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Application of Metacognitive Knowledge-Based Learning On Students' Learning Outcomes in Heredity Material at Grade IXth Junior High School of SMP Negeri 1 Talaga Jaya

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Abstract

This study aims to the determine the application of metacognitive knowledge-based learning on students' learning outcomes in heredity material grade IXth at Junior High School of SMP Negeri 1 Talaga Jaya. This study employs a quantitative descriptive approach, utilizing a pre-experimental design that includes a single group pretest and posttest design. The subjects consist of grade IXth-group 1 during the odd semester of the 2022/2023 academic year, comprising a total of 30 students. The instruments used in this study consisted of questions based on metacognitive knowledge, lesson plans students' worksheet, teacher activity sheet, and student activity sheet. The research data are analyzed using the formula of teacher ativity, student activity, individual completeness, pretest and posttest average scores, and students' N-gain. The result showed that the scores of students' learning outcomes increased, as observable from the posttest scores, which were higher than the pretest scores. The pretest score obtained at the first meeting was 28.53 and the posttest was 75.07. In the second meeting the pretest score was 21.27 and the posttest was 77.00 for the third meeting the pretest score was 27.00 and the posttest was 78,06. In addition, the N-gain score of students at the first meeting was 0.65 or in the medium category, in the second meeting was 0.71 an in the third meeting was 0.71 or in the high categories

Keywords: *Heredity material, Learning outcomes, Metacognitive knowledge-based learning,*

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INTRODUCTION

The 2013 curriculum has several revisions which are changes from the previous curriculum, namely KTSP (curriculum at the education unit level) which is divided into four standards, including graduation standards, content standards, process standards, and assessment standards. Guided by graduate competency standards, the scope for the cognitive domain of students at the secondary school level is grouped into several

categories of knowledge such as factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge.

The standard of metacognitive knowledge is a requirement that must be met by intermediate level students. This is because metacognitive knowledge is very important for students to have, considering that the material at the intermediate level is getting wider and deeper. Science learning prioritizes the learning process. In science learning, metacognitive knowledge is needed, as stated by (Lestari et al., 2017). In the process of learning science, especially biology, students must have the ability to regulate their cognitive processes strategically. This allows them to effectively identify and establish relationships between the concepts they seek, by utilizing their metacognitive knowledge. Metacognitive knowledge is very important for students, especially in the field of science, especially biology. These subjects cover both real and abstract concepts, so they require a deeper level of understanding. Metacognitive knowledge plays an important role in facilitating effective learning and understanding of biology.

Referring to observations and interviews with teachers who teach science subjects in class IX, it was obtained that the learning outcomes of students for biology lessons, especially on inheritance material, have not met the KKM (minimum completeness criteria), the KKM score in SMP Negeri 1 Talaga Jaya science subjects is 75. The average student only gets a score of 60. Low student learning outcomes occur because they have difficulty in understanding trait inheritance material, for example on the subject of monohybrid crosses and dihybrid crosses. Trait inheritance material has abstract and complicated characteristics. This is also in line with the Susantini (2016) idea where in trait inheritance material, students tend not to understand the mechanism. Inheritance material has several concepts that have a fairly high level of difficulty because they are complex and complicated. The learning taught by the teacher is only how students solve inheritance problems following what is conveyed by the teacher. The teacher has not explained the relationship and relationship between material concepts, so the concepts conveyed are not comprehensive. For teachers it is very important to apply an appropriate learning, so that students are more emphasized on how they assess and think.

Understanding the concept of inheritance alone is not enough if only rely on material from teachers only; The student must independently develop his own understanding. Having metacognitive knowledge will enable students to build knowledge systematically between biological concepts and effectively solve problems related to those concepts by utilizing three types of knowledge: declarative, procedural, and conditional. By having metacognitive knowledge, students can accurately assess their level of mastery of a particular idea, allowing them to organize and improve their cognitive capacity effectively. Metacognition, as defined by Romli (2012) refers to the capacity to manage and regulate one's cognitive processes when engaged in learning and thinking. When students have strong metacognitive knowledge, they can easily use effective ways or activities to enhance their learning.

