

International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com editor@ijmmu.com ISSN 2364-5369 Volume 12, Issue 1 December, 2025 Pages: 376-385

Development of a Task-Based Yogyakarta Studies Learning Model in Higher Education

Doni Dwi Hartanto¹; Nurhidayati¹; Sri Harti Widyastuti¹; Galang Prastowo¹

Department of Javanese Language Education, Universitas Negeri Yogyakarta, Indonesia http://dx.doi.org/10.18415/ijmmu.v12i12.7197

Abstract

Learning about Yogyakarta is one form of implementing the Regional Regulation of the Special Region of Yogyakarta Province. It is hoped that the Yogyakarta Studies learning will be able to incorporate the unique character values of Yogyakarta into the learning process. The purpose of this research is to develop a Task-Based Keyogyakartaan Learning Model for Higher Education. The research method used is Research and Development, with the research subjects being UNY academic staff who participated in the Yogyakarta Studies course. Data was collected through observation, questionnaires, interviews, and documentation. The research instruments used were questionnaires, interview guidelines, and questionnaires. Data analysis was conducted using qualitative descriptive techniques. Based on the data analysis conducted, task-based learning in higher education is still very low, at only 5%. Currently, 85% of Yogyakarta Studies learning is still lecture- and discussion-based, and 10% is case study-based. Therefore, it is necessary to develop a prototype of the Task-Based Yogyakarta Studies Learning Model for Higher Education. The resulting prototype is a Task-Based Yogyakarta Studies Learning Model product designed for university students, particularly those in the Faculty of Languages, Arts, and Culture at Yogyakarta State University.

Keywords: Learning Model; Task-Based Learning; Yogyakarta-Based Learning Curiosity

Introduction

National education functions to develop capabilities, shape character, and build a dignified national civilization to enlighten the life of the nation. It aims to develop the potential of students to become faithful individuals, devoted to the One God, have noble morals, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Undang-Undang Sistem Pendidikan Nasional Nomor 20 tahun 2003 bab II pasal 3). The formation of national character and civilization is the responsibility of each educational unit and society. As a cultural and educational center, DIY should be a pioneer in culture-based education that has implications for the formation of good character in its young generation.

As a special region, Yogyakarta has the freedom to develop its culture. The development objectives of Yogyakarta are the values of Yogyakarta, which include religious and spiritual values, moral

values, social values, customs and traditions, education and knowledge, technology, spatial planning and architecture, livelihoods, arts, language, cultural heritage objects and areas, leadership and governance, struggle and nationalism, and the spirit of Yogyakarta (Baskoro, 2024). All of these values are based on ideas that form the character of Yogyakarta, which then serve as a reference for Yogyakarta education.

Yogyakarta studies of education have become an important topic that has been addressed for quite some time. Research on education from a Yogyakarta perspective was first conducted by Universitas Negeri Yogyakarta (UNY) in 2016 and continued in 2017. Next, to produce the Yogyakarta Education Model, the research was resumed in 2018 and 2019. In the following period, the Yogyakarta Education Council began to introduce Yogyakarta Studies to be implemented in primary, secondary, and higher education. The research findings from UNY become the content taught at each of these levels. The Yogyakarta Citizenship Education Movement, which began in 2022, continues to this day. The massive socialization that was carried out turned out to be uneven, and not all schools in Yogyakarta have implemented it. As an educational institution, UNY has a greater responsibility to implement and develop Yogyakarta Studies, as well as the responsibility to implement Regional Regulation Number 5 of 2011 concerning the Management and Implementation of Culture-Based Education.

Yogyakarta Studies Education is one form of realization and implementation of Yogyakarta Special Region Provincial Regulation Number 5 of 2011 concerning the Management and Implementation of Culture-Based Education. In his explanation, it was stated that culture-based education is education organized to meet national education standards, enriched with comparative and competitive advantages based on noble cultural values, so that students can actively develop their potential and become superior, intelligent, visionary, sensitive to the environment and cultural diversity, and responsive to global developments. This aligns with the characteristics of the community in the Yogyakarta region, which is closely tied to culture. Of course, it is hoped that the cultural values that exist within its society will be preserved through formal education in schools, from primary to higher education, as well as non-formal and informal education.

