of MBKM Program for Narotama University Students

Answer		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student exchange	457	28.0	28.0	28.0
	Internship/Work Practice	335	20.5	20.5	48.5
	Teaching Assistant in Education Unit	31	1.9	1.9	50.4
	Research	335	20.5	20.5	70.9
	Humanitarian Project	51	3.1	3.1	74.0
	Entrepreneurial Activities	113	6.9	6.9	81.0
	Independent Study/Project	45	2.8	2.8	83.7
	Building a Village	266	16.3	16.3	100.0
	Total	1,633	100.0	100.0	

Table 6 shows the MBKM program chosen by Narotama University students. The available data shows that the most chosen program is Student Exchange with a total of 457 people, equivalent to 20% of the total research respondents. The next option is internship and research with the same number of applicants, namely 335 people. In third place is building a village with 266 enthusiasts. This study focuses on students who take part in the MBKM building a village program. The activities carried out in this program are various, one of which is the installation of a renewable energy system for a better village environment.

This study involved eight departments at Narotama University Surabaya. The data for the eight departments can be seen in Figure 1.

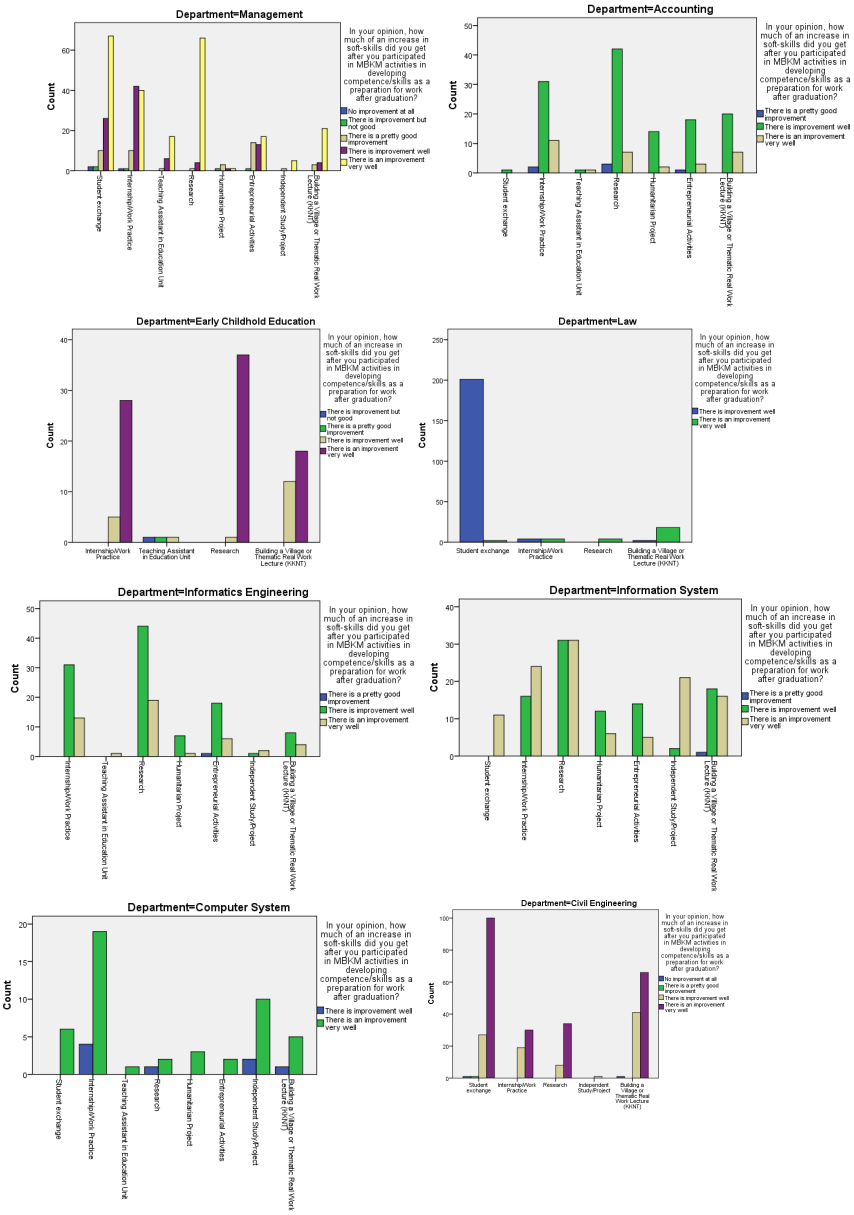

Figure 1 The impact of MBKM on students as well as the experience of students in being fully involved in MBKM, increasing competency soft skills as a provision of work competencies after graduation

Figure 1 shows the eight departments at Narotama University and the various MBKM programs selected by students. The government has set eight MBKM programs, but students are given the freedom to choose the MBKM program to be run. This research is focused on building a village program. The available data shows that the civil engineering study program students most participate in the building a village program compared to other study programs.

