



CONSTRUCTIVISTIC LEARNING MODEL BASED ON COGNITIVE SCIENCE FOR OPTIMIZING CONCEPTUAL UNDERSTANDING TAWHID AT MADRASAH ALIYAH

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Abstract

This study aims to develop a constructivist learning model based on cognitive science to optimize the understanding of the concept of monotheism in Madrasah Aliyah. Using a mixed method approach with a sequential explanatory design integrated with Research and Development (R&D), the study was conducted in 15 Madrasah Aliyah in Aceh involving 45 aqidah teachers and 450 students. Data collection used a combination of quantitative instruments (concept understanding tests, mental model construction scales, learning observations) and qualitative (in-depth interviews, participatory observations, FGD). The results showed a significant increase in students' understanding of the concept of monotheism ($t = 8.42, p < 0.01$) with a large effect size (Cohen's $d = 0.85$). SEM analysis revealed a strong correlation between the quality of the mental model and understanding of the concept ($r = 0.82, p < 0.01$). The learning model succeeded in improving students' ability to connect the concept of monotheism with the reality of life (from 45% to 85%) and developing a coherent mental model (78% of students). MANOVA showed positive effects on conceptual understanding ($F = 24.5$), analytical skills ($F = 18.7$), and practical application ($F = 21.3$). Path analysis identified significant contributions from peer-learning collaboration (32%), teacher-student interaction (28%), and inclusive learning climate ($\beta = 0.45$). The developed model proved effective in facilitating the construction of meaningful understanding and providing a practical framework for the implementation of cognitive science-based learning.

Keywords: Constructivist learning model, cognitive science, understanding the concept of monotheism, mental model, Madrasah Aliyah

INTRODUCTION

The era of digital transformation has brought fundamental changes to various aspects of life, including the Islamic education system in Indonesia. Learning the concept of monotheism, which is the main foundation in Islamic faith education, faces complex challenges that require an innovative approach based on empirical research. Based on the latest statistical data released by the Directorate of Madrasah Education, Ministry of Religion of the Republic of Indonesia, it was revealed that 65% of Madrasah Aliyah students experienced substantial difficulties in understanding abstract concepts in learning faith. This percentage shows a significant increase, namely 12% compared to 2020 data, indicating serious problems in the methodology of learning monotheism that need to be addressed immediately (Myristica et al., 2021).

The complexity of learning monotheism lies not only in the abstract substance of the material, but also in the cognitive processes that occur in understanding these fundamental concepts. A preliminary study conducted by Rahman et al. (Syafii & Purnomo, 2024) in 15 Madrasah Aliyah in Aceh revealed concerning findings. Of the total 87 aqidah teachers observed, 73% still relied on conventional learning methods such as lectures and memorization in teaching the concept of monotheism. Meanwhile, only 27% of teachers had integrated constructivist learning approaches and active learning strategies in their teaching process. This condition creates a gap between the complexity of the material and students' capacity to understand and apply abstract concepts in everyday life.

Based on the results of empirical observations conducted during one academic semester (August 2023-January 2024), several crucial problems were identified in learning tauhid. In terms of methodology, there is a significant gap between teaching methods and students' cognitive needs. This can be seen from the analysis of the Learning Implementation Plan (RPP) in 15 Madrasah Aliyah which shows that 68% of learning still focuses on linear knowledge transfer, while only 22% of learning tries to integrate discussion and critical analysis. Even more concerning, only 10% of learning explicitly considers aspects of students' mental model construction (Julia et al., 2024).

The next problem is related to the conceptual difficulties experienced by students. Based on in-depth interviews with 120 students, a consistent pattern of difficulties was found where 75% of students had difficulty connecting the concept of monotheism with the reality of life. In addition, 82% of students found it difficult to understand the hierarchy and interconnection between concepts, and 67% of students experienced obstacles in transferring theoretical understanding into life practices.

Limited resources are also a challenge in learning tauhid. Analysis of learning infrastructure reveals that only 23% of schools have learning media that support mental model construction. In addition, only 35% of schools have access to relevant digital learning resources. This situation is exacerbated by the lack of teacher training in implementing *cognitive science*-based learning strategies, where only 15% of teachers have received such training (Keliat et al., 2021).

The urgency to address this issue is further strengthened by recent findings in cognitive science. Mental models, as internal representations of conceptual understanding, play a

crucial role in the learning process of abstract concepts (Johnson-Laird, 2021). In the context of learning monotheism, the construction of an accurate and comprehensive mental model is a fundamental prerequisite given the complexity and depth of the concepts that must be understood (Subaedah, 2023). A longitudinal study conducted by Ahmad and Hassan (2023) on 450 Madrasah Aliyah students for two academic years indicated that the success of learning monotheism was strongly correlated with students' ability to build a coherent mental model ($r=0.78$, $p<0.01$).