In an effort to achieve this, there is a need for culturally-based educational management. Referring to the DIY Provincial Regulation No. 5 of 2011, the management of culture-based education falls under the authority of local governments, district/city governments, education providers, and educational units, so that it can proceed in accordance with the goals of education. The management and organization of regional education are required to uphold the noble values of culture, where the noble cultural values in question include: a) honesty, b) humility, c) order/discipline, d) morality, e) politeness/courtesy; f) patience, g) cooperation, h) tolerance, i) responsibility, j) justice, k) caring, l) self-confidence, m) self-control, n) integrity, o) hard work/perseverance/diligence, p) thoroughness, q) leadership, and/or r) resilience. These noble values are in line with the values and sub-values promoted in Yogyakarta Education. Yogyakarta Studies Education is a development of the results of Yogyakarta Studies research conducted since 2016.

The values being promoted in Yogyakarta Education align with the Special Region of Yogyakarta Special Region Regional Regulation Number 3 of 2017 concerning the Preservation and Development of Culture. Article 3 states that the purpose of regulating the preservation and development of culture is to a) strengthen the character and identity of society, b) realize the preservation of DIY cultural values in the lives of society, institutions, and government, c) develop DIY culture to increase cultural resilience and the contribution of DIY culture amidst world civilization, d) equalize access to cultural activities and increase appreciation for art and creativity in cultural works, and e) improve community welfare.

In today's rapidly globalizing world, Yogyakarta Studies is expected to be a strong foundation for society, especially students, in facing paradigm shifts, particularly in the field of education. Distinctive values such as "memayu hayuning bawana" (making the world beautiful) and "hamangku, hamengku,

hamengkoni" (holding, protecting, and controlling) are expected to continue to thrive within society. Therefore, the distinctive values of Yogyakarta Education must be taught, starting from primary education up to higher education. In order to re-ground the noble values of Yogyakarta through Yogyakarta Education, it is felt necessary to implement education about Yogyakarta values in higher education so that it can become one of the avenues for the future dissemination of Yogyakarta educational values. With the strengthening of Yogyakarta Education, which contains noble values and local wisdom, it is hoped that it will be able to become a path for revitalization, adaptation-reactualization, and internalization of the unique values of Yogyakarta (Triwahyuningsih, dkk., 2023). An appropriate model of Yogyakarta Education needs to be designed and structured to facilitate students' needs in classroom learning. One way to do this is by developing a Task-Based Yogyakarta Education Model within courses.

Task-Based Learning is a learning model in which the learning process is carried out in three main activities: 1) pre-task (preparatory), 2) task (meaning focus and interactive process), and 3) post-task (attending to form) (Prabhu, 1987). Task-Based Learning (TBL) is a teaching model that uses a set of tasks as the core for planning, organizing materials, and/or content, and applying them in a learning process (Sulaiman, 2020). Task-based learning is believed to be capable of stimulating the acquisition process and the theoretical rationale that has guided research into it (Robinson, 2011). This means that by implementing a task-based learning model, it is hoped that students will be able to internalize the values of Yogyakarta Education and stimulate further activities based on the implementation they have gained. Various studies have revealed the effects of task-based learning models, one of which shows that it is effectively applied in language learning, where it is able to improve the four language skills: listening, speaking, reading, and writing (Cholifah & Herawati, 2017). Task-Based Learning Model is one of the learning models that attempts to develop learners' basic skills, including thinking skills, decision-making skills, creativity, problem-solving abilities, and to foster learners' self-confidence and self-management (Erawati, 2019).

Research related to Yogyakarta Education has previously been conducted by other researchers, namely *Character Education in the Yogyakarta Perspective* (Widyastuti & Hartanto, 2023). The research focuses on the distinctive character values from a Yogyakarta perspective, such as *sangkan paraning dumadi; wiras;*, *wiraga; wirama; mikul dhuwur mendhem jero; hamangku, hamengku, hamengkoni; sengguh; ora mingkuhl momot;* dan *prasaja*. Another study related to Yogyakartan identity in education is "*Integrating Noble Character Education and Yogyakartan Uniqueness in Character Education Branding at SD Ngentak*" (Mintarini, 2025). This research focuses on integrating character values thru local culture-based learning. The study found that the synergy of character education and local wisdom is an effective strategy for achieving an excellent and meaningful school.

This research aims to produce a task-based Yogyakarta Studies education model in higher education. The method for Yogyakarta Studies learning adopts from task-based language teaching, which is a teaching method that uses tasks as the core unit for planning and structuring materials in language learning (Richards, 2001:223). This is in line with the implementation of Yogyakarta Education as an MBKM course at the Faculty of Languages, Arts, and Culture, UNY. Therefore, a comprehensive model of Yogyakarta Education is highly needed for further learning of Yogyakarta Education so that it can be implemented in other faculties.

