# Exploring the impact of intelligence quotient on mastery of biodiversity through e-modules

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**A R T I C L E   I N F O**

**A B S T R A C T**

E-modules can facilitate student understanding of complex biological concepts, including biodiversity, but their effectiveness also depends on individual student abilities. One significant factor influencing this success is the students' intelligence quotient, which affects how they process and comprehend complex information. This research aims to determine the relationship between intelligence quotient with mastery of biodiversity material using e-modules. The method used in this research is a quantitative descriptive method with correlation studies. The sample was taken from as many as 177 students from SMAN in Tangerang City was collected using multistage random sampling technique. To assess these skills, a test instrument in the form of multiple-choice questions is used. The prerequisite test shows that the data is normally distributed, the data is homogeneous, the data is linear, the data is free from symptoms of heteroscedasticity, the data is not multicollinearity, and the data is free from symptoms of autocorrelation. Through testing the hypothesis, the equation $\hat{Y} = 41.268 + 0.580X_1$ is obtained. The correlation coefficient obtained was 0.881, which means there is a very strong relationship. . Based on this research, it can be concluded that there is a positive relationship between intelligence quotient, reading comprehension ability, and mastery of biodiversity material using e-modules.

## INTRODUCTION

The Industrial Revolution 4.0 era is an era where the application of information and communication technology in all aspects of life has become very dominant, changing the way humans learn, work, and interact (Gleason, 2018). This era is marked by technological advances such as the Internet of Things (IoT), artificial intelligence (AI), big data, and learning management systems (LMS), all of which contribute to major transformations in the world of education (Kahar et al., 2021; Li et al., 2017). The field of education is closely related to the Industrial Revolution 4.0, which can be used to support learning patterns and thinking patterns as well as develop creative and innovative innovations from students in order to produce the nation's next generation who are superior and able to compete (Pratidhina, 2020). One form of utilizing educational technology is the use of e-modules to improve the quality of student learning, especially in the context of biology lessons about biodiversity.

E-modules can illustrate various aspects of biodiversity, starting from introducing unique types of flora and fauna in various parts of the world to the ecological and evolutionary processes that influence their distribution and diversity (Rahma et al., 2023). This can be integrated by providing dynamic images, videos, and simulations (Kiong et al., 2012; Nunung & Kusyanti, 2021) that depict natural habitats, interspecies interaction patterns, and the impact of human activities on biodiversity. This not only makes it easier for students to master biodiversity material but also increases their awareness of the importance of preserving biodiversity for ecosystem balance and human survival.

Apart from that, by using e-modules students can learn more independently and according to their learning speed, so that it can help students with various levels of cognitive ability (Rahma et al., 2023) to master biodiversity material more effectively. This is in line with research by Al-Muhdhar et al. (2021) that the use of e-modules can make it easier for students to understand complex concepts in biology in plant material and the respiratory system (Lase & Harefa, 2022). However, the success of e-modules as teaching materials is independent of the design and content but also of the ability of students to understand them individually (Delita et al., 2022). Many aspects influence the success of e-modules as a learning tool, and one of them is the level of Intelligence quotient.

Intelligence quotient, which is usually measured by the Intelligence Quotient test (IQ test), refers to a person's general cognitive abilities, such as reasoning, problem-solving, and abstract thinking (Binet, 2019). This is an important factor that can influence how students process and understand complex information, such as that often found in biology material (Etobro & Fabinu, 2017). Based on the context of mastering material using e-modules, students with a certain level of Intelligence quotient may need a different approach or explanation to understand the concepts presented. Research on the relationship between Intelligence quotient and mastery of biodiversity material using e-modules still needs to be conducted. However, there is research conducted by Bungawati et al. (2018) stated that the Intelligence quotient influences biology learning outcomes with a contribution value of 15.2%. Based on this research, it was also concluded that the higher the Intelligence quotient, the better the learning outcomes.

Remember that in class X, students begin to be introduced to this material, and it becomes the basis for them to understand biology further. Therefore, analysis of the Intelligence quotient and reading comprehension of class so that students can understand the material better. The purpose of this study is to analyze the extent to which intelligence quotient is correlated with mastery of biodiversity material using e-modules.