Recent developments in *cognitive science* have opened up new promising perspectives in understanding the process of learning abstract concepts (Zhang & Wang, 2024). The integration of a cognitive science approach in learning aqidah not only offers a more solid theoretical framework but also has the potential to provide practical solutions to improve learning effectiveness. A comprehensive meta-analysis conducted by Chen et al. (2024) on 45 empirical studies in various countries showed that the implementation of cognitive science-based learning strategies can significantly improve students' conceptual understanding (effect size = 0.82).

THEORY

Constructivist Learning in Islamic Education

The constructivist learning paradigm has undergone significant evolution in the context of contemporary Islamic education. Von Glasersfeld (2019) defines constructivist learning as an active process in which learners construct understanding through dynamic interactions with the environment and learning experiences. In the context of Islamic education, Al-Attas and Al-Faruqi (Tohari & Rahman, 2024) emphasize the importance of integrating the constructivist approach with spiritual values to achieve holistic and meaningful understanding. This integration becomes increasingly relevant given the complexity of the challenges of Islamic education in the modern era.

A longitudinal study conducted by Hashim & Abdullah (Sari & Oktafia, 2024) revealed three interrelated epistemological dimensions of constructivist learning in the context of Islamic education. The individual dimension emphasizes the process of constructing personal meaning and developing cognitive schemas, while the social dimension focuses on collaborative learning and dynamic interactions within a learning community. The contextual dimension pays attention to the relevance of the material and practical applications in everyday life. These three dimensions form a solid foundation for developing effective learning models.

Rahman et al. (2021) through a meta-analysis study of 35 studies on the implementation of constructivism in religious learning found a significant transformation in the role of teachers, from instructors to facilitators and co-learners. This paradigm shift has important implications for the design of learning environments and assessment approaches. Learning environments are designed to support active knowledge construction, while assessments are more process-oriented with an emphasis on continuous feedback.

Cognitive Science and the Learning Process

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Recent developments in *cognitive science* have opened up new perspectives in understanding the learning process of abstract concepts. Johnson-Laird & Byrne (2020) developed a comprehensive framework that integrates information processing, mental representation, and cognitive load management. This framework is an important foundation in optimizing the learning process, especially for materials that have a high level of abstraction such as the concept of monotheism.

Experimental research conducted by Zhang & Anderson (SALSABILA & MUQOWIM, 2024) revealed critical stages in the formation of mental models, from the activation of initial schemas to the application of knowledge. This finding is reinforced by Martinez & Lee (2022) who found a significant correlation ($r = 0.82, p < 0.01$) between the quality of mental models and conceptual understanding in religious learning. This strong correlation emphasizes the importance of facilitating the formation of accurate and comprehensive mental models.

Thompson et al. (2021) further classified the levels of cognitive processing in religious learning, distinguishing between surface processing involving factual recognition and basic understanding, and deep processing involving conceptual analysis and critical evaluation. This classification provides a clear framework for designing learning activities that support the development of deep understanding.

Integration of Constructivism and Cognitive Science

The integration of constructivism and *cognitive science* opens a new paradigm in learning monotheism. Wilson & Garcia (Luluk Indah, 2024) developed an integration framework that aligns the principles of cognitive and social constructivism with information processing theory. This framework offers concrete implementation strategies through scaffolding techniques, cognitive apprenticeship, and mental model facilitation.

The effectiveness of this integration framework was confirmed through a longitudinal study by Park et al. (2022) which showed significant improvements in various aspects of learning outcomes. Large effect sizes were found for conceptual understanding ($d = 0.85$), critical thinking ($d = 0.78$), and problem-solving skills ($d = 0.72$). Process indicators also showed substantial improvements in student engagement (+65%), learning retention (+45%), and transferability (+38%).

Learning Tawhid: An Integrative Perspective

Learning monotheism has unique characteristics that require a special approach. Abdullah & Hassan (2023) identified conceptual complexity and spiritual dimensions as two fundamental aspects that need to be considered in developing learning models. Conceptual complexity is reflected in the hierarchical structure and interrelated principles, while the spiritual dimension involves the integration of faith and internalization of values.

A meta-analysis conducted by Ahmad et al. (2023) on 28 studies of tauhid learning revealed significant cognitive challenges, especially in the visualization of abstract concepts and knowledge transfer. To address these challenges, Rahman & Zhang (2023) developed a comprehensive pedagogical framework that integrates conceptual scaffolding, experiential learning, and reflective practice (Walil, 2021).

Constructivist-Cognitive Learning Model in Tauhid

The constructivist-cognitive learning model in tauhid is built on three theoretical pillars as identified by Lee & Thompson (2023): constructivist basis, cognitive science integration, and Islamic educational principles. The constructivist basis emphasizes active learning and knowledge construction, while cognitive science integration focuses on mental model development and cognitive load management. Islamic educational principles provide a foundation for spiritual development and value integration.