Method

This research uses the Research and Development (R&D) approach, adapted from the Dick and Carry (1996) development model with the ADDIE flow: analysis, design, development, implementation, and evaluation. The visualization of the ADDIE stages, adopted from Mulyatiningsih (2016), can be seen in the following image.

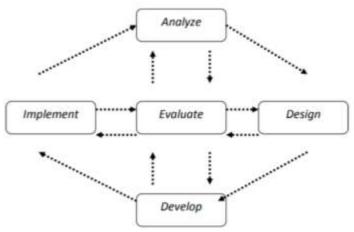


Figure 1. ADDIE Stages

The details of the activities in the research and development of the Keyogyakartaan Learning Model in this study can be seen in the following table.

Table 1. Details of Activities for the Keyogyakartaan Learning Model Development Stage

Development	Aktivitas
Stage	
Year 1 (2025)	
Analysis	Observing and analyzing new and relevant learning models and methods that meet
	the needs of the target audience, learning environment, technology, material
	characteristics, and students.
Design	Learning model design with details:
	- setting learning objectivers
	- designing learning scenarios
	- designing learning material devices
	- designing learning evaluations
	- designing product usage instructions
Development	- to realize conceptual designs into a product in the form of learning materials by
	applying a new model consisting of teaching modules, learning media, and
	learning materials.
	- to create instruments for measuring product performance.
Year 2 (2026)	
Implementation	- the resulting prototype was validated by experts and practitioners.
	- after being deemed suitable, the product can be implemented in classroom
	learning.
	- rechecking the product development objectives, student interaction, and initial
	feedback from the evaluation process.
Evaluation	- critically reviewing the impact of learning
	- measuring the achievement of product development goals
	- measuring what the targets have achieved
	- seeking information on factors that support good results

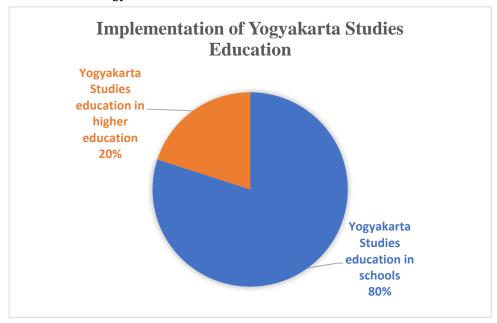
The model evaluation is conducted in two forms: formative and summative. Formative evaluation is carried out at the end of each weekly face-to-face session. Summative evaluation is used to measure the final competency of the Javanese Studies course in accordance with the learning objectives. The evaluation results are used to provide feedback to the users of the learning model. The research subjects

for the development of the Keyogyakartaan Learning Model at Yogyakarta State University are the university's academic community who are taking the MBKM Keyogyakartaan course in 2025 at Yogyakarta State University. This is to see and map the appropriate and effective utilization model of the Keyogyakartaan Learning Model that can be applied in task-based universities. Data collection in this study used several methods, namely: observation, questionnaires, interviews, and documentation. Observation was conducted to observe the implementation of the model at the university. Questionnaires and interviews are needed to determine the responses of students and lecturers teaching the Keyogyakartaan course at UNY. Tests are conducted to measure the effectiveness of the developed model.

The research instruments are questionnaires, interview guidelines, and questionnaires. Questionnaires and interview guidelines are used to gather data during the analysis of model development needs and to gather feedback on model usage. Questionnaires are used to collect product development data as a measure of expert and practitioner validity. The results of expert and practitioner reviews were used as the basis for revising the product into a prototype suitable for implementation. Data analysis techniques in R&D research (Nadiyah & Faaizah, 2015) can be performed using qualitative descriptive techniques. The data from expert and practitioner reviews regarding material feasibility and model feasibility were grouped with the results of questionnaires and interviews with lecturers and students. The information is grouped into inputs, responses, criticisms, and suggestions for improvement, covering questionnaires, interviews, and surveys. The data analysis results are used to revise the product.