## METHODS
### Research Design

This research is a type of correlational quantitative research (Creswell, 2019) by collecting numerical data such as scores from intelligence quotient and scores from mastery tests on biodiversity material. This research was conducted in January 2024 involving a high school. The author formulates that the independent variable or independent variable is students' intelligence quotient and reading comprehension abilities, which can influence students' success in understanding the material from the e-module, and the dependent variable or dependent variable is mastery of biodiversity material using the e-module. The Ministry of Education and Culture issued the e-module used in implementing this research with the title High School Biology Learning Module.

## Population and Sample

The population in this study was 318 class Determining the sample size was carried out by statistical calculations using the Slovin Formula. The Slovin formula was used to determine a sample from a known population, namely 177 class X students

## Instrument

The instrument used was a questionnaire on Google form in the form of questions. The variables used are intelligence quotient and mastery of biodiversity using e-modules. The intelligence quotient possessed by students was obtained through secondary data from SMAN 12 Tangerang. Meanwhile, the instrument for mastering biodiversity material using e-modules uses 30 multiple-choice questions with a score of 1 for the correct answer and 0 for the wrong answer. These questions were developed from learning objectives based on material that students have studied and that students must have in the 2023 independent synchronization biology subject learning outcomes referring to indicators from Anderson & Krathwohl (2010).

The instrument for mastering biodiversity material using e-modules has been tested with the results of the validity test by experts and empirical validity test analysis. Based on the validity test by experts, the results in the substance category were very feasible, meaning that the instrument was in accordance with the indicators and grids and in line with the indicators from Anderson & Krathwohl (2010). The construction category received very feasible criteria, the instruments developed were dominated by narratives, but there were some pictures, tables, and diagrams so that it was easier for students to understand the material being taught. Because the language category uses communicative, clear, easy-to-understand Indonesian, meets adequate and appropriate standards. The overall results of logical validity by three expert validators showed an average score of 89%, meaning that the reading comprehension ability instrument was in the very feasible category for use and testing. Furthermore, an empirical validity test was carried out and the results showed that out of 30 questions tested, 25 questions were declared valid, and 5 questions were declared invalid.

## Procedure

The preparation, implementation, and data collection phases comprised the three phases of the study procedure. The stage of research preparation is dedicated to getting everything ready for the study. In this step, instruments for mastering biodiversity material utilizing e-modules are prepared, research permits are obtained, research tools are prepared, and observations are used to select the research location. The research will then be implemented and carried out. First, permission to observe in a high school and a collaborative agreement with the subject teacher to conduct research will be sought. Next, a Google form link will be sent to students, who will fill it out according to the instructions provided. Throughout the filling process, the researcher will accompany the students, and the Google form will be withdrawn. Finally, the data collection stage involves gathering the answers from Google Forms and compiling them into an Excel file. The responses from respondents will be automatically entered into the gathered file, and the students' selections will be noted.

## Data Analysis Techniques

The data obtained from the research instrument will be analyzed through several stages, namely prerequisite testing and hypothesis testing. Prerequisite tests include normality test, homogeneity test, linearity test, heteroscedasticity test, multicollinearity test, and autocorrelation test. Next, the hypothesis test was carried out by a simple linear regression test, and the coefficient of determination test.

## RESULTS AND DISCUSSION

The research results were obtained from processing data on intelligence quotient scores, reading comprehension ability, and mastery of material using e-modules for class X students at SMAN 12 Tangerang City. Research shows the average, highest score, lowest score, and standard deviation of students' intelligence quotient scores and mastery of material using e-modules.

**Table 1**.

Descriptive Statistics of Intelligence Quotient Values and Mastery of Material Using E-Module.

| Variable | N | Minimum | Maximum | Mean | Std. Deviation |
|----------|-----|---------|---------|-------|----------------|
| X | 177.00 | 90.00 | 120.00 | 97.34 | 6.472 |
| Y | 177.00 | 84.00 | 100.00 | 97.24 | 3.044 |

Information:

X = Intelligence Quotient

Y = Mastery of Biodiversity Material Using E-Modul

Based on Table 1 above, it can be concluded that the number of samples in this study was 177 samples, with a variable amounting to 97.34 with a standard deviation of 6.472. Variable Y, namely mastery of biodiversity material using e-modules, has the smallest (minimum) value of 84 and the largest (maximum) value of 100. The average mastery of biodiversity material using e-modules for 177 students shows a result of 97.24 with a standard deviation of 3.044. Next, statistical hypothesis testing was carried out using the IBM SPSS 25.0 program with a significance level of $\alpha$ = 0.05. In this research, hypothesis testing was carried out, namely.