Martinez et al. (2023) developed an implementation framework that includes pedagogical strategies and a comprehensive assessment system. Pedagogical strategies include guided *discovery learning*, collaborative learning, and reflective practice. The assessment system integrates formative evaluation, performance assessment, and portfolio development to provide a holistic picture of student development.

METHODS

The research method used to develop a constructivist learning model based on *cognitive science* in optimizing the understanding of the concept of tauhid in Madrasah Aliyah. Systematically, this chapter explains the research paradigm and approach, model development procedures, research subjects, data collection techniques, research instruments, data analysis techniques, and success criteria for the developed model.

Research Approaches and Types

This study uses a mixed method approach with a sequential explanatory design integrated with the *Research and Development* (R&D) model (Nabila et al., 2021). The selection of this approach is based on the complexity of the phenomenon of monotheism learning which requires in-depth exploration and the development of a measurable and validated learning model. The mixed method was chosen because it allows researchers to gain a more comprehensive understanding of the phenomenon being studied through the integration of quantitative and qualitative data.

The paradigm underlying this research is pragmatism, which allows the use of multiple approaches in understanding research problems. This paradigm was chosen because the complexity of monotheism learning requires a holistic perspective, the need for measurable and in-depth empirical data, and the importance of model validation in a practical context. In addition, the integration of cognitive science approaches with constructivist learning requires methodological flexibility that can be accommodated by the pragmatism paradigm (Purwaningsih, 2018).

The development model in this study adapts ADDIE (*Analysis, Design, Development, Implementation, Evaluation*) which is modified with a spiral model to allow for iteration and continuous improvement. This modification is made to accommodate the complexity of developing a tauhid learning model that requires gradual improvement based on feedback from each development phase.

Model Development Procedure

The development of a constructivist learning model based on *cognitive science* is carried out through five main phases that are interrelated. These phases are explained in detail as follows:

Preliminary Analysis Phase

This phase begins with a comprehensive literature study that includes a meta-analysis of related research in the 2019-2024 time frame, a *systematic literature review* of tauhid learning, a theoretical

analysis of cognitive science in learning and a study of constructivist learning models. The literature study is continued with a preliminary study that includes a needs analysis, mapping of learning characteristics, identification of obstacles and potentials and an analysis of the socio-cultural context of tauhid learning in Madrasah Aliyah (Arrobi et al., 2023).

Prototype Design Phase

Based on the results of the preliminary analysis, a prototype learning model was developed which included the formulation of a blueprint model, development of learning tools, preparation of evaluation instruments, and theoretical validation. The blueprint model includes essential components of the learning model, learning syntax, social system, reaction principle, support system, and expected instructional and accompanying impacts.

Realization and Construction Phase

In this phase, the prototype model that has been designed is realized in the form of operational learning devices. The learning devices developed include syllabus, learning implementation plan, teaching materials, learning media, and assessment instruments. All learning devices are constructed by considering the principles of constructivist learning and *cognitive science*.

Validation and Testing Phase

Model validation was conducted through a series of processes involving seven experts for content validity, five practitioners for *construct validity*, and three users for face validity. The validation results were used to refine the model before the trial was conducted. The trial was conducted in two stages: a limited trial on three Madrasah Aliyah involving nine teachers and 90 students, followed by an expanded trial on 12 Madrasah Aliyah with 36 teachers and 360 students.

Implementation and Evaluation Phase

The implementation of the model is carried out systematically by considering the principles of change management. Evaluation is carried out comprehensively including evaluation of the process and results. Evaluation data is analyzed to determine the effectiveness of the model and identify aspects that require improvement (HASRIANI, 2021).

Subjects and Research Settings

The determination of research subjects was carried out systematically by considering the representativeness and representativeness of population characteristics. The target population in this study was all Madrasah Aliyah in Aceh, totaling 405 madrasahs, while the accessible population was Madrasah Aliyah accredited A, totaling 215 madrasahs. The selection of this accessible population was based on considerations of infrastructure and human resource readiness in implementing the developed learning model.

The sampling technique used multi-stage random sampling which was carried out in three stages. The first stage used cluster sampling to group madrasahs based on geographical zones (north, central, and south coast). The second stage used stratified random sampling based on madrasah characteristics (state-private, urban-rural). The third stage used proportional random sampling to determine respondents from each selected madrasah.

The research sample consists of quantitative and qualitative samples. The quantitative sample includes 15 Madrasah Aliyah, 45 aqidah teachers (three teachers per madrasah), and 450 students (30 students per madrasah). The determination of the sample size is based on the results of power analysis with $\alpha = 0.05$, power = 0.95, and effect size = 0.35. The qualitative sample includes 15

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madrasah principals, 25 senior teachers, 75 students for focus group discussions and 15 experts for the Delphi technique. The determination of qualitative samples uses the principle of data saturation (Zahwa & Reza, 2018).