Metacognitive knowledge is very influential for the learning outcomes of learners. (Hadizah & Muhfahroyin, 2012) revealed that there are several relationships between students' metacognitive knowledge and biology learning outcomes. The findings obtained by (Magno, 2010) that greater metacognitive knowledge has a positive effect on learning outcomes, because students who have effective methods know more about their own

learning process. Metacognitive knowledge correlates strongly with student learning outcomes. A person's acquisition of knowledge is influenced by his metacognitive awareness (Peryana et al., 2021).

These problems can be overcome by incorporating metacognitive knowledge-based learning into the learning process. By applying metacognitive-based learning, students can effectively organize their cognitive processes to solve problems effectively and understand complex concepts.

METHOD

This type of study includes quantitative descriptive studies. The subjects he tested in class IX1 SMP Negeri 1 Telaga Jaya totaled 30 students, for the 2022/2023 academic year.The design of this study uses pre-experimental design through the design of one group pretest and posttest design. The design of this study also refers to the goal to be achieved, which is to attempt to assess the application of metacognitive knowledge-based learning on trait inheritance material. The following is a table of research design one group pretest and posttest design.

Table 1. One group Pretest and Posttest Design Research

Pretest	*Treatment*	*Posttest*
O_1	X	O_2

O_1 = The group was given a metacognitive knowledge-based test before the learning was carried out (pretest)
X = The group was given a metacognitive knowledge-based test on trait inheritance material
O_2 = The group was given a metacognitive knowledge-based test after learning (posttest)

The data obtained in this study are divided into primary data and additional data. Primary data refers to students' academic achievement, while additional data relates to activities carried out by teachers and students. In carrying out the analysis of the results of teacher and student activities, the calculation of the data is carried out through Teacher and student activity formula, below:

$$\text{Percentage of Each Aspect} = \frac{\text{Score each aspect obtained}}{\text{Total aspect score}} x\ 100\%$$

The data analyzed must pay attention to the criteria for teacher and student activities below,

Table 2. Teacher Activity Criteria (Ritzalona, 2018)

Activity (%)	**Criteria**
86 – 100	Excellent
71 – 85	good
50 – 70	good enough
≤ 50	not good enough

Table 3. Student Activity Criteria (Ritzalona, 2018)

Activity (%)	Criteria
76-100	Excellent
51-75	good
26-50	good enough
≤ 25	not good enough

Learning outcome data is obtained through the output of pretest and posttest results given at the beginning and end of learning. The formula used in assessing the completeness of individual learning according (Prayitno & Hidayati, 2021) is below:

$$\text{Individual Completeness} = \frac{\text{number of score obtained}}{\text{maximum score}} x\ 100\%$$

Analysis of the achievement of student learning outcomes can generally be described through a description of the average value of student learning outcomes in the classroom which is used in assessing the average grade point including,

$$\text{x} = \frac{\text{X1+X2+}\cdots..\text{+Xn}}{N}$$

Information:
X = Class grade point average
X1+X2+…+Xn = Total overall student scores
N = Total number of students

Research classes are given a pretest before learning and posttest after learning. The difference between pretest and posttest findings is used in measuring learning outcomes through the use of the N-Gain formula (Normality gain). The (Mursali, 2016) formula used is,

$$\text{N-Gain} = \frac{\text{score posttest} - \text{score pretest}}{\textit{score ideal} - \textit{score pretest}}$$

Informasi:
N High Gain = value (0,70 < g < 1,00)
N Medium Gain = value (0,3 < g < 0,7)
N Low Gain = value (g < 0,3)

RESULTS AND DISCUSSION

Data from observations of teacher activities are carried out during learning activities. The assessed aspects consist of 17 aspects that refer to the implementation of learning activities.