One of the building village programs implemented by Narotama University and has become a priority is the installation of a solar power system. The installation of this solar power system is to meet the needs for electrical energy in rural areas as well as to create a better environment. The series of installed solar power systems can be seen in Figure 2.

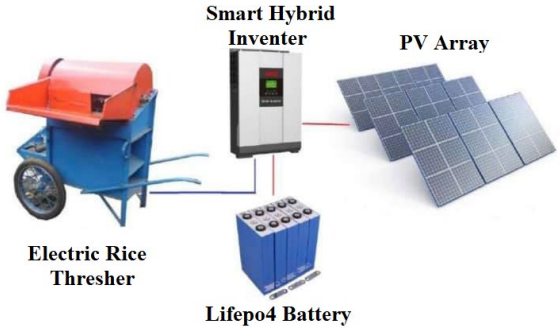

Figure 2 Series of Solar Power System To Create Better Village Environment

One of the solar power systems is installed to meet the energy needs to drive the electric rice thresher. Problems that arise in rural areas are the electricity network that has not entered the village or the electricity supply that is not stable and not continuous. The existence of this solar power system will greatly assist the fulfillment of the energy supply. This system can be used separately or can be used in a hybrid manner, combined with energy supply from the state electricity company. The way this system works is that solar energy is captured through solar cell panels. The energy taken is then sent to the smart hybrid inventor, and then stored in the battery. When needed, the energy stored in the battery is sent to electrical devices via a smart hybrid converter.
The involvement of students in the MBKM program, especially in building village activities, provides great benefits for students. This can be seen in Table 7.

Table 7 Cross tabulation between MBKM type and developing competencies

MBKM type	Developing competencies as a provision to work after graduation		Total
	Very helpful	Quite useful	
Student exchange	448	9	457
Internship	285	50	335
Teaching Assistant in Education Unit	23	8	31
Research	288	47	335
Humanitarian Project	33	18	51
Entrepreneurial Activities	82	31	113
Independent Study	44	1	45
Building a Village	236	30	266
Total	1.439	194	1.633

Table 7 shows the eight choices of MBKM programs and their benefits in improving student competence. This competency is useful for students when they enter the world of work. Existing data shows that all MBKM programs can improve student competence. Specifically for the building a village program, 266 research respondents gave an assessment. All research respondents assessed that the building a village program was able to improve student competence.

4.2 Discussion

Solar power systems have become an interesting topic of discussion in recent years. Solar power is one of the renewable energy sources that are available in abundance; therefore this energy needs to be utilized optimally. Currently, the Indonesian government has set a target for the use of solar power for 2025 and 2050. Achieving this target requires the support of various parties, one of which is universities.

Along with the MBKM program launched by the Government of Indonesia, student involvement in research activities and lecturer service is increasing. Especially for the building a village program, students are directly involved in contributing to the development of a village. Narotama University has involved many students in this activity, one of which is the implementation of solar power systems in agriculture.
The involvement of students in this activity provides many benefits. The benefits that can be obtained by students are summarized in the table below:

Table 8 Advantages of students joining the MBKM program

No	Indicator	Description
1	Developing competencies as a provision to work after graduation	The MBKM program aided students in developing the abilities and skills they would need after graduation.
2	Skill Improvement After Participating in MBKM Activities	Respondents who participate in the "Building a Village" activity believe that MBKM activities help them improve their skills.
3	Importance of MBKM to prepare for the post-college period	Students that participated in the "Building a Village" program thought MBKM was crucial in preparing for life after college.
4	The ability of MBKM activities to meet the needs of future graduates	Students that participated in the MBKM program "Building a Village" said the activities are ideal for higher schools to satisfy the demands of future graduates.

The old problem that occurs in the world of education is that there is currently a large gap between the quality of graduates and the needs of the industry. Currently, universities have not been able to produce graduates who are by the qualities needed and expected by universities (Fajar & Hartanto, 2019). As a result, many college graduates are unemployed; it is not up to the industrial world.
The existence of the MBKM program is expected to be a solution to overcome this problem. Students are deployed to the field for quite a long time, which is between 6 months to 1 year. In this period, students are expected to be able to learn firsthand about real-life conditions and provide solutions to various problems that occur. This process is expected to be able to provide thinking skills and skills so that when these students graduate and enter the world of work, they will be able to adapt quickly.
The results of this study support the research that has been carried out by Rahmawanti and Nurzaelani (2022). The MBKM program has a goal, one of which is to increase the competence of soft skills and hard skills of graduates. The purpose of this study was to determine the increase in student soft skills and hard skills as a result of the MBKM program. The research method used a descriptive survey with a sample of 140 students who took part in the MBKM program. The instrument was made to measure the increase in soft skills and hard skills of students who take part in the MBKM program with 5 indicators for soft skills, namely: (1) communication skills, (2) problem-solving abilities, (3) creativity, (4) conflict resolution skills, and (5) awareness of other cultures. Meanwhile, the indicators of hard skills discussed in this study include (1) empathy, (2) social skills, (3) the ability to use technology, (4) creative and innovative thinking, and (5) the ability to write and conduct research.
In addition, this program can also support the performance of higher education institutions, especially in research and community service issues. Narotama University has conducted a building a village program by taking the topic of solar power issues. The topic of solar power is also one of the interesting topics to be researched. The document by year, results of 83 documents, range of years to analyze: 2011 to 2021. There are: 2021 13 documents, 2020 10, 2019 10, 2018 13, 2017 7, 2016 11, 2015 5, 2014 5, 2013 4, 2012 3, and 2011 2 papers.
There are 83 document results of solar infrastructure articles on scopus.com. Select year range to analyze: 2011 to 2021, documents per year by source documents. There is more than one paper: Energy Policy 3 documents, Renewable Energy 3, Solar Energy 3, Advances In Intelligent Systems and Computing 2, Applied Energy 2, Applied Sciences Switzerland 2, Energy Procedia 2, Proceedings of The International Astronautical Congress IAC 2, and Sustainability Switzerland 2 articles.

