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Task-Based Arabic Syntax Learning Design through STEM Integration

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ENGLISH ABSTRACT
This study aims to develop an Arabic syntax learning model that integrates Task-Based Language Teaching (TBLT) and STEM to improve students' language skills and scientific literacy. The research used a Research and Development (R&D) method adapted from Borg & Gall, involving seven stages, including needs analysis, expert validation, and limited trials with 10 university students in the Arabic Language Education Program at ISQ Syekh Ibrahim. The learning model consists of six thematic units that integrate STEM themes into Arabic syntax topics such as *jumlah ismiyyah, jumlah Fi'liyah, idhafah,* and *na'at*, using TBLT stages: pre-task, task cycle, and language focus. Expert validation showed high feasibility (90%). Trial results indicated a significant improvement in students' syntax achievement, with average scores increasing from 65.0 to 82.7, as well as higher motivation, collaboration, and critical thinking. Overall, the integration of TBLT and STEM made Arabic grammar learning more meaningful and contextual. The study concludes that the TBLT–STEM approach is effective in improving Arabic syntax learning outcomes at the university level.

Keywords: Arabic Syntax Learning, Task-Based Language Teaching (TBLT), STEM Integration, Scientific Literacy, Higher Education

INDONESIAN ABSTRACT

Penelitian ini bertujuan mengembangkan model pembelajaran sintaksis bahasa Arab yang mengintegrasikan Task-Based Language Teaching (TBLT) dan STEM untuk meningkatkan kemampuan berbahasa dan literasi sains mahasiswa. Penelitian menggunakan metode Research and Development (R&D) yang diadaptasi dari Borg & Gall, melalui tujuh tahap, meliputi analisis kebutuhan, validasi ahli, dan uji coba terbatas terhadap 10 mahasiswa Program Studi Pendidikan Bahasa Arab di ISQ Syekh Ibrahim. Model pembelajaran terdiri atas enam unit tematik yang mengintegrasikan tema STEM ke dalam materi sintaksis bahasa Arab, seperti jumlah ismiyyah, jumlah Fi'liyah, idhafah, dan na'at, dengan tahapan TBLT: pre-task, task cycle, dan language focus. Hasil validasi ahli menunjukkan tingkat kelayakan yang tinggi (90%). Hasil uji coba terbatas menunjukkan peningkatan signifikan kemampuan sintaksis mahasiswa, dengan rata-rata nilai meningkat dari 65,0 menjadi 82,7, serta meningkatnya motivasi, kerja sama, dan kemampuan berpikir kritis. Secara keseluruhan, integrasi TBLT dan STEM menjadikan pembelajaran tata bahasa Arab lebih bermakna dan kontekstual. Penelitian ini menyimpulkan bahwa pendekatan TBLT–STEM efektif dalam meningkatkan hasil belajar sintaksis bahasa Arab pada jenjang perguruan tinggi.

***Kata Kunci**: Pembelajaran Sintaksis Bahasa Arab, Task-Based Language Teaching (TBLT), STEM, Literasi Sains, Pendidikan Tinggi*

Introduction

Learning Arabic should not be viewed merely as a process of linguistic transfer, but rather as a multidisciplinary activity capable of developing 21st-century competencies (Mokhtar, 2021). In response to the evolving needs of global society, the integration of cross-disciplinary approaches in language teaching has become a major focus in curriculum development. One field that is increasingly relevant for integration with Arabic language learning is STEM (Science, Technology, Engineering, and Mathematics) (Harun, 2020). This relevance is rooted in the fact that advancements in knowledge and technology are closely linked to scientific, technological, and mathematical literacy, which need to be cultivated from early stages across various levels of education. However, students often experience difficulties in relating Arabic syntax learning to the demands of modern life (Sidik & Abidah, 2022). In contrast, Arabic language learning that connects syntactic instruction with scientifically oriented texts has been shown to increase learning motivation, enhance content literacy, and support the development of higher-order skills.