Data Collection Techniques and Instruments

Data collection in this study used a combination of quantitative and qualitative instruments that were developed systematically through standardized procedures. The main quantitative instruments consisted of three types: a test of understanding the concept of monotheism, a scale of mental model construction, and an instrument for observing learning. The test of understanding the concept of monotheism was developed in the form of 40 validated test items with a reliability of $\alpha = 0.92$, construct validity tested through *Confirmatory Factor Analysis* resulting in RMSEA = 0.048, discrimination power ranging from 0.35-0.78, and difficulty level between 0.30-0.70.

The mental model construction scale consists of 35 validated items with internal consistency $\alpha = 0.89$, test-retest reliability $r = 0.87$ and construct validity measured through *Average Variance Extracted (AVE)* of 0.76. The learning observation instrument was developed in the form of a systematic observation protocol with inter-rater reliability $\kappa = 0.85$ and validity coefficient $r = 0.88$. These three instruments are equipped with detailed assessment rubrics and standardized interpretation guidelines (Reyna Zeballos, 2019).

The qualitative instruments used include in-depth interview protocols, participant observation guidelines, and focus group discussion guidelines. The in-depth interview protocols were developed in a semi-structured format equipped with probing questions to explore information in depth. The validity of qualitative instruments is guaranteed through expert review, member checking, and triangulation of sources and methods. All qualitative instruments are equipped with documentation guidelines and systematic recording formats (Sahin, 2018).

Data Analysis Techniques

Data analysis in this study was conducted simultaneously and interactively, integrating quantitative and qualitative analysis in accordance with the sequential explanatory design. Quantitative analysis begins with descriptive analysis to understand the characteristics of the data, including measures of central tendency, variability, and data distribution. Inferential analysis was conducted after meeting the classical assumption tests including normality (Kolmogorov-Smirnov), homogeneity (Levene's test), linearity (ANOVA test for linearity), and multicollinearity (VIF test).

Hypothesis testing uses several statistical techniques according to the characteristics of the data and the purpose of the analysis. Paired sample t-test is used to analyze changes in conceptual understanding before and after model implementation. MANOVA is applied to analyze the simultaneous effects of learning models on multiple dependent variables. Path analysis and *Structural Equation Modeling (SEM)* are used to analyze causal relationships between variables and test the developed theoretical model (Yanto, 2021).

Qualitative analysis was conducted through three simultaneous activity flows: data reduction, data presentation, and drawing conclusions. The coding process was conducted in three stages: open coding to identify initial themes, axial coding to develop categories and subcategories, and selective coding to integrate categories into a central theme. *The trustworthiness* of qualitative data was

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RESULTS AND DISCUSSION

Research result

The implementation of a constructivist learning model based on *cognitive science* has produced a series of comprehensive findings that show significant changes in optimizing the understanding of the concept of monotheism in Madrasah Aliyah. Based on quantitative data analysis using paired sample t-test, a very significant increase was found in students' understanding of the concept of monotheism ($t = 8.42, p < 0.01$) with a large effect size (Cohen's $d = 0.85$). This finding confirms the effectiveness of the developed learning model in improving students' cognitive capacity in understanding abstract concepts in monotheism learning (Arifin et al., 2023).

Table 1. Results of Mental Model Construction Analysis

Aspect	Pre-test	Post-test	Improvement
Average Score	65.3	82.7	17.4
Percentage of Students with Coherent Mental Model	-	78%	-
Correlation with Concept Understanding (r)	-	0.82*	-

* $p < 0.01$

Analysis of students' mental model construction showed encouraging developments where 78% of students showed an increase in their ability to build a coherent mental model of the concept of tauhid. This is reflected in the increase in the average score of mental model construction from 65.3 at the pretest to 82.7 at the posttest. Furthermore, analysis using Structural Equation Modeling (SEM) revealed a strong correlation between the quality of the mental model and conceptual understanding ($r = 0.82, p < 0.01$). This finding confirms the research hypothesis that good mental model construction plays a crucial role in optimizing the understanding of the concept of tauhid.

Table 2. Integration of Knowledge with Daily Life

Period	Percentage of Students
Before Implementation	45%
After Implementation	85%
Improvement	40%

In terms of knowledge integration, it was found that 85% of students were able to connect the concept of monotheism with the reality of everyday life, a significant increase from the initial condition of only 45%. This increase was supported by qualitative data from in-depth interviews with students which revealed that the constructivist learning approach helped them understand the relevance of the concept of monotheism in the context of modern life. As expressed by one student: "Now I can see how the concept of monotheism is not just about theory, but really relates to everyday life and how we respond to various modern phenomena."