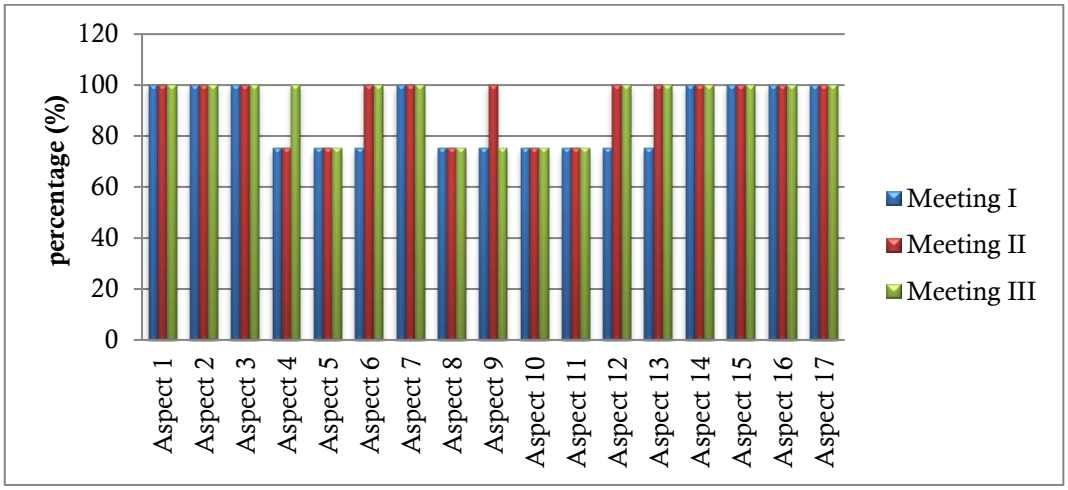

Figure 1. Graph of the Average Percentage of Teacher Activity

Referring to Figure 1, it shows that the percentage obtained is very good and good. Then a number of aspects have increased, for example in the aspect of conveying perception and motivation, because the teacher provides perception and motivation then provides examples by displaying images and is associated with the daily environment so as to help facilitate the understanding of students. This can also be noticed through the activities of students who pay attention to the images displayed and respond well. Perception in learning is the first step in assessing the readiness of students in the learning process. Early learning activities by providing perception can build student motivation and attention in the process of following learning. Giving perception with the knowledge that students already have both from experience in everyday life makes them interested in the material to be learned. Involving students in early learning activities through apperception can stimulate their motivation and attention in engaging in the learning process. Giving perception with the knowledge that students already have both from experience in everyday life makes students interested in the material to be learned. Student motivation is an important component that influences learning outcomes. Students who are motivated will show increased perseverance, increased perseverance, and unwavering focus during the learning process. Fostering an interest in learning is a crucial aspect that must be prioritized in educational efforts in schools.

The aspect of conveying objectives obtains good criteria for meetings I, II, III because there are a number of students who have not paid attention and recorded the learning objectives outlined by the teacher. Teachers should exert greater efforts to foster enthusiasm among all students to engage in the learning process. The teacher's responsibility in this learning is to inspire and encourage students to be actively involved in the learning process to achieve goals in class. When students understand the importance of the learning objectives that need to be achieved, they will be actively involved in the learning process.

The aspect of displaying images / videos at meetings I to III through categories is very good because by displaying videos / images can facilitate students in learning activities. Referring to (Nurrita, 2018) learning media such as videos / images as one

aspect of learning success. The use of videos / images in learning will be more interesting and fun can help clarify the material delivered during teaching and learning activities.

The aspect of organizing students to write questions from images / videos that have been observed criteria obtained both at meetings I, II, II teachers guide students to be able to write or ask directly related to the observed videos / images. However, students' questions are not related to those observed and there are still students who cannot ask questions. With students trained to be able to ask questions, students have the opportunity to analyze data and information that can be used in supporting their opinions on a problem.

The aspect of guiding students is carrying out presentations, dividing students into several groups and providing guidance for students in groups with good criteria. Because teachers have not maximized in controlling group discussion activities. Only a few learners asked questions as the teacher guided the group discussion. At the time of grouping, all students have not been actively related, there are still students who occupy themselves with other activities, for example telling stories with their group friends.

The aspect provides reinforcement of the percentage material obtained with good categories at meetings I, II, III because the teacher explains again about the material that is still unclear and uses language that is not difficult for students to understand. The aspect of concluding the material at meeting I with good criteria then the aspect increased at meetings II and III, because the teacher has not involved students to provide conclusions.