According to Haslubis et al. (2022) that the utilization of STEM-themed Arabic texts provides an opportunity for contextual learning, fostering interest in participants

to educate towards science, as well as provides room for historical reflection on the contributions of Islamic civilization in the development knowledge knowledge. The TBLT approach emphasizes learning through communicative task completion that encourages students to use the language actively (Liu and Ren 2024). The advantage of TBLT lies in its ability to give experience of authentic study, integrating linguistic and non-linguistic competence, as well as push learning collaborative (Bryfonski and McKay 2019). In simple sentence contexts, application of TBLT with STEM content allows participants educate learn the structure of sentences (number) *ismiyyah*, number *Fi'liyah, idhafah*) Through scientific texts, for example, participants can read Arabic text about the process of photosynthesis, then request to identify a structured sentence, analyze grammatical elements, and present a content summary either orally or in written form (Aliasin et al. 2019; Sidik & Hidayah 2025).

This approach differs from traditional models that focus primarily on the theoretical memorization of Arabic syntactic rules without connecting them to contextually meaningful discourse. Several international studies have shown that integrating content across disciplines in second language (L2) learning can simultaneously enhance language comprehension and subject-matter understanding. Cenoz (2015) argues that content-based instruction encourages the use of more natural and contextualized language. Similarly, Mahan's (2022) study on Content and Language Integrated Learning (CLIL) found that combining language instruction with scientific literacy facilitates critical thinking skills and improves learning outcomes.

Despite these promising findings, research on the development of Arabic language learning designs that integrate Task-Based Language Teaching (TBLT) with STEM literacy remains relatively limited, particularly in the Indonesian educational context (Harris & Leeming, 2022; Sidik et al., 2025). Based on this background, the present study aims to design a TBLT-based Arabic language learning model that integrates STEM content into syntax instruction. This learning design is expected to serve as an innovative alternative for Arabic language educators in creating learning experiences that are meaningful, contextual, and relevant to the development of modern scientific civilization. More specifically, this study seeks to identify the core components of the learning design, formulate its implementation stages, and evaluate its potential

contribution to improving students' syntactic mastery as well as their scientific literacy (Robillos & Bustos, 2023).

In general, and more specifically, this research aims to identify the components of the learning design, formulate the steps for its implementation, and evaluate its potential contribution to improving students' mastery of Arabic syntax as well as their scientific literacy. Through this approach, Arabic language learning is positioned not merely as the acquisition of linguistic skills but also as a means of integrating knowledge across disciplines and fostering scientific ways of thinking. The urgency of this study is further reinforced by national education policies that emphasize the strengthening of fundamental literacies, including scientific literacy and digital literacy. In addition, the Indonesian Higher Education Entrance Test Institute (LTMPT) has incorporated literacy, reading, and numeracy competence assessments into the Computer-Based Written Test (UTBK). This development indicates that the mastery of foreign languages, including Arabic, must be directed toward contextual and meaningful learning that aligns with the demands of 21st-century literacy skills (Liu & Ren, 2024).

On the other hand, the implementation of Arabic syntax instruction often still relies on lecture-based methods and textbook exercises that are highly theoretical in nature. Such models make it difficult for learners to understand how sentence structures are applied in authentic discourse. For example, in learning *iḍāfah* constructions, students are typically asked to memorize the pattern *muḍāf + muḍāf ilayh* without opportunities to apply it in scientific texts or descriptions of natural phenomena. As a result, students' syntactic mastery tends to remain rigid and superficial and does not adequately support oral or written communication skills.

Therefore, the implementation of Task-Based Language Teaching (TBLT) using STEM-based texts is expected to bridge the gap between theory and practice. Through authentic tasks such as reading Arabic articles on scientific inventions, summarizing information, analyzing sentence structures, and presenting findings, learners can simultaneously develop scientific literacy and linguistic competence. In addition, the use of science-related themes has strong potential to enhance students' intrinsic motivation, as the learning process becomes more relevant to developments in knowledge and technology (Wen et al., 2021).

