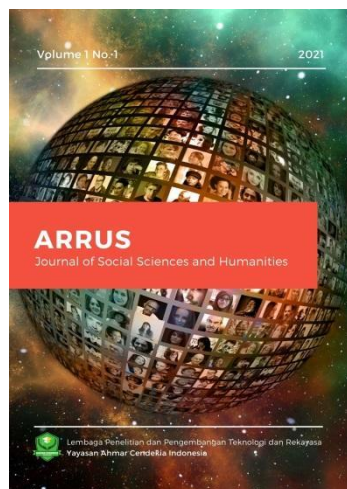




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RESEARCH ARTICLE

The Effect of the Team Assisted Individualization Model Assisted by Wordwall on Students' Critical Thinking Skills in Biology Learning

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Abstract: This study aims to determine the effect of the Team Assisted Individualization (TAI) cooperative learning model assisted by Wordwall media on students' learning outcomes in biodiversity material, considering the low active involvement of students in conventional biology learning. The research uses an experimental approach with a one-group pretest-posttest design involving 33 students from class X at SMA Negeri 14 Gowa, selected through purposive sampling from a population of 360 students. The instrument used was a multiple-choice learning outcome test administered before and after the treatment, accompanied by a documentation study. Data were analyzed descriptively and inferentially using the Shapiro-Wilk normality test and the Paired Samples T-Test assisted by SPSS. The research results showed an increase in the average learning outcomes from 54.06 in the pretest to 80.97 in the posttest, with a t-test significance value of 0.000 ($p < 0.05$), thus H_0 was rejected and H_a was accepted. These findings prove that the TAI model assisted by Wordwall has a significant impact on improving students' learning outcomes. Practically, this model can be used as an alternative biology learning strategy that encourages student activity, collaboration, and motivation in the classroom.

Keywords: Team Assisted Individualization, Wordwall, Learning Outcomes, Cooperative Learning

1. Introduction

The curriculum, as a learning plan device, is designed to direct the educational process toward comprehensively established goals (Pratycia et al., 2023), thus its formulation demands careful analysis from curriculum designers and developers to ensure that the applied learning strategies are always relevant to the needs of the students (Yunita et al., 2023). Efforts to renew the curriculum, one of which is through the Merdeka Curriculum, are intended to provide a more flexible learning space centered on students' interests and talents (Evi, 2022; Syahrul, 2022; Shinta et al., 2024), in line with the mandate of the National Education System Law No. 20 of 2003, which emphasizes education as a conscious effort to develop students' potential comprehensively (Desi, 2022). In realizing these goals, teachers occupy a central position as planners and implementers of learning (Dea, 2020; Mashari et al., 2019), who are required to design optimal educational interactions between teachers, students, and the learning environment so that the learning outcomes achieved align with the learning objectives (Hamid, 2019).



The ideal condition has not yet been fully realized in the field. The initial observation conducted in class X6 at SMA Negeri 14 Gowa during the odd semester of the 2024/2025 academic year showed that the average biology learning outcomes of the students only reached 74.02, still below the Minimum Completeness Criteria (KKM) of 80. The low achievement is suspected to be related to the teaching model applied by the teacher, which is still considered simple and less varied, thus not yet able to optimize student active involvement in the learning process (Agustin, 2020; Saptono, 2016). One of the alternatives offered to address this issue is the Team Assisted Individualization (TAI) cooperative learning model, which combines individual and group learning by placing more capable students as assistants for those who need help (Susanti, 2016; Mirdad, 2020; Sjafai, 2017), thereby training students to respect each other, be responsible, and confidently express their opinions (Nurzakiaty, 2015). The application of this model is considered to be more optimal when supported by interactive learning media such as Wordwall, which provides various forms of quizzes and web-based educational games, thereby enhancing students' interest and understanding of the material (Nuritta, 2018; Nuraeni, 2023; Nurinda, 2023).