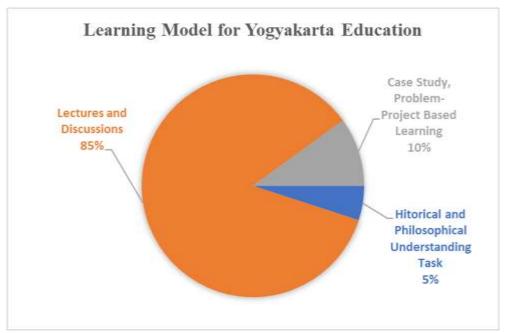
Result and Discussion

The results of this study represent the needs analysis regarding the development of a Yogyakarta-based education model using university assignments and represent the developed model. The results of the needs analysis were gathered from 77 respondents. Based on responses regarding the implementation of Javanese studies education at the university level, it was found that only 20% of respondents understood it. This was less understood by the respondents. This means the general public is more familiar with Yogyakarta studies education at the school level, reaching 80%. Many students are unaware that universities also offer Yogyakarta studies education.



Graphic 1. Yogyakarta Education Management

Next, the responses regarding the Yogyakarta Education learning model, organized by UNY, received varied feedback. This can be observed in the following diagram.



Graphic 2. The Current Learning Model for Yogyakarta education

Based on the results of problem screening related to the learning model that has been implemented, it shows that the lectures are not very interesting. The methods used tend to be lectures and discussions about the main book on education in Yogyakarta. This is very uninteresting for students. This response, with 85% of the votes, indicates the dominance of lectures and discussions. Case studies only reached 10% and tasks assessing understanding of historical and philosophical values only reached 5%. Therefore, the level of critical, analytical, and creative thinking development among students needs to be improved. Therefore, it is necessary to develop a task-based education model for Yogyakarta studies in higher education. The task-based Yogyakarta studies learning model in higher education is a model developed to support the implementation of Yogyakarta studies education in higher education. Yogyakarta is known as a special region with unique characteristics in its history, culture, and system of government. This uniqueness not only serves as a regional identity but also as a rich source of learning to strengthen students' character and national insight. Therefore, the development of a Task-Based Yogyakarta Learning Model in Higher Education is important as a form of implementing local values in higher education. Here is the prototype of the Yogyakarta-based learning development model product.



Figure 2. Product Prototype

Purpose of Model Development

The model development is designed to equip students with a deep understanding of Yogyakarta's unique characteristics, encompassing its historical, cultural, governance, and underlying philosophical values. This understanding is not merely passive, but is used to develop critical, analytical, and reflective thinking skills in examining various socio-cultural phenomena occurring in Yogyakarta. This thinking process is expected to foster an appreciative and caring attitude toward culture and local wisdom, so that students become not only observers but also part of the preservers and positive agents of change. Ultimately, this entire series of processes is aimed at producing academic works and creative products relevant to the context of Yogyakarta, such as research, journals, artworks, or community empowerment models, which make a tangible contribution to the development and preservation of the special status of the Special Region of Yogyakarta.

Basis for Model Development

The development of the learning model was carried out by considering four foundations: Theoretical Foundation, Philosophical Foundation, Pedagogical Foundation, and Sociocultural Foundation. The following is an explanation of each foundation used in developing the model. Theoretical Foundation, which is the theoretical framework of concepts used as a guide for developing the model. The theoretical foundations used include Constructivism (Piaget and Vygotsky), which emphasizes that knowledge must be actively constructed by students; this is realized through tasks that require direct exploration and elaboration with the context of Yogyakarta, such as observations and field projects. This knowledge construction process is enriched by Sociocultural theory (Vygotsky, 1978), which emphasizes that meaningful learning occurs through social interaction and cultural mediation, making collaboration with the local community, cultural informants, and interdisciplinary group work key elements. This direct experience was then processed through the lens of Experiential Learning (Kolb, 1984), where students went through a complete cycle starting from concrete experiences in the field, reflection in journals, conceptualization of theory, to planning experiments or follow-up actions.

The entire process is reinforced by a humanistic approach that emphasizes the search for personal meaning and self-actualization, encouraging deep reflection on local wisdom values such as *hamemayu*

hayuning bawana and the ethics of care. Another theoretical foundation used is Constructive Alignment (Biggs & Tang, 2011), which is implemented by closely aligning Graduate Learning Outcomes (GLO), learning activities, and assessment systems. Rubrics are specifically designed to directly assess the intended achievements of each given task.