**Table 2.**

Simple Linear Regression Statistical Analysis of Intelligence quotient with Mastery of Biodiversity Material After Using E-Modules

| Regression | Regression Equations | Sig. |
|------------|---------------------|------|
| X ⟶ Y | $\hat{Y} = 41.268 + 0.580X_1$ | 0.000 |

Information:

X = Intelligence Quotient

Y = Mastery of Biodiversity Material Using E-Module

The results of the simple linear regression model test obtained a significance value of 0.00, so accept $H_0$, which means that the intelligence quotient variable (X) has a significant effect on the variable mastery of biodiversity material using e-module (Y). The significant regression model produces an equation model $\hat{Y} = 41.268 + 0.580X$. Correlation testing with the coefficient of determination was carried out using Pearson Product Moment. Based on the results of calculations using the SPSS 25.0 program, a value (Sig.) of 0.000 < 0.05 is obtained, so accept H0, which means that the intelligence quotient variable (X) has a positive relationship with the material mastery variable using e-module (Y).

**Table 3.**

Correlation Coefficient, Determination and Significance of Correlation of Intelligence Quotient with Mastery of Biodiversity Material Using E-Module

| Correlation | Pearson Product Moment | | |
|-------------|------------------------|----------|------|
| | $r_{count}$ | $R = r^2$ | Sig. |
| X ⟶ Y | 0.881 | 0.776 | 0.000 |

Information:

X = Intelligence Quotient

Y = Mastery of Biodiversity Material Using E-Module

Based on Table 3, the correlation coefficient ($r_{xy}$) is 0.881, which means the correlation relationship with the criteria is very strong. The result of the coefficient of determination is 77.6%. This can be interpreted that intelligence quotient contributes 77.6% to the mastery of biodiversity material using e-modules, while 22.4% is related to other factors.

The results of hypothesis testing show that there is a significant correlation between intelligence quotient and mastery of biodiversity material using e-modules. The correlation coefficient results of intelligence quotient with mastery of material using an e-module is 0.881, which means the correlation relationship is solid, and the coefficient of determination is 77.6%. This shows that the use of e-modules can make a significant contribution to mastering biodiversity material, especially for students with specific intellectual abilities. There is a strong correlation between intelligence quotient and mastery of the material, the use of e-modules is an effective means of increasing students' mastery of the material

in studying biodiversity topics. These results are in accordance with research conducted by Kurniawati & Zubir (2020), that intelligence quotient has a significant effect on student learning achievement and has a coefficient of determination value of 29.4%.

Based on the results obtained, intelligence quotient has a vital contribution to consider in learning. However, the other 22.4% is the influence of other factors outside intellectual intelligence. Kurnia (2019) shows that intelligence quotient is not the only factor that predicts a person's achievement, there is emotional intelligence and spiritual intelligence that influence learning achievement. This is in line with research by Agustina et al. (2017) that intelligence quotient has a 20% influence on a person's achievement, while other factors cause 80%.

The results of the Pearson Correlation show a positive value, which means that intelligence quotient influences the level of student's mastery of the material. The higher the intellectual intelligence, the higher the mastery of the material achieved. Likewise, vice versa, the lower the intelligence quotient of students, the lower their mastery of the material tends to be. This is in line with the statement of Bungawati et al. (2018) that the higher a person's intellectual intelligence, the greater the individual's chances of achieving success and achievement. Meanwhile, the lower a person's level of intellectual intelligence, the more difficult they tend to be in receiving and processing information, which influences their academic achievement.

The intelligence quotient is needed to assess how well someone can understand ideas or concepts expressed verbally, which means the ability to transform abstract things into concrete actions (Liu et al., 2017; Isnain et al., 2021). Intelligence quotient is also closely related to a person's ability to communicate, both orally and in writing, which shows that students with this ability have a more significant opportunity to excel in school lessons (Suyanto, 2015; Rosa, 2018).

Based on the results obtained, a person's intelligence quotient is critical in the process of receiving and understanding the information in the e-module well. This is supported by research by AR & Syahrizal (2016) that the information received by students with intelligence quotient must be sufficient to process information effectively. This research also states that intelligence quotient is influenced by educational and environmental factors, so that intelligence quotient can be improved so that students are faster and more precise in solving various learning problems. However, the use of e-modules can help individuals with various levels of intelligence quotient to improve students' understanding of learning material.