Research on the TAI model and Wordwall media is not actually a new thing. Safitri (2017) found that the TAI model positively influenced students' chemistry learning outcomes on the topic of ion equilibrium and the pH of salt solutions, while Ayu (2022) demonstrated that the independent use of Wordwall media could improve students' learning outcomes on the topic of the periodic table of elements compared to the control class. Both studies, although relevant, still treat the learning model and media separately — one focuses on the student grouping strategy (TAI) without utilizing interactive digital media, while the other tests the effectiveness of Wordwall media without combining it with a systematic cooperative learning structure. No research has yet specifically integrated the TAI model with the aid of Wordwall media, especially on biodiversity material at the high school level, leaving a gap that needs to be filled to complete the empirical evidence regarding the effectiveness of their combination. Based on this gap, this study offers novelty in the form of the integration of the TAI-type cooperative learning model with the aid of Wordwall media simultaneously on biodiversity material in class X at SMA Negeri 14 Gowa, a combination that has not been tested in previous studies. This integration is expected not only to improve students' cognitive learning outcomes but also to encourage collaboration and learning motivation through a more interactive learning experience. This study aims to determine whether there is a significant effect of implementing the Team Assisted Individualization type of cooperative learning model with the aid of Wordwall media on the learning outcomes of students at SMA Negeri 14 Gowa.

2. Literature Review

Cooperative learning is built on the assumption that the synergy arising from small group cooperation generates greater learning motivation compared to an individual competitive environment (Naniek, 2017). In this model, students are grouped heterogeneously — in terms of ability, gender, or character — to co-construct concepts and solve problems collectively, with each member still being held accountable for the group's results (Syahraini, 2017). The characteristic that distinguishes it from other learning strategies is not merely sitting in groups, but the presence of an explicit cooperative structure: individual success is dependent on team success, so students who have a better grasp of the material are encouraged to help their peers who are lagging behind (Hasanah, 2021). Such a structure has been consistently reported to enhance critical thinking skills, the ability to evaluate arguments, and a sense of solidarity among students (Leksono et al., 2020; Prasetyawati, 2021).

Team Assisted Individualization (TAI) is a variant of cooperative learning that specifically combines individual learning and group learning: students first work on the material independently, then discuss the results in heterogeneous groups consisting of four to five members, with more capable students acting as assistants for their peers who need help (Nurzakiaty, 2015; Susanti, 2016). Because it is student-centered, the teacher in this model

shifts from the role of a sole content deliverer to a facilitator (Ryskimar et al., 2022). This structure is implemented through eight sequential components (Table 1), starting from student placement based on initial abilities to the classical review of material (Fitriah et al., 2022).

Table 1. Components of the TAI Type Cooperative Learning Model

Component	Teacher Activities
Placement Test	Measuring students' initial abilities through previous results or pretest
Teams	Forming heterogeneous groups based on test results, gender, and background
Teaching Group	Explaining a summary of the material before assignments
Student Creative	Emphasizing that individual success depends on group success
Team Study	Guiding struggling students through peer tutoring within the group
Team Recognition & Team Score	Appreciating groups that successfully complete tasks
Fact Test	Conducting a posttest based on the material that has been learned
Whole Class Units	Reviewing material in a classical manner at the end of the lesson

Source: Fitriah et al. (2022).

The effectiveness of cooperative structures such as TAI is also determined by the media that supports the evaluation and training processes. Wordwall is available as a web-based application that packages learning evaluations in the format of interactive games — ranging from quizzes, word matching, to spin-the-wheel games — which can be accessed through a browser without special installation (Sakinata et al., 2022; Rizka et al., 2024). The characteristics of the games allow teachers to monitor the difficulty level of the questions as well as the students' achievement rankings in real-time (Permana, 2022), while for students, this format transforms evaluation from a stressful activity into a more relaxed and less monotonous experience (Mohammad, 2021; Nurinda, 2023).