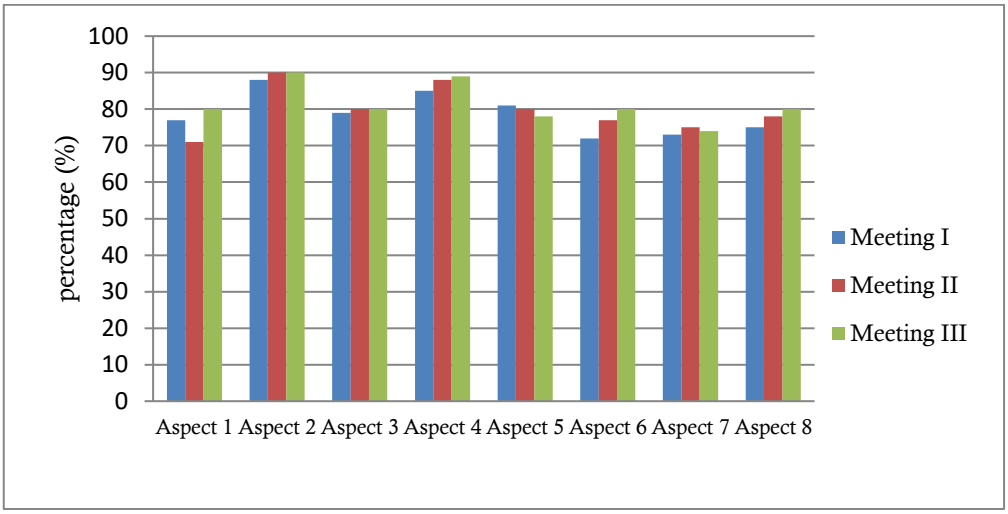

Figure 2. Graph of the Average Percentage of Student Activity

Aspects provide reflection and follow-up on material that has already been delivered percentage obtained with good criteria at meeting I. Teachers engage in reflective practice and offer constructive feedback to students to ask any aspect of the material that they find confusing. Activities validate that learning aligns with the topic. The teacher encourages students to comment on the overall learning process, even though only a small number of students are able to ask questions, students are still afraid of asking wrong questions then this aspect increases in meetings II and III because many students have begun to respond to the learning delivered by the teacher. According to (Faizin, 2018) Reflection allows students to assess the knowledge and understanding they gain,

thus impacting their learning outcomes by encouraging them to reflect on their learning activities.

Observation data related to student activities obtained through observation of student activities in learning activities which include 8 aspects that refer to the implementation of learning activities. Student activities are declared crucial so that the learning outcomes obtained can be achieved properly because student activities determine the final results of the learning process. At the time of learning, not only teachers play an active role but students also contribute actively to the learning process activities. Based on the analysis of observational data on student activities from meetings I to III shows that the percentage of student activities in the categories obtained is very good and good. At meetings I, II, III the highest aspect is in the aspect of observing images / videos carefully and carefully because by using images or videos learning becomes more interesting thereby making improvements to student learning motivation and facilitating students' understanding of the material described.

The presentation of the results of group discussions at meeting I was low because students still lacked confidence in presenting the findings of their group discussions. Presentations during group discussions facilitate the exchange of ideas among students, while increasing self-confidence by bringing out various abilities, such as problem analysis, expressing opinions, and defending group point of view.

The aspect of responding to the perceptions conveyed by students at the second meeting is low, because it is still lacking in responding to the perceptions expressed by the teacher. Providing apperception before learning activities take place has great benefits for student learning readiness. Apperception plays an important role in the learning process by setting conditions that support learning and providing an overview of the subject matter to be delivered to students. Learning readiness refers to the state of being ready and accepting of learning. These are qualities that can be nurtured and enhanced in students, allowing them to actively engage and respond during learning activities.

The aspect of being able to express opinions at meeting III is low because students are afraid to express opinions. This will hinder the achievement of academic success of students. Limited involvement and absence of communication between students and between students and teachers during the learning process adversely affect students' motivation to improve their academic achievement, thus adversely affecting their learning outcomes. The acquisition of proficient opinion skills by students is expected to contribute to achieving optimal learning outcomes. Without the capacity to articulate their point of view, students will face many distractions and obstacles in achieving academic achievement. Barriers for students to achieve success in learning can be caused by their limited capacity to articulate their point of view, as it reflects their cognitive abilities.