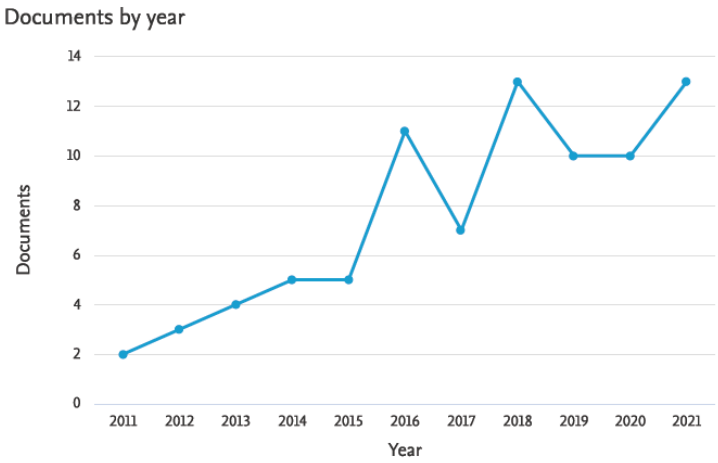

Figure 3 Solar Infrastructure articles on scopus.com, documents by year

The existing paper is from Stanford University 4, Deutsches Zentrum fur Luft- und Raumfahrt 3, Temple University 3, National Renewable Energy Laboratory 3, Kansas State University 2, University of California, Davis 2, Chemical Process Engineering Research Institute 2, Alexander Technological Educational Institute of Thessaloniki 2, Carnegie Institution of Washington 2, ETH Zürich 2, Center For Research And Technology – Hellas 2, California Institute of Technology 2, Amity University 2, and Korea Institute of Civil Engineering and Building Technology KICT 2 papers. The country of origin of the articles in The United States 24 documents, India 9, Germany 7, France 6, Italy 5, the United Kingdom 5, Greece 4, Russian Federation 4, South Korea 4, and Switzerland 4 documents. Fields of science that discuss solar infrastructure include Engineering 36, Environmental Science 21, Computer Science 15, Social Sciences 12, Materials Science 8, Physics and Astronomy 8, Chemical Engineering 6, Earth and Planetary Sciences 6, and Mathematics 6. Currently, there are no articles from Indonesia that discuss the solar infrastructure that has been indexed by Scopus. Therefore, research that discusses solar infrastructure in Indonesia needs to be improved.

5. Conclusion

The MBKM program at Narotama University Surabaya has involved eight departments, namely the management department, the law department, the civil engineering department, the accounting department, the information systems department, the information engineering department, and the early childhood education department. This study focuses on students who take part in the MBKM building a village program. The activities carried out in this program are various, one of which is the installation of a renewable energy system for a better village environment. The civil engineering study program students most participate in the building a village program compared to other study programs. Student interest in this program is high and students are willing to recommend the MBKM program to other fellow students. The MBKM activities that have been followed have been able to improve the competencies and skills needed by students later when they graduate and enter the world of work. This MBKM activity can be a solution to reduce the gap that exists between university graduates and industry needs. The suggestion that can be given is that Narotama University continues to improve MBKM activities, especially building a village. Many villages in Indonesia are still underdeveloped, and universities need intervention so that these villages can continue to develop and progress. Lecturers who join this program must also actively provide direction to students during the process so that the benefits that can be felt by students can be maximized.

Acknowledgments

The authors thank to Sekretariat Ditjen Pendidikan Tinggi, Riset dan Teknologi Direktorat Jenderal Pendidikan Tinggi, Riset dan Teknologi Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi, Indonesia, For Their Grants Financial Support Scheme, Program Penelitian Kebijakan Merdeka Belajar Kampus Merdeka dan Pengabdian Masyarakat Berbasis Hasil Penelitian dan Purwarupa PTS 2021

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