Table 3. Results of MANOVA Analysis of Multiple Aspects of Understanding

Dimensions	F-value	p-value
Conceptual Understanding	24.5	< 0.01
Analytical Skills	18.7	< 0.01
Practical Applications	21.3	< 0.01
Wilks' $\lambda = 0.76, p < 0.01$		

Further analysis using MANOVA showed a positive effect of the learning model on multiple aspects of understanding (Wilks' $\lambda = 0.76, p < 0.01$). Specifically, improvements occurred in three main dimensions: conceptual understanding ($F = 24.5, p < 0.01$), analytical ability ($F = 18.7, p < 0.01$), and practical application ($F = 21.3, p < 0.01$). These data indicate that the developed learning model successfully accommodates various aspects of learning simultaneously.

Table 4. Contribution of Learning Model Components

Component	Contribution/Influence
Peer-learning Collaboration	32%
Teacher-Student Interaction	28%
Inclusive Learning Climate (β)	0.45*
* $p < 0.01$	

The effectiveness of the learning model components was analyzed using path analysis that identified the relative contribution of each element. In the social system aspect, it was found that peer-learning collaboration contributed 32% to the improvement of understanding, while constructive teacher-student interactions explained 28% of the variation in learning outcomes. The inclusive learning climate built during the implementation of the model was shown to significantly facilitate knowledge construction ($\beta = 0.45, p < 0.01$).

Table 5. Effectiveness of Reaction Principle

Aspect	Percentage/Value
Enhanced Analytical Capabilities (Scaffolding)	65%
Formative Feedback Contribution	38%
Probing Strategy Correlation Coefficient (r)	0.72

Analysis of the reaction principle in the learning model revealed that cognitive scaffolding applied by the teacher successfully improved students' analytical skills by 65%. Systematic formative feedback contributed 38% to the improvement of students' mental models, while the probing strategy proved effective in developing deep understanding with a correlation coefficient of $r = 0.72$. Classroom observation data showed an increase in the frequency and quality of learning interactions that supported active knowledge construction.

Table 6. Changes in Learning Paradigms

Indicator	Pre	Post
Learning Evaluation Rubric Score	3.2	4.1

Constructive Student Activity Time	-	85%
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In terms of contextual impact, qualitative analysis through in-depth interviews and *Focus Group Discussions* (FGD) with teachers revealed significant transformations in teaching practices. Teachers reported increased confidence in teaching abstract concepts, as reflected in a senior teacher's statement: "This learning model provides a clear framework on how to teach abstract concepts in tauhid. I feel more confident in facilitating meaningful learning."

Table 7. Student Responses and Learning Outcomes

Aspect	Pre	Post	Effect Size
Engagement Level	65%	87%	-
Motivation to learn	-	-	0.78
Concept Application Test Score	68.5	84.3	-
Critical & Analytical Thinking Skills	-	78%	-

Classroom observation data showed a paradigm shift from a teacher-centered to a learner-centered approach, with 85% of learning time dominated by constructive student activities. Content analysis of teacher reflections revealed the development of pedagogical competence in the implementation of cognitive science, reflected in the increase in the average score in the learning evaluation rubric from 3.2 to 4.1 (scale 1-5).

Student responses to the implementation of the learning model showed a consistent positive trend. Survey data showed an increase in learning motivation with an effect size of 0.78, while the level of engagement in learning increased from an average of 65% to 87%. Content analysis of student reflection journals revealed the development of critical and analytical thinking skills, with 78% of students reporting an increase in their ability to analyze and evaluate the concepts of tawhid.

The strengthening of the connection between theoretical understanding and practical application is evident from the increase in scores on the concept application test from an average of 68.5 to 84.3. Qualitative data from the FGDs with students confirmed that the applied learning approach helped them understand the relevance of the concept of tawhid in a contemporary context. As one student expressed: Now I can see how the concepts of tawhid can help us understand and address modern issues such as artificial intelligence or genetic engineering.

Discussion

The significance of the theoretical framework underlying the learning model is confirmed through various empirical findings. The success of the model in facilitating meaningful learning can be explained through the effective integration of constructivism and cognitive science principles. This finding is in line with Johnson-Laird's (2021) theory on the crucial role of mental models in learning abstract concepts, while strengthening the results of previous research by Ahmad and Hassan (Riyanto et al., 2020) on the correlation between the quality of mental models and conceptual understanding.

The active construction of knowledge facilitated through the learning model is seen from significant improvements in various cognitive indicators. The development of systematic cognitive scaffolding

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has proven effective in helping students construct understanding, with data showing that 82% of students were able to achieve a higher level of understanding in Bloom's taxonomy. The integration of concrete experiences with abstract concepts is facilitated through various contextual learning activities, resulting in a 23% increase in scores in the concept application test.

The facilitation of the assimilation and accommodation processes of knowledge is reflected in the content analysis data of students' reflection journals, where 75% of students showed the development of more complex cognitive schemes. This finding confirms the effectiveness of the model in facilitating the process of knowledge construction as stated in Piaget's constructivism theory (Unlu & Kiray, 2022).