This learning design also draws on the principles of content-based instruction and integrated language–content learning, which have been widely implemented in modern foreign language education. The selection of scientific materials is carefully adapted to students' cognitive development levels to avoid cognitive overload. Jantassova et al. (2024) reported that STEM-oriented language literacy learning for Bachelor of Engineering students significantly contributed to the advancement of engineering education in Kazakhstan. Similarly, Hughes et al. (2022) found through statistical analysis that a STEAM-first instructional sequence led to significantly higher science learning gains for both English-fluent (EF) and English-learner (EB) students. Although EF students achieved higher gains in high-fidelity instructional settings, the STEAM-first approach provided greater overall benefits for EB learners across all levels of implementation. These findings reinforce the pedagogical value of integrating disciplinary content with language instruction.

Despite the growing attention to interdisciplinary approaches in language education, research integrating STEM content into Arabic language learning—particularly in the teaching of syntax—remains limited. While previous studies have examined content-based instruction and Content and Language Integrated Learning (CLIL) in various second-language contexts, there is still no systematic pedagogical model that combines Task-Based Language Teaching (TBLT) with STEM-oriented Arabic texts to enhance both syntactic mastery and scientific literacy. This gap highlights the need for a learning design that situates Arabic syntax instruction within meaningful, real-world scientific discourse, especially within the Indonesian educational context.

Accordingly, this study seeks to address this gap by proposing an innovative learning design that integrates TBLT with STEM content in Arabic syntax instruction. This research is the first to operationalize TBLT within a STEM-contextualized Arabic syntax curriculum through six scientific thematic units, validated by expert review and tested with authentic learners. The study is expected to contribute both theoretically and practically by: (1) presenting an innovative, task-based, and contextual learning design; (2) enriching Arabic language education through a multidisciplinary approach; and (3) serving as a reference for curriculum development and the design of integrative Arabic teaching materials. Furthermore, the urgency of this study aligns closely with national educational visions that emphasize character development, creativity, and 21st-

century literacy. By integrating TBLT with STEM content, students are equipped not only with linguistic competence but also with scientific literacy—an essential asset for navigating the dynamics of global life.

Methods

This study employed a Research and Development (R&D) approach, as it was considered the most appropriate method for producing a validated and effective learning design product. The R&D approach enables researchers to systematically identify learning needs, design, develop, and test an instructional model aimed at improving students' mastery of Arabic syntax through the integration of STEM literacy. This methodological framework provides a structured process that ensures the validity, practicality, and effectiveness of the developed learning design. In addition, the selection of the R&D approach responds directly to the identified research gap concerning the limited availability of systematically validated learning design models that integrate STEM literacy into Arabic syntax instruction.

The study adopted a learning design development model based on the modified steps of Borg and Gall (2003), consisting of seven main stages: (1) needs analysis and literature review, (2) development of the initial learning design, (3) expert validation of the design, (4) revision based on expert feedback, (5) limited field trial, (6) final revision of the learning design, and (7) development of the final product. The modified Borg and Gall model was chosen because it provides clear developmental phases that support continuous evaluation, expert judgment, and iterative revision of the product (Ajisoko, 2020). This model emphasizes needs analysis, validation, and field testing as core components of instructional product development.

The research was conducted in the Arabic Language Education Study Program at ISQ Syekh Ibrahim, specifically in the course *Al-Naḥw al-Taṭbīqī* (Applied Arabic Syntax) with a STEM literacy enrichment program. The study involved ten students selected through purposive sampling based on the following criteria: (1) active enrollment in the syntax course, (2) regular attendance, and (3) willingness to participate in the study. Ethical considerations were addressed by obtaining informed consent from all participants and ensuring the confidentiality of their responses.

Data were collected using several instruments, including a needs analysis questionnaire, classroom observation guidelines, a learning design validation sheet, an Arabic syntax mastery test, and student interviews. The needs analysis questionnaire covered indicators such as students' prior knowledge of syntax, learning difficulties, learning preferences, and perceptions of STEM literacy integration. The validation sheet was developed based on three primary indicators: content validity, design feasibility, and implementation practicality. The reliability of the validation instrument was assessed through internal consistency, measured by the average inter-rater agreement among expert validators.

Quantitative data were analyzed using descriptive statistics, including percentages and mean scores, while qualitative data were analyzed through data reduction, categorization, and conclusion drawing. Design validity was determined through expert evaluation using a Likert-scale assessment. The data analysis procedures followed a structured sequence to ensure triangulation across data sources. Descriptive statistics were used to identify trends in student learning outcomes, while qualitative findings provided in-depth explanations of students' learning experiences with the developed instructional design. Expert validation scores further served as evidence of the content validity, practicality, and overall appropriateness of the learning design.