Learning outcomes themselves are understood as the gains that emerge from an individual's interaction with their learning environment, reflected in changes in knowledge, attitudes, and skills that can be measured through assessment (Hardiyanto et al., 2015; Siti, 2018). This achievement is influenced by internal factors (intelligence, interest, motivation) as well as external factors, including the teaching approaches and strategies chosen by the teacher (Siti, 2018) which means that the choice of learning models and media is not merely a technical variation, but one of the direct determinants of students' academic achievement (Agustin, 2020).

These three theoretical frameworks cooperative learning, TAI, and Wordwall media logically complement each other in explaining why their combination has the potential to improve learning outcomes. The cooperative structure of TAI provides social mechanisms (peer tutoring, group responsibility) that theoretically enhance student engagement compared to pure individual learning (Naniek, 2017), while Wordwall supplies evaluative elements that maintain high engagement through gamification (Rizka et al., 2024). Empirical support for each component separately is already quite strong: Safitri (2017) noted a significant influence of TAI on chemistry learning outcomes, while Ayu (2022) noted a similar effect for Wordwall on the periodic table of elements material. However, this literature review also reveals methodological weaknesses that should be noted: most of the conceptual references mentioned above including the definitions of TAI and the advantages of Wordwall are sourced from unpublished theses and small/local journals, rather than reputable indexed journals, so their theoretical validity should be cross-verified with more established literature, such as Tinungki's (2015) study on TAI in the context of mathematical communication skills, before being used as a basis for generalization. Based on this framework, this study formulates the hypothesis that the application of the TAI model assisted by Wordwall has a

significant effect on students' learning outcomes in the subject of biodiversity (H_1), contrary to the null hypothesis which states that there is no effect (H_0).

3. Research Method and Materials

This study uses a one-group pretest-posttest design, conducted in the even semester of the 2025/2026 academic year at SMA Negeri 14 Gowa. The research subjects were 33 students from class X3, selected through purposive sampling from a population of 360 class X students based on the consideration of class characteristic equivalence. The independent variable in this study is the Team Assisted Individualization (TAI) cooperative learning model assisted by Wordwall media, while the dependent variable is the students' learning outcomes on biodiversity material. The research procedure began with a pretest to measure the students' initial abilities, followed by the implementation of the TAI learning model assisted by Wordwall, and concluded with a posttest to measure changes in learning outcomes after the treatment.

Data were collected using two techniques. First, a multiple-choice learning outcome test was administered as a pretest and posttest to measure students' cognitive achievements before and after the treatment. Second, documentation study in the form of school profiles, organizational structure, and daily biology test scores of students as supporting data.

Data were analyzed descriptively (mean, median, mode, standard deviation, and frequency distribution) to categorize student learning outcomes based on a five-point scale and the Minimum Completeness Criteria ($KKM \geq 65$ individually and $\geq 75\%$ classically). Prerequisite tests were conducted through the Shapiro-Wilk normality test ($\alpha = 0.05$), and hypothesis testing was performed using the Paired Samples T-Test assisted by SPSS to determine significant differences between pretest and posttest scores.

4. Results and Discussion

The data on student learning outcomes before and after the implementation of the TAI cooperative learning model assisted by Wordwall media show a consistent improvement pattern (Table 2). The average score of the students increased from 54.06 in the pretest to 80.97 in the posttest, followed by an increase in the median score from 56.00 to 80.00 and the mode from 60 to 80 — an indication that the improvement did not only occur in the group average but shifted uniformly toward higher values. Interestingly, the data distribution actually narrowed after the treatment: the standard deviation decreased from 8.667 to 7.144 and the score range from 32 to 24, with the lowest score rising from 36 to 68. This pattern indicates that the treatment not only boosts high-achieving students but also lifts those who were previously lagging behind, thereby reducing the achievement gap among students.