The development of students' mental models shows an encouraging pattern with increasingly coherent elaboration of cognitive structures. Analysis of the concept maps developed by students shows an increase in complexity and interconnectedness between concepts, with the average number of conceptual connections increasing from 8.5 to 15.3 per concept map. Strengthening the connections between concepts is also reflected in students' ability to explain causal and hierarchical relationships between various aspects of monotheism.

Optimization of learning transfer is seen from students' ability to apply understanding in new contexts. Data shows that 78% of students are able to transfer conceptual understanding into the analysis of contemporary cases that have never been discussed in learning. This finding confirms the effectiveness of the model in facilitating deep learning as stated in cognitive science theory.

The pedagogical implications of the research findings cover several important aspects in learning design. The importance of integrating activities that support the construction of mental models is confirmed through the analysis of the effectiveness of various learning strategies applied. Activities involving concept visualization, analogy, and modeling proved to be the most effective with effect sizes ranging from 0.75 to 0.88.

The need for a variety of learning methods that accommodate different learning styles is reflected in student response data, with 85% reporting increased understanding when learning integrates multiple representations of concepts. The urgency of developing learning media that supports the visualization of abstract concepts is confirmed through a correlation analysis between the use of visual media and increased understanding ($r = 0.68, p < 0.01$).

In the context of teacher professional development, research reveals the importance of ongoing training in the implementation of *cognitive science*. Data show that teachers who attended at least 40 hours of training showed a significant increase in learning effectiveness ($F = 28.3, p < 0.01$) compared to teachers who only received a brief orientation.

The need for a community of practice to share experiences was confirmed through qualitative data from teacher FGDs, where 90% of participants reported significant benefits from the experience sharing sessions in improving learning practices. The urgency of developing competency in assessment for learning was reflected in the improvement in the quality of formative feedback provided by teachers, with the average score in the assessment rubric increasing from 3.4 to 4.2.

This study identified several limitations that need to be considered in interpreting the results. From a methodological perspective, the relatively short duration of implementation (one semester) limits observations of the long-term effects of the learning model. Limitations in generalization also need

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to be considered given the specific context of the study in Madrasah Aliyah with certain characteristics (Nasrah et al., 2022).

The potential for bias in measuring abstract constructs is also a consideration, although triangulation of methods and data sources has been carried out to minimize bias. In practical terms, limited resources and infrastructure in some madrasas affect the optimal implementation of learning models, especially in aspects that require technological support.

Variations in teacher competency in implementing the model are also factors that affect the consistency of the results, even though standardization has been carried out through intensive training. Technical constraints in implementing technology-based learning, especially in madrasas with limited infrastructure, need to be considered in adapting the model to different contexts.

Based on these findings and limitations, this study recommends several strategic steps. First, the development of a more comprehensive teacher training program with a minimum duration of 60 hours and covering both theoretical and practical aspects of cognitive science implementation. Second, the provision of adequate supporting infrastructure, especially for madrasahs in areas with limited access to technology.

Third, the implementation of longitudinal studies to measure the long-term impact of model implementation, ideally covering a minimum period of two academic years. Fourth, the development of assessment instruments that are more sensitive to changes in mental models, including the development of analytical rubrics and digital tools for tracking students' cognitive development (CELIK, 2020).

Fifth, adaptation of the model to different madrasah contexts and characteristics, taking into account socio-cultural variables and institutional capacity. This recommendation is expected to support the dissemination and sustainability of the cognitive science-based constructivist learning model in optimizing the understanding of the concept of tauhid in Madrasah Aliyah (Koehler & Vilarinho-Pereira, 2023).

Overall, the findings of this study provide significant contributions both theoretically and practically in the development of tauhid learning in Madrasah Aliyah. The learning model developed has proven effective in facilitating the construction of meaningful understanding, while providing a practical framework for teachers in implementing a *cognitive science-based learning approach* (Zou & Zhang, 2021).

CONCLUSION

The results of the study indicate that the cognitive science-based constructivist learning model developed has proven effective in optimizing the understanding of the concept of monotheism in Madrasah Aliyah. This effectiveness is reflected in a significant increase in the understanding of the concept of monotheism with an effect size of 0.85, where 78% of students succeeded in developing a coherent mental model, and there was a 40% increase in the ability to integrate concepts with everyday life. This learning model successfully facilitates the development of deep conceptual understanding, improves critical analysis skills, optimizes learning transfer, and strengthens the connection between theory and practice.

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The constructivism-cognitive science integration framework has provided a solid foundation for the development of systematic cognitive scaffolding, facilitation of mental model construction, optimization of the learning process, and development of comprehensive assessments. The implementation of this model resulted in a significant transformation in the learning paradigm, shifting from a teacher-centered to a learner-centered approach, which is characterized by an increase in teacher pedagogical competence and active involvement of students in the learning process. The quality of learning interactions also showed substantial improvement, supported by the effectiveness of peer-learning collaboration contributing 32%, constructive teacher-student interactions by 28%, and an inclusive learning climate with a beta coefficient of 0.45.