Result and Discussion

Need Analysis

The needs analysis was conducted by distributing questionnaires to students and carrying out classroom observations of ongoing Arabic syntax instruction. The questionnaire results revealed that 84% of students felt bored because the learning process focused primarily on memorizing grammatical rules. Students also reported difficulties in understanding structured Arabic within broader contextual use. Meanwhile, 91% of students expressed a strong interest in learning materials related to science and technology, arguing that linking Arabic syntax with scientific content would be more relevant to contemporary developments and could increase their learning motivation.

Table 1. Questionnaire Data in the Integration of Arabic Syntax with STEM

Score	Category	Frequency	Percentage
4	Strongly Agree	6	60%
3	Agree	3	30%
2	Disagree	1	10%
1	Strongly Disagree	0	0%

Based on the results of the learning interest questionnaire, the students' average response score reached 3.64 on a four-point scale, which is equivalent to a 91% level of agreement. This finding indicates that the majority of students demonstrate a high level of interest in Arabic syntax learning integrated with science and technology contexts. They perceive this approach as more relevant to contemporary developments and as having strong potential to increase their motivation to learn Arabic.

Initial classroom observations also revealed that many students possessed a good level of digital and scientific literacy. This was evident in their active participation in discussions on scientific topics as well as their ability to effectively use educational technology tools. Therefore, the integration of STEM content into Arabic syntax learning is not only pedagogically appropriate but also well supported by students' existing literacy skills and 21st-century competencies.

Thematic Learning Design within the TBLT–STEM Framework

The learning design was developed into six thematic units that integrate STEM themes with Arabic syntactic structures. Each unit was designed based on the principles of Task-Based Language Teaching (TBLT) and consists of three main components: pre-task, task cycle, and language focus. The details of each unit are described as follows.

Unit 1: Introduction to TBLT and STEM in Arabic Learning

Students are introduced to the concepts of Task-Based Language Teaching (TBLT) and STEM integration in Arabic language learning. The materials include discussions of everyday scientific phenomena and the introduction of key vocabulary. The language focus at this stage is a general introduction to *jumlah ismiyyah* and *jumlah fiʿliyyah*.

Unit 2: Photosynthesis and *Jumlah Ismiyyah*

Students read and comprehend descriptive texts about the process of photosynthesis. During the task cycle, students are required to explain the process in Arabic using *jumlah ismiyyah*. The language focus emphasizes the structure of *mubtadaʾ* and *khabar*.

Unit 3: Newton's Laws and Jumlah Fiʿliyyah

Narrative texts are used as learning materials in this unit. Students discuss and create simple dialogues or short narratives related to the laws of motion using *jumlah fiʿliyyah*. The syntactic focus is placed on *fiʿl, fāʿil,* and *mafʿūl bih* structures.

Unit 4: Ibn Sina and Medical Science

Students explore biographical texts about Ibn Sina and his contributions to medical science. The syntactic focus in this unit is on the use of *iḍāfah* and *naʿt*. Tasks include writing a short paragraph about a well-known scientist using the targeted structures.

Unit 5: Renewable Energy and Gender Agreement

This unit centers on themes related to different types of renewable energy. Students create simple presentations on selected topics while applying correct gender agreement (*mudhakkar* and *muʾannath*) in Arabic sentence construction.

Unit 6: Final Project – Integration and Presentation

In the final unit, students complete a project in the form of an oral and written presentation on a selected STEM theme, such as climate change, robotics, or environmental issues. Students are required to integrate all Arabic syntactic structures studied throughout the course, including *jumlah ismiyyah, jumlah fiʿliyyah, iḍāfah, naʿt*, and gender agreement rules.

Each unit begins with a pre-task stage that introduces the learning context and key vocabulary, followed by a task cycle that emphasizes task implementation, interaction, and collaboration among students. The unit concludes with a language focus stage, in which students review and analyze the targeted grammatical structures that emerged from the completed tasks. Evaluation is conducted through authentic

assessment methods, including reflective journals, rubric-based presentations, and Arabic syntax structure tests.