Data on student learning outcomes through the application of metacognitive knowledge-based learning are obtained from the implementation of pretest and posttest. The completeness score of student learning outcomes is in line with the maximum completeness criteria (KKM) determined by the school, which is 75.

Table 4. N-Gain Analysis of Learning Outcomes of Students Meeting I, II and III

Value	Pretest	Posttest	N-Gain	Criteria
Average meeting I	28.53	75.07	0.65	Medium
Average meeting II	21.27	77.00	0.71	High
Average meeting III	27.00	78.06	0.71	High

Based on the learning outcomes of students in trait inheritance material, it shows that the average score before and after applying metacognitive knowledge-based learning at meeting I with the topic of genetic material discussion the average pretest score obtained is 28.53 while the average posttest obtained is 75.07. Meeting II with the topic of the law of inheritance trait the average score obtained was 21.27 while the average posttest score was 77.00. Meeting III with the topic of the discussion of inherited trait disorders in humans got an average pretest score of 27.00 while the posttest was 78.06. The learning outcomes of students on trait inheritance material show that in each The pretest obtained 100% is incomplete, because the average results obtained by students below the minimum completeness (KKM) ≤75 as determined by the school. The lack of individual completeness scores (pretest) at each meeting because students have not been able to respond to procedural and condissonal questions, students can only respond to declarative questions.

After applying metacognitive knowledge-based learning at each meeting, students' posttest scores were categorized completely with a value of ≥75, it showed that by applying metacognitive knowledge-based learning, there was an increase in student learning outcomes. This increase is also because they begin to understand the material being studied and are able to answer declarative, procedural and conditional questions. This is in accordance with (Fauziyah et al., 2013) that there is a relationship between metacognitive knowledge and student learning outcomes. If students use their metacognitive knowledge optimally, then the learning results obtained are maximized because students have awareness of their cognition. Metacognitive knowledge helps students in problem-solving activities including three knowledge, namely declarative, procedural, and conditional. Metacognitive knowledge refers to awareness of knowledge and thinking processes systematically in a learning process that is divided into several knowledge, including declarative, procedural, and conditional. Metacognitive information is essential for effective learning because it allows students to organize their cognitive abilities and identify their weaknesses, thereby facilitating improvements in future learning efforts (Fisher, 2021).

The normality gain (N-Gain) value of each meeting obtained by learners from the difference in value between pretest and posttest. The n-gain data obtained reflects that there is an increase in learning outcomes during 3 meetings, this is in accordance with Hake (Mursali, 2016) gain, which is the difference between pretest and posttest scores, the normality gain test shows an increase in understanding and mastery of student concepts after learning.

Understanding of a biological concept, especially inheritance material, is not enough just to listen to the delivery from the teacher, but students must also construct an understanding of the concept of material. Metacognitive knowledge helps learners build

their knowledge. Thus learners are able to apply the correct discovery process in learning. Learners must first understand declarative and procedural knowledge to be able to have conditional knowledge (Chase & Abrahamson, 2018).

Metacognitive knowledge plays an important role in the learning process as it facilitates students' understanding of learning activities, changes their thought processes, improves the understanding and application of acquired knowledge, and also impacts their problem-solving abilities. Metacognitive knowledge has a relationship with learning outcomes in line with the findings (Schraw et al., 2006) proving that increasing students' metacognition knowledge can make their learning outcomes also increase. Thus learners must have a clear understanding of their awareness of metacognitive knowledge. This is important to empower students in managing the learning process. Metacognitive information is an important element of cognitive ability and has a significant impact on learning outcomes.

CONCLUSION

Based on the results of the research and the description of the discussion, it can be concluded that by applying metacognitive knowledge-based learning can improve student learning outcomes on trait inheritance material in the grade IXth -group 1 Junior High School of SMP Negeri Talaga Jaya is noticed through an increase in posttest scores higher than pretest scores.