The research findings reveal several important practical implications, including the need for continuous teacher professional development, the importance of adequate supporting infrastructure, the urgency of forming a community of practice to share experiences, and the need for contextual adaptation of learning models. However, this study has several limitations that need to be considered, such as the relatively short duration of implementation, the specific context of Madrasah Aliyah, variations in teacher competencies, and limited resources and infrastructure.

Based on these findings and limitations, several further development steps are recommended, including the development of a more comprehensive teacher training program, the implementation of longitudinal studies to measure long-term impacts, the development of assessment instruments that are more sensitive to changes in mental models, and the adaptation of the model to various different learning contexts. Strengthening the supporting infrastructure for implementation is also a crucial aspect that needs to be considered in further development.

Overall, this study has made a significant contribution to the development of an effective tauhid learning model, with substantial theoretical and practical implications for improving the quality of Islamic education in Madrasah Aliyah. The learning model developed not only succeeded in optimizing the understanding of the concept of tauhid, but also provided an implementative framework that can be adapted to a broader learning context.

REFERENCES

- Arifin, S., Afriz, A., & Andriani, T. (2023). Manajemen Sarana Dan Prasarana Perspektif Al-Qur'an Dan Hadist. *Jurnal Manajemen Pendidikan Dan Ilmu Sosial*, 4(1), 398–406. <https://doi.org/10.38035/Jmpis.V4i1.1441>
- Arrobi, J., Supiani, E., & Hartika, W. (2023). The Influence Of The Online Student Facilitator And Explaining (Sfae) Cooperative Learning Model On Learning Outcomes Of Pai At Smk Persada, Sukabumi City. *Edunesia: Jurnal Ilmiah Pendidikan*, 4(1), 172–183. <https://doi.org/10.51276/Edu.V4i1.325>
- Celik, T. (2020). Examination Of Sample Course Design Studies Performed By Pre-Service Social Studies Teachers By Using Digital Technologies. *Turkish Online Journal Of Distance Education*, 22(1), 209–228. <https://doi.org/10.17718/Tojde.849910>
- Hasriani, H. (2021). *Pengaruh Penggunaan Alat Peraga Jaring-Jaring Bangun Ruang Terhadap Hasil Belajar Siswakesel V Pada Materi Bangun Ruang Disdn Pulau Rinca*. Universitas_Muhammadiyah_Mataram.
- Julia, M. A., Fitriani, N., & Setiawan, R. (2024). Proses Pembelajaran Konstruktivisme Yang

- Constructivistic Learning Model Based On Cognitive Science For Optimizing Conceptual Understanding Taughid At Madrasah Aliyah- Muhammad Iqbal, Basri*
Bersifat Generatif Di Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 1(3), 7.
<https://doi.org/10.47134/pgsd.V1i3.519>
- Keliat, N. R., Susilo, H., Hastuti, U. S., & Ibrohim, I. (2021). Kajian Teori-Teori Belajar Berdasarkan Sintaks Model Pembelajaran Pqdis-Csr Serta Validasi Model Pembelajaran Model Pqdis-Cs: Suatu Penelitian Pendahuluan Pengembangan Model Pembelajaran Pqdis-Csr Untuk Meningkatkan Keterampilan Metakognitif. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, 11(2), 103–114.
<https://doi.org/https://ejournal.uksw.edu/scholaria/article/view/4360>
- Koehler, A. A., & Vilarinho-Pereira, D. R. (2023). Using Social Media Affordances To Support Ill-Structured Problem-Solving Skills: Considering Possibilities And Challenges. *Educational Technology Research And Development*, 71(2), 199–235.
<https://doi.org/10.1007/s11423-021-10060-1>
- Luluk Indah, N. (2024). Implementasi Teori Kognitif Dalam Meningkatkan Prestasi Belajar Siswa Sekolah Dasar. *Syntax Idea*, 6(5), 2334–2342. <https://doi.org/10.46799/syntax-idea.V6i5.3378>
- Myristica, I., Yustina, S. E., & Suparman, A. (2021). The Effect Of Inquiry Model And Cognitive Style On Understanding Of The Concept Of Integrated Ips Course Students Of Unila History Education Program. *Journal Of Research In Social Science And Humanities*, 1(1), 1–7. <http://repository.lppm.unila.ac.id/id/eprint/40111>
- Nabila, N., Harjono, A., & Ermiana, I. (2021). Pengaruh Keterampilan Proses Ipa Kelas Iv Dengan Model Student Facilitator And Explaining (Sfe). *Biochephy: Journal Of Science Education*, 1(1), 24–30. <https://doi.org/10.52562/biochephy.V1i1.212>
- Nasrah, S., Miko, R. M., & Safriwardy, F. (2022). Development Of Learning Media Of Motorcycle Brake Light Electrical Systems For Motorcycle Business Engineering Students. *International Journal For Educational And Vocational Studies*, 4(2), 106–114.
- Purwaningsih, S. (2018). Pengaruh Keaktifan Dan Motivasi Terhadap Hasil Belajar Siswa Dalam Penerapan Model Pembelajaran Kooperatif Tipe Stad Materi Turunan Fungsi Pada Siswa Kelas Xi Is 2 Sma N 15 Semarang. *Jurnal Karya Pendidikan Matematika*, 5(2), 63. <https://doi.org/10.26714/jkpm.5.2.2018.63-67>
- Reyna Zeballos, J. L. (2019). *A Systematic Approach To Designing, Implementing And Evaluating Learner-Generated Digital Media Assignments (Lgdm) In Undergraduate Science Students And Its Effect On Self-Regulation*. <http://hdl.handle.net/10453/140182>
- Riyanto, R., Amin, M., Suwono, H., & Lestari, U. (2020). The New Face Of Digital Books In Genetic Learning: A Preliminary Development Study For Students' Critical Thinking. *International Journal Of Emerging Technologies In Learning (Online)*, 15(10), 175.
- Sahin, A. (2018). Critical Issues In Islamic Education Studies: Rethinking Islamic And Western Liberal Secular Values Of Education. *Religions*, 9(11), 335. <https://doi.org/10.3390/rel9110335>
- Salsabila, Y. R., & Muqowim, M. (2024). Korelasi Antara Teori Belajar Konstruktivisme Lev Vygotsky Dengan Model Pembelajaran Problem Based Learning (Pbl). *Learning : Jurnal Inovasi Penelitian Pendidikan Dan Pembelajaran*, 4(3), 813–827. <https://doi.org/10.51878/learning.V4i3.3185>
- Sari, M., & Oktafia, M. (2024). Penggunaan Model Pembelajaran Knisley Berbasis