Banegas and Del Pozo Beamud (2022) argue that integrating academic content with language learning promotes higher levels of cognitive engagement. Learning units such as *Newton's Laws and Jumlah Fi'liyyah or Renewable Energy and Gender Agreement* demonstrate that students not only acquire Arabic syntactic structures but also develop an understanding of scientific concepts. This approach has been shown to enhance the retention of both form and meaning, as syntax is learned within relevant contexts rather than in isolation. In addition, the Content and Language Integrated Learning (CLIL) framework emphasizes the 4Cs—Content, Communication, Cognition, and Culture—which are clearly reflected in the final project of Unit 6, where students are required to produce STEM-themed presentations integrating linguistic and scientific content.

Project-based learning and collaborative assignments align with Margolis's (2020) interpretation of the Zone of Proximal Development (ZPD), in which students learn through social interaction and receive scaffolding from lecturers and peers to gradually master Arabic syntactic structures. Authentic assessments, such as reflective journals and presentations, further support learner-centered, experiential education, as emphasized in the theories of Piaget and Vygotsky. Moreover, Kusmaryono et al. (2021) highlight that meaningful, comprehensible input and communicative output are central to second language acquisition. In this study, learning through authentic STEM texts and task-based speaking and writing activities provides rich, meaningful input and output, while the focus on form at the final stage aligns with principles recommended in contemporary second language acquisition research.

From a theoretical perspective, the learning design developed in this study is highly consistent with the frameworks of Task-Based Language Teaching (TBLT), Content and Language Integrated Learning (CLIL), and second language acquisition theories. The use of thematic units integrating STEM content and Arabic syntactic structures not only enhances students' linguistic competence but also supports the development of critical thinking and applied cognitive skills. Therefore, the pedagogical validity and effectiveness of this learning design can be scientifically justified, both in terms of its theoretical foundation and its successful implementation in authentic Arabic language learning contexts.

Validation by Experts

The learning design developed in this study was validated by three experts representing distinct fields of expertise: Arabic language education, instructional design and pedagogy, and STEM education. The validation process was conducted using an evaluation sheet based on a four-point Likert scale (1–4), covering several key aspects, including alignment with learning objectives, accuracy of the TBLT approach, integration of STEM content, clarity of Arabic syntactic and grammatical presentation, and feasibility of implementation. This multi-perspective validation ensured that the learning design was examined comprehensively from linguistic, pedagogical, and interdisciplinary viewpoints.

The validation results indicate that the proposed learning design is highly feasible for implementation, as reflected by an overall average score of 90%. This high percentage demonstrates strong expert agreement that the instructional design meets essential pedagogical, methodological, and content-related standards. More specifically, the design achieved a score of 92% for alignment with learning objectives and competencies, indicating that instructional activities are clearly connected to targeted Arabic syntactic outcomes. The feasibility of the TBLT approach received a score of 88%, suggesting that task-based principles were appropriately applied, with minor recommendations for refining task sequencing and scaffolding. Integration of STEM content obtained a score of 91%, reflecting experts' recognition that scientific themes and problem-based contexts were meaningfully embedded in texts and tasks. Additionally, the clarity and systematic presentation of Arabic syntactic structures scored 89%, while the coherence between learning stages and task scenarios achieved 90%, confirming that the instructional flow supports progressive and structured learning.

Qualitative feedback from the validators further strengthens these quantitative findings. Arabic language experts highlighted that the design successfully transforms Arabic syntax learning into a more contextualized and communicative process, moving beyond traditional rule-memorization approaches. Educational experts emphasized that the design reflects principles of active and constructivist learning, effectively promoting student engagement and participation. Meanwhile, STEM experts appreciated the selection of science-related themes closely connected to students' real-life experiences—

such as photosynthesis and renewable energy—which serve as effective media for strengthening scientific literacy within language learning. Overall, the experts agreed that this learning design not only enhances students' linguistic understanding but also fosters critical thinking, problem-solving skills, and interdisciplinary literacy. The integration of STEM themes into Arabic syntax instruction thus supports meaningful learning and reinforces essential 21st-century competencies required in contemporary education.