Table 2. Descriptive Statistics of Student Learning Outcomes (Pretest–Posttest)

Statistics	Pretest	Posttest
N	33	33
Mean	54,06	80,97
Median	56,00	80,00
Modus	60	80
Std. Deviasi	8,667	7,144
Rentang	32	24
Minimum	36	68
Maksimum	68	92

Source: SPSS data processing results.

Before hypothesis testing, the data were tested for normality using the Shapiro-Wilk test (Table 3); the significance values of the pretest (0.175) and posttest (0.073) were both above



0.05, indicating that both data groups met the assumption of normal distribution and were suitable for parametric statistical testing. The results of the Paired Samples T-Test (Table 3) show a mean difference of 26.909 with a significance value of 0.000 ($p < 0.05$), which means H_0 is rejected and H_a is accepted: there is a statistically significant difference in learning outcomes before and after the application of the TAI model assisted by Wordwall on biodiversity material.

Table 3. Shapiro-Wilk Normality Test Results

Data	Statistic (df=33)	Sig.
Pretest	0,954	0,175
Posttest	0,941	0,073

Source: SPSS data processing results.

Table 4. Results of the Paired Samples T-Test

Uji T Paired Sampel T-Test	Mean Difference	Std. Deviasi	t	Sig. (2-tailed)
Pretest - Posttest	-26,909	11,193	-13,811	0,000

Source: SPSS data processing results.

This improvement aligns with the basic logic of cooperative learning, which positions students as active subjects who help each other in small and heterogeneous groups (Naniek, 2017). The TAI structure specifically allows students who have a better grasp of the material to act as "assistants" for their groupmates (Tinungki, 2015) — a mechanism that appears to work effectively in this class, as evidenced by the reduced post-treatment standard deviation: students who initially had low scores were the most helped by peer tutoring interactions, not just those who were already excelling from the beginning.

The role of the Wordwall media cannot be separated from this achievement either. As an interactive quiz-based evaluation tool, Wordwall provides immediate feedback that transforms the evaluation process from merely formal tests into more enjoyable activities (Rizka et al., 2024; Mohammad, 2021), consistent with the argument that learning media serves to bridge messages so that they are easier for students to understand (Aisyah et al., 2023). However, these findings also open up room for criticism: the study did not involve a control group, so the observed score increase could potentially be influenced by the testing effect or the maturation of students' learning over the research period, rather than solely by the treatment itself — an inherent limitation of the one-group pretest-posttest design that needs to be considered when interpreting the magnitude of the effect.

Compared to previous research, this finding both reinforces and complements. Safitri (2017) showed that TAI effectively improves chemistry learning outcomes, and Ayu (2022) showed that Wordwall effectively improves learning outcomes on the periodic table of elements; however, both tested the model and media separately. This study shows that when TAI and Wordwall are combined, their impact on biology learning outcomes remains significant and even demonstrates a pattern of achievement distribution that was not explicitly reported in either of the previous studies — an initial indication that the integration of cooperative grouping strategies with digital evaluation media can reinforce each other, although the generalization of this conclusion still requires testing in a design involving a comparison group.

5. Conclusion

This study proves that the application of the Team Assisted Individualization (TAI) cooperative learning model assisted by Wordwall media has a significant impact on students' learning outcomes on biodiversity material in class X at SMA Negeri 14 Gowa, as evidenced by the increase in the average score from 54.06 on the pretest to 80.97 on the posttest and the results of the Paired Samples T-Test with a significance of 0.000 ($p < 0.05$), thus



addressing the research objectives proposed at the beginning. These findings indicate that the combination of cooperative grouping strategies and digital evaluation media mutually reinforce the effectiveness of learning, rather than merely being the sum of two separate methods. Based on this, biology teachers are advised to consider the TAI model assisted by Wordwall as an alternative active learning strategy, especially for material that requires both conceptual understanding and memorization of terms such as biodiversity. Meanwhile, the school should ensure the availability of adequate internet access and digital devices in the classroom so that the implementation of web-based learning media can run consistently, not just as a one-time trial.

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