This reinforces the fact that intelligence quotient has functions starting from the level of remembering, understanding, applying, analyzing, and synthesizing to evaluating, becoming a thinking process that brings results in the form of high reasoning and creativity for students (Sanusi, 2018). A person with a good intelligence quotient is expected to be able to overcome various difficulties in learning (Kathirisetty et al., 2022). Therefore, educational institutions need to guide the development of intelligence quotient to achieve the desired goals through a learning process that allows the acquisition of knowledge, which is an essential aspect of the development of intelligence quotient in formal education.

It is still believed that students' intelligence quotient determines students ability to understand and process information during the learning process. Apart from that, according to Kurniawati & Zubir (2020), intelligence quotient can also help teachers or instructors understand the condition of students, including whether they can participate in learning well, as well as predict the possibility of success or failure in the learning process.

## CONCLUSION

There is a positive relationship between intelligence quotient and mastery of biodiversity material using e-modules with a correlation coefficient value of 0.881, which means the correlation relationship is solid. A determination value of 77.6% is obtained.

## REFERENCES

Agustina, T., Restuati, M., & Asphani, F. (2017). Hubungan kecerdasan emosional dan kecerdasan intelektual terhadap hasil belajar biologi siswa pada materi sistem saraf di SMA Asy-Syafi'iyah Medan. *Jurnal Pendidikan Matematika Dan Sains*, *12*(1), 39–43. https://doi.org/10.24114/jpms.v12i1.9002

Al-Muhdhar, M. H. I., Basaroh, A. S., Prasetyo, T. I., Sumberartha, I. W., Mardiyanti, L., & Fanani, Z. (2021).

Improvement of creative thinking skills and environmental literacy through the e-module of surrounding nature exploration. *AIP Conference Proceedings*, *030003*. https://doi.org/https://doi.org/10.1063/5.0043102

Anderson, L. W., & Krathwohl, D. R. (2010). *Kerangka Landasan Untuk Pembelajaran, Pengajaran, dan Asesmen (Revisi Taksonomi Pendidikan Bloom)*. Pustaka Pelajar.

AR, N., & Syahrizal. (2016). Relation Between Intellectual Intelligence and Learning Achievement of the Students of Dayah Almadinatuddiniyah Syamsuddhuha, Cot Murong, North Aceh. *Edukasi Islami: Jurnal Pendidikan Islam*, *14*(02), 207–222. https://doi.org/10.32729/edukasi.v14i2.18

Binet, A. (2019). *The Mind and The Brain : Dahsyatnya Otak dan Pikiran Manusia*. Desa Pustaka Indonesia.

Bungawati, Taiyeb, A. M., & Hartati. (2018). Pengaruh Kecerdasan Intelektual, Kecerdasan Emosional Dan Kecerdasan Spiritual Terhadap Hasil Belajar Biologi Siswa SMA Negeri di Kabupaten Soppeng. *Journal of Biology Education*, *1*(3), 192–202. https://doi.org/10.35580/ujbe.v1i2.6419

Creswell, J. W. (2019). *Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed* (Edisi Keti). Pustaka Pelajar.

Delita, F., Berutu, N., & Nofrion. (2022). Online Learning: the Effects of Using E-Modules on Self-Efficacy, Motivation and Learning Outcomes. *Turkish Online Journal of Distance Education*, *23*(4), 0–3. https://doi.org/10.17718/tojde.1182760

Etobro, A. B., & Fabinu, O. E. (2017). Students' Perceptions Of Difficult Concepts In Biology In Senior Secondary Schools In Lagos State. *Global Journal Of Education Research*, *16*, 139–147. http://dx.doi.org/10.4314/gjedr.v16i2.8

Gleason, N. W. (2018). The fourth industrial revolution and higher education. In *Higher Education in the Era of the Fourth Industrial Revolution*. Nature Singapore.