Philosophical Foundation, which are the basic principles derived from philosophy as the basis for thinking. The development of this model uses the following approaches: 1) contextual, which emphasizes that learning should be rooted in real-life experiences, making the material come alive and relevant for students; 2) humanistic, ensuring that the learning process not only pursues cognitive achievement but is also directed toward the holistic development of human potential, including emotional, social, and values aspects; 3) constructivist, where knowledge is not seen as something passively transferred, but actively constructed by students thru their social and cultural interactions. These three foundations complement each other to create a learning ecosystem where students not only understand information but also find meaning, develop themselves, and build their knowledge through engagement with the social world around them.

The Pedagogical Foundation, which is the basic principle of how to teach, serves as the basis for designing, implementing, and evaluating the learning process. The pedagogical foundations used in model development are: 1) the curriculum is designed in line with the Merdeka Belajar Kampus Merdeka (MBKM) paradigm, which provides flexibility for students to develop their potential thru flexible learning, both on and off campus; 2) it is aimed at building 21st-century competencies, which are based on four main pillars: critical thinking to analyze problems in depth, creativity in generating innovative solutions, collaboration thru teamwork in diverse groups, and effective communication to convey ideas. Thus, the integration between the spirit of MBKM and the strengthening of these four competencies aims to prepare graduates who not only master knowledge but are also adaptable, resilient, and ready to contribute to the complex dynamics of global society.

Sociocultural Foundation, which is a perspective in learning that emphasizes that the human learning process is fundamentally shaped by social interaction and the cultural context in which the individual is situated. The sociocultural foundation in the development of this model is: 1) deeply integrating the values of local Yogyakarta culture, both philosophical values such as the Philosophical Axis which underlies the city's spatial layout, and practical aspects such as etiquette, customs, and tangible (e.g., historical buildings and crafts) and intangible (e.g., performing arts and oral traditions) cultural heritage; 2) strengthening students' character to align with the noble values of *Hamemayu Hayuning Bawana* — a Javanese philosophy that teaches us to always beautify and maintain world harmony. Through the internalization of these values, students are expected not only to become intelligent academic individuals but also to develop respect, social responsibility, and become cultural actors who actively contribute to caring for and beautifying life in their environment.

Relevant Task-Based Learning Models

The task-based learning development model implemented is based on several models. Here are some relevant learning models designed for development. Project-Based Learning (PjBL) is a task in the form of an authentic, time-bound project (Thomas, 2000). This model is suitable for creating cultural catalogs, documentary videos, or exhibitions. Problem-Based Learning (PBL) is a learning model that starts with open-ended problems (Barrows & Tamblyn, 1980). This model is suitable for issues related to the preservation of cultural heritage sites or the philosophy of urban space governance. Task-Based Learning (TBL/TBLT), is the assignment as the main unit of learning, focusing on authentic task performance and formative feedback. Inquiry-Based Learning, which is a systematic questioning-based investigation, is relevant for mini-research projects such as those on the history of March 11th, special status, and the palace-monument axis. Service-Learning, which is academic work integrated with

community service (Eyler & Giles, 1999), is used, for example, to curate cultural information for tourist villages or schools. Authentic Assessment is the process of evaluating that mimics real-world practices; task products are useful (curatorial posters, educational videos, policy briefs) (Wiggins, 1998/2011).

Policy Implementation Basis

The development of this learning development model is guided by the National Higher Education Standards (Permendikbud No. 3 of 2020), which ensure academic quality by emphasizing the importance of clear learning outcomes and student-centered learning implementation. In line with this, the *Merdeka Belajar-Kampus Merdeka* (MBKM) policy provides its operational framework by opening up broad opportunities for students to enrich their competencies through direct learning experiences outside of campus, such as internships, independent projects, and collaborations with various partner communities or institutions. Thus, the integration between meeting national standards and the spirit of MBKM creates an educational ecosystem that not only ensures depth of knowledge but also the relevance and practical skills of graduates in addressing real-world challenges.

Task-Based Learning Strategy for Yogyakarta Studies

This series of learning methods is designed to create a comprehensive and in-depth experience thru a dynamic blended-learning approach. Activities began with individual and group assignments to build a basic conceptual understanding, which was then enriched directly thru field studies to cultural sites such as museums, palaces, and cultural villages to authentically experience socio-cultural realities. The results of this field exploration are then transformed into creative projects in the form of videos, articles, or cultural catalogs, challenging students to process data and observations into a communicative work. This entire process is enriched and critically tested thru interactive discussions with cultural figures, community leaders, and academics, serving as a vital connecting bridge between classroom theory, field practice, and deep reflection.