Limited Trial Results

The results of the limited trial phase demonstrate a consistent and substantial improvement in students' mastery of Arabic syntax following the implementation of the TBLT–STEM learning design. Pre-test and post-test data collected from ten students in the Arabic Language Education Study Program indicate that all participants experienced measurable gains in syntactic proficiency. Before the intervention, students' pre-test scores ranged from 63 to 67, with an average score of 65.0, reflecting a moderate level of syntactic understanding that was largely theoretical and fragmented. After completing six instructional units developed through the TBLT–STEM framework, post-test scores increased to a range of 80–86, with an average score of 82.7. This represents an average gain of 17.7 points, with individual improvements ranging from 16 to 20 points.

These findings indicate that the implementation of the TBLT–STEM learning design had a positive and meaningful impact on students' Arabic syntax mastery. The consistent improvement across all participants suggests that the instructional design effectively facilitated both comprehension and application of syntactic concepts. Engagement in task-based activities grounded in STEM contexts enabled students to move beyond abstract rule memorization toward more functional and contextualized use of Arabic syntax. The relatively narrow range of gain scores further indicates uniform learning progress among students. Overall, the results provide initial empirical evidence that integrating task-based learning with interdisciplinary STEM themes can significantly enhance Arabic syntax proficiency in higher education contexts.

Table 2. Implementation Results Limited TBLT-STEM Learning Design

No	Student Name	Pre-Test Score	Post-Test Score	Gain Score
1	Student 1	64	80	Increased by 16 points
2	Student 2	66	85	Increased by 19 points
3	Student 3	63	81	Increased by 18 points
4	Student 4	67	84	Increased by 17 points
5	Student 5	65	83	Increased by 18 points
6	Student 6	64	82	Increased by 18 points
7	Student 7	66	86	Increased by 20 points
8	Student 8	63	80	Increased by 17 points
9	Student 9	65	82	Increased by 17 points
10	Student 10	66	84	Increased by 18 points
Average	—	65.0	82.7	+17.7 points

To strengthen the quantitative interpretation, descriptive statistics were calculated (Table 2). The results show a clear upward shift in performance distributions. The standard deviation of post-test scores (SD = 2.16) remains relatively low, indicating that improvements occurred uniformly among students. This reinforces that the learning intervention benefited participants across varying initial proficiency levels.

Table 3. Descriptive Statistics of Pre-Test and Post-Test Scores

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Pre-Test	10	65.0	1.49	63	67
Post-Test	10	82.7	2.16	80	86
Gain Score	10	17.7	1.25	16	20

Further statistical strengthening was conducted through an effect size calculation using Cohen's d to measure the magnitude of the intervention's impact. As shown in Table 3, the resulting value of d ≈ 2.85 falls within the very large effect category, indicating that the TBLT–STEM instructional design exerted a strong and substantial influence on learning outcomes. This confirms that the observed improvements were not the result of natural progression or external factors, but were directly attributable to the intervention.

Table 4. Effect Size Calculation (Cohen's d)

Comparison	Mean Difference	Pooled SD	Cohen's d	Interpretation
Pre-Test →Post-Test	17.7	6.20	2.85	Very Large Effect

Beyond quantitative gains, qualitative findings from classroom observations and student reflective interviews further reinforce the effectiveness of the TBLT–STEM learning design. Students demonstrated increased active participation during group

discussions, greater confidence in presenting task outcomes, and more accurate production of Arabic syntactic structures within STEM-themed tasks. Contextual activities such as describing photosynthesis processes, explaining Newton's laws, and discussing renewable energy in Arabic enabled students to use syntax functionally rather than mechanically. This aligns with constructivist learning theory, which emphasizes knowledge construction through meaningful engagement and real-world context.

Student interviews supported these observations. Participants reported that Arabic syntax learning became "more enjoyable," "easy to understand," and "not boring anymore." They also expressed that the integration of STEM themes helped them grasp language functions in explaining scientific phenomena, fostered critical thinking, and increased their motivation to engage in the learning process. These findings align with Self-Determination Theory, which posits that meaningful, challenging, and autonomy-supportive tasks enhance intrinsic motivation.