Isnain, Z., Jazuli, M., & Suharto, S. (2021). Catharsis : Journal of Arts Education The Impact of Intelligence Quotient On The Learning Outcomes of Musical Art in State Schools. *Catharsis: Journal of Arts Education*, *10*(2), 130–141. https://doi.org/ 10.15294/ catharsis.v10i2.51535

Kahar, M. I., Cika, H., Nur Afni, & Nur Eka Wahyuningsih. (2021). Pendidikan Era Revolusi Industri 4.0 Menuju Era Society 5.0 Di Masa Pandemi Covid 19. *Moderasi: Jurnal Studi Ilmu Pengetahuan Sosial*, *2*(1), 58–78. https://doi.org/10.24239/moderasi.vol2.iss1.40

Kathirisetty, N., Jadeja, R., Garg, D., & Thakkar, H. K. (2022). On the Design of Student Assessment Model Based on Intelligence Quotient Using Machine Learning. *IEEE Access*, *10*, 48733–48746. https://doi.org/10.1109/ACCESS.2022.3171807

Kiong, T. T., Yunos, J., Mohammad, B., Othman, W., Heong, Y. M., & Mohamad, M. M. (2012). The Development and Implementation of Buzan Mind Mapping Module. *Procedia - Social and Behavioral Sciences*, *69*(May 2014), 705–708. https://doi.org/10.1016/j.sbspro.2012.11.464

Kurnia, H. (2019). Pengaruh Kecerdasan Intelektual, Emosional Dan Spiritual Terhadap Prestasi Belajar Pendidikan Kewarganegaraan. *Academy of Education Journal*, *10*(01), 1–21. https://doi.org/10.47200/aoej.v10i01.267

Kurniawati, K., & Zubir, Y. (2020). Kecerdasan intelektual dan prestasi belajar siswa kelas XI MIPA SMA Negeri 8 Yogyakarta. *Jurnal Psikologi Terapan Dan Pendidikan*, *2*(2), 103. https://doi.org/10.26555/jptp.v2i2.21073

Lase, N. K., & Harefa, K. (2022). Development Of Biology E-Modules Using Proffesional PDF Flip Application On Human Respriratory System Materials. *Scientia*, *11*(2), 750–755. http://infor.seaninstitute.org/index.php/pendidikan/article/view/1032

Li, G., Hou, Y., & Wu, A. (2017). Fourth Industrial Revolution: technological drivers, impacts and coping methods. *Chinese Geographical Science*, *27*(4), 626–637. https://doi.org/10.1007/s11769-017-0890-x

Liu, F., Shi, Y., & Liu, Y. (2017). Intelligence quotient and intelligence grade of artificial intelligence. *Annals of Data Science, 4*, 179-191. https://doi.org/10.1007/s40745-017-0109-0

Nunung, R., & Kusyanti, T. (2021). International Journal of Active Learning Development of Interactive Digital Module Based on Virtual Laboratories in The Covid-19 Pandemic Era in Dynamic Fluid Materials. *International Journal of Active Learning*, *6*(1), 41–48. https://www.learntechlib.org/p/219439/

Pratidhina, E. (2020). Education 4 . 0 : Pergeseran pendidikan sebagai konsekuensi revolusi industri 4 . 0. *Humanika, Kajian Ilmiah Mata Kuliah Umum*, *20*(1), 1–12.

https://doi.org/10.21831/hum.v20i1.29290.1-12

Rahma, K. A., Nugroho, A. S., & Mulyaningrum, E. R. (2023). E - Modul Keanekaragaman Hayati Sebagai Implementasi Hasil Penelitian Jenis Tumbuhan Obat dan Pemanfaatannya Desa Kayen. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, *15*(1), 71–75. https://doi.org/10.30599/jti.v15i1.1750 E-Modul

Rosa, E. (2018). Pengaruh Persepsi Peserta Didik Atas Gaya Belajar Dan Kecerdasan Intelektual Terhadap Prestasi Belajar Bahasa Inggris. *INFERENCE: Journal of English Language Teaching*, *01*(01), 1–98. https://core.ac.uk/download/pdf/236199354.pdf

Sanusi, A. (2018). *Pendidikan untuk Kearifan : Mempertimbangkan Kembali Sistem Nilai, Belajar, dan Kecerdasan* (Y. Iriantara (ed.)). Penerbit Nuansa.

Suyanto, A. (2015). The Effectiveness Of Mindmapping In Improving Students. *IJEE (Indonesian Journal of English Education)*, *2*(2), 101–119. https://doi.org/10.15408/ijee.v2i2.3089