Conclusion

Research on the Development of Task-Based Keyogyakartaan Learning Model in Higher Education found that this learning model is used as an alternative learning strategy that integrates local values into the academic process. This model is designed to provide a contextual learning experience through assignments focused on studying the unique features of Yogyakarta, from historical and cultural aspects to its system of government and local wisdom. This model serves as a means to deepen and direct students' understanding of Yogyakarta's unique characteristics. Students are trained to think critically, analytically, and reflectively in connecting theory with local reality. Task-based learning provides space for the development of students' creativity, independence, and academic responsibility. Integrating local Yogyakarta values can strengthen students' cultural identity and foster an appreciative attitude toward the nation's cultural heritage. Thus, this learning model not only contributes to academic mastery but also instills character values and a love for local culture.

References

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). A taxonomy for learning, teaching, and assessing (Rev. ed.). Longman.

Barrows, H. S., & Tamblyn, R. (1980). Problem-based learning: An approach to medical education. Springer.

- Biggs, J., & Tang, C. (2011). Teaching for quality learning at university (4th ed.). McGraw-Hill & Open University Press.
- Cholifah, M. & Herawati, S. (2017). Pengajaran Bahasa Berbasis Tugas (Task Based Language Teaching): Pendekatan Yang Efektif Dalam Pengajaran Bahasa Inggris. Jurnal Ilmiah Bahasa Dan Sastra, 4(2), 131-137. https://doi.org/10.21067/jibs.v4i2.3187.
- Erawati, Ni Ketut. (2019). Literature Review: Implementasi Pembelajaran Berbasis Tugas (Task Based Learning) Dalam Dokumentasi Asuhan Kebidanan. Jurnal Kebidanan MIDWINERSLION, 4(1). 1-8. https://doi.org/10.52073/midwinerslion.v4i1.42.
- Eyler, J., & Giles Jr., D. E. (1999). Where's the learning in service-learning? Jossey-Bass. Kementerian Pendidikan dan Kebudayaan. (2020). Permendikbud No. 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi.
- Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice-Hall.
- Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge University Press.
- Merrill, M. D. (2002). First principles of instruction. Educational Technology Research and Development, 50(3), 43–59.
- Mulyatiningsih, E. (2016). Metode penelitian terapan bidang pendidikan. Uny Press.
- Nadiyah, R. S., & Faaizah, S. (2015). The development of online project-based collaborative learning using ADDIE model. Procedia-Social and Behavioral Sciences, 195, 1803-1812.
- Peraturan Daerah Istimewa Daerah Istimewa Yogyakarta Nomor 3 Tahun 2017 Tentang Pemeliharaan dan Pengembangan Kebudayaan.
- Peraturan Daerah Provinsi Daerah Istimewa Yogyakarta Nomor 5 Tahun 2011 Tentang Pengelolaan dan Penyelenggaraan Pendidikan Berbasis Budaya.
- Piaget, J. (1970). Science of education and the psychology of the child. Viking.
- Prabhu, N. (1987). Second Language Pedagogy. Oxford University.
- Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods. Journal of Engineering Education, 95(2), 123–138.
- Robinson, P. (2011). Task-based Learning: A Review of Issue. Language Learning: Tokyo. A Journal of Research in Language Studies (s1), 1-36. https://doi.org/10.1111/j.1467-9922.2011.00641.x.
- Sulaiman. (2020). Model Pembelajaran Bahasa Berbasis Tugas (PBBT) Melalui Pembelajaran Daring. METALINGUA: 5(2),95-100. Jurnal Pendidikan Bahasa dan Sastra Indonesia, https://doi.org/10.21107/metalingua.v5i2.8886
- Thomas, J. W. (2000). A review of research on project-based learning. Autodesk Foundation.
- Triwahyuningsih, Zuliyah, S., Abdi, N.S., Arif., D.B. (2023). Penguatan Kearifan Lokal Daerah Istimewa Yogyakarta: Kajian Perdais DIY No. 3 Tahun 2017 Tentang Pemeliharaan dan Pengembangan Kebudayaan. Jurnal Civic Hukum, 8(1), 1-13. https://doi.org/10.22219/jch.v8i1.24800.
- Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
- Wiggins, G. (1998/2011). Educative assessment: Designing assessments to inform and improvestudent performance. Jossey-Bass.

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).