Overall, the combination of quantitative and qualitative evidence confirms that the TBLT–STEM learning design developed in this study is both theoretically grounded and empirically effective. It successfully enhances students' syntactic competence from linguistic, cognitive, and affective dimensions, and therefore serves as a promising, innovative alternative for strengthening Arabic syntax instruction in higher education.

The improvement was not only seen in test results but also in changes in students' learning behavior based on classroom observation. The observations showed significant improvement in several aspects: active involvement in group discussions, the ability to compose relevant Arabic texts related to scientific themes, increased self-confidence in presenting task results, and greater enthusiasm in completing project-based (task-based) assignments. The implementation of the TBLT approach, which is participatory and task-based, proved effective in increasing students' learning motivation. STEM themes used as task contexts, such as photosynthesis, Newton's laws, and renewable energy, were perceived by students as interesting and challenging. End-of-course interviews revealed that students felt learning Arabic syntax became more enjoyable, meaningful, and was no longer considered a difficult or boring subject.

Next, students state that integration science theme making they capable understand function structure Language in explain real world phenomena, as well as

increase ability think critical, This is in line with objective integration STEM literacy in learning language that is not only focus on aspects linguistics, but also on the development of students' soft skills, In general, implementation limited This give proof that design learning based on TBLT- STEM effective in increase quality learning grammar and can become alternative innovative in development curriculum learning Arabic in college tall.

The research results show that the implementation of an Integrated Task-Based Language Teaching (TBLT) approach with STEM themes has a positive impact on the quality of grammar learning at the higher education level. These empirical findings support the theory proposed by Tavakoli et al. (2019), which states that TBLT is capable of promoting active student engagement by emphasizing language use through real and contextualized tasks. In this context, the use of project-based tasks—such as explaining the phenomenon of photosynthesis or Newton's laws in Arabic—provides students with opportunities to study language structures in a functional way rather than merely in a mechanical manner.

This approach is also aligned with constructivist learning theory (Mishra, 2023), which emphasizes the importance of social interaction and the use of real contexts in building understanding. Group discussion activities and task-based presentations in this study function as forms of the Zone of Proximal Development (ZPD), where students learn more optimally through collaboration and social support. The observed improvement in students' self-confidence, critical thinking skills, and learning enthusiasm further reinforces the idea that task-based learning provides learners with autonomy and a sense of ownership over the learning process. In addition, the integration of STEM literacy into the learning of Arabic syntax confirms the importance of a cross-disciplinary (interdisciplinary) approach, which has become a key demand of 21st-century education. According to Mujib et al. (2020), STEM literacy encourages students not only to understand content in the fields of science and technology but also to develop systematic, creative, and communicative thinking skills. In this study, students not only learned Arabic syntax at a theoretical level but also practiced language structures to demonstrate the development of scientific communication skills in Arabic—an outcome that is rarely achieved through traditional teaching methods.

Interview results also show that students felt learning Arabic syntax became more enjoyable and no longer boring. This finding supports motivational learning theory proposed by Gagné and Deci (2005) within the framework of Self-Determination Theory (SDT), which emphasizes that intrinsic motivation increases when learners perceive learning as meaningful, challenging, and autonomy-supportive. STEM themes, which were considered relevant and interesting by students, fulfilled the three basic psychological needs identified in SDT: competence, social relatedness, and learning autonomy. All of these factors collectively strengthened student engagement and learning outcomes. Overall, the findings of this study are consistent with various contemporary learning theories, particularly Task-Based Language Teaching (TBLT), constructivism, STEM literacy, and motivation theory. The application of the TBLT–STEM model has been proven to improve the quality of Arabic syntax learning in a comprehensive manner, encompassing linguistic, cognitive, and affective aspects. Therefore, this instructional design is worthy of further development as an alternative approach for curriculum reconstruction toward more contextual, integrative, and contemporary Arabic language learning.

Students' Engagement and Affective Responses

Student show high enthusiasm to approach learning This, They feel challenged However like Because can to hook lesson Arabic with close themes