REFERENCES

Chase, K., & Abrahamson, D. (2018). Searching for buried treasure: uncovering discovery in discovery-based learning. *Instructional Science*, *46*(1), 11–33. https://doi.org/10.1007/s11251-017-9433-1

Faizin, K. (2018). Pemanfaatan Jurnal Refleksi Sebagai Strategi Metakognitif Dalam Meningkatkan Keaktifan Dan Hasil Belajar Matematika. *Lentera Pendidikan : Jurnal Ilmu Tarbiyah Dan Keguruan*, *21*(1), 33–47. https://doi.org/10.24252/lp.2018v21n1i4

Fauziyah, D. R., Corebima, A. D., & ... (2013). Hubungan Keterampilan Metakognitif terhadap Hasil Belajar Biologi dan Retensi Siswa Kelas X dengan Penerapan Strategi Pembelajaran Think Pair Share di …. … *Education. Tersedia Di …*, *January*. https://www.researchgate.net/profile/Siti-Zubaidah-7/publication/322291711_hubungan_keterampilan_metakognitif_terhadap_hasil_belajar_biologi_dan_retensi_siswa_keas_x_dengan_penerapan_strategi_pembelajaran_think_pair_share_di_sma_negeri_6_malang/links/5a50

Fisher, D. (2021). European Journal of Educational Research. *European Journal of Educational Research*, *11*(1), 69–81.

Hadizah, E., & Muhfahroyin, M. (2012). Meningkatkan Kemampuan Metakognisi Dan Hasil Belajar Biologi Siswa Sma Pgri 1 Punggur Melalui Penerapan Metode Inkuiri Terbimbing (Guide Inquiry). *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *3*(2).

https://doi.org/10.24127/bioedukasi.v3i2.262

Lestari, H. N., Suganda, O., & Widiantie, R. (2017). Hubungan Antara Pengetahuan Metakognitif Dengan Kemampuan Pemecahan Masalah Melalui Model Problem Based Learning (Pbl) Pada Konsep Pencemaran Lingkungan Di Kelas X. *Quagga : Jurnal Pendidikan Dan Biologi*, *9*(02), 27. https://doi.org/10.25134/quagga.v9i02.745

Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning*, *5*(2), 137–156. https://doi.org/10.1007/s11409-010-9054-4

Mursali, S. (2016). Implementasi Perangkat Pembelajaran Biologi Sma Berbasis Metakognitif Untuk Meningkatkan Kemampuan Kognitif Dan Mengembangkan Karakter Mandiri Siswa. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *1*(3), 307–314. https://doi.org/10.22219/jpbi.v1i3.2663

Nurrita, T. (2018). Pengembangan Media Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa. *MISYKAT: Jurnal Ilmu-Ilmu Al-Quran, Hadist, Syari'ah Dan Tarbiyah*, *3*(1), 171. https://doi.org/10.33511/misykat.v3n1.171

Peryana, R., Anggraito, Y. U., & Widiatningrum, T. (2021). The Development of Supplement Book on Biodiversity Chapter Based on Dragonfly Diversity in Lusi Watershed. *Journal of Biology Education*, *10*(1), 52–62.

Prayitno, T. A., & Hidayati, N. (2021). Analisis Kebutuhan Pengembangan Materi Biologi Umum Multimedia Interaktif Berbasis Web dan Android. *Prosiding Seminar Nasional IKIP Budi Utomo*, *2*(01), 262–270. https://doi.org/10.33503/prosiding.v2i01.1505

Ritzalona. (2018). Peningkatan Hasil Belajar Siswa Kelas VIIIB SMP Negeri 5 Benai Dengan Menggunakan Peta Konsep. *Jurnal Ilmu Pendidikan Sosial, Sains, Dan Humaniora*, *4*(2), 347–353.

Romli, M. (2012). Strategi Membangun Metakognisi Siswa SMA dalam Pemecahan Masalah Matematika. *Aksioma*, *1*(2), 1–17. https://media.neliti.com/media/publications/176833-ID-strategi-membangun-metakognisi-siswa-sma.pdf

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, *36*(1–2), 111–139. https://doi.org/10.1007/s11165-005-3917-8

Susantini, E. (2016). Strategi Metakognitif dalam Pembelajaran Kooperatif untuk Meningkatkan Kualitas Proses Pembelajaran Genetika di SMA. In *Jurnal Ilmu Pendidikan* (Vol. 12, Issue (1), pp. 62–76). http://journal.um.ac.id/index.php/jip/article/view/82

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