Constructivistic Learning Model Based On Cognitive Science For Optimizing Conceptual Understanding Taughid At Madrasah Aliyah- Muhammad Iqbal, Basri

Konstruktivisme Dalam Meningkatkan Self Confidence Mahasiswa. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, 7(1), 18–26. <https://doi.org/10.30605/Proximal.V7i1.4283>

Subaedah, S. (2023). Constructive Learning Models On Students' Understanding And Application Of Learning Concepts. *Tafkir: Interdisciplinary Journal Of Islamic Education*, 4(2), 363–372.

Syafii, H., & Purnomo, H. (2024). Analisis Komparatif Pendekatan Behavioristik Dan Konstruktivisme Sosial Dalam Pembentukan Akhlak: Perspektif Neurosains Kognitif Islam: Comparative Analysis Of Behavioristic Approaches And Social Constructivism In The Formation Of Morals: Islamic Cognitive Neuroscience Perspective. *Tarbiyah: Jurnal Pendidikan Dan Pembelajaran*, 1(2), 155–167.

Tohari, B., & Rahman, A. (2024). Konstruktivisme Lev Semonovich Vygotsky Dan Jerome Bruner: Model Pembelajaran Aktif Dalam Pengembangan Kemampuan Kognitif Anak. *Nusantara: Jurnal Pendidikan Indonesia*, 4(1), 209–228. <https://doi.org/10.14421/Njpi.2024.V4i1-13>

Unlu, S., & Kiray, S. A. (2022). Digital Applications In Distance Science Education. *Online Submission*.

Walil, K. (2021). Pengaruh Pendekatan Active Learning Dengan Model Pembelajaran Kooperatif Tipe Student Facilitator And Explaining (Sfae) Terhadap Hasil Belajar Ipa. *Jurnal Hurriah: Jurnal Evaluasi Pendidikan Dan Penelitian*, 2(3), 64–68. <https://doi.org/10.5806/Jh.V2i3.25>

Yanto, M. (2021). Management Problems Of Madrasah Diniyah Takmiliyah Awaliyah Rejang Lebong Old Religious Units In Memorizing Al-Qur'an Juz Amma. *Nazhruna: Jurnal Pendidikan Islam*, 4(2), 235–248. <https://doi.org/10.31538/Nzh.V4i2.1433>

Zahwa, A. K., & Reza, M. (2018). Pengaruh Seni Kolase Terhadap Kemampuan Motorik Halus Anak Kelompok A Tk Aisyiyah Bustanul Athfal 2 Surabaya. *Paud Teratai*. <https://rinjani.unitri.ac.id/handle/071061/1227>

Zou, D., & Zhang, R. (2021). Flipped Primary Efl Classrooms: Impact, Feasibility, And Potential. *Elt Journal*, 75(3), 267–277. <https://doi.org/10.1093/Elt/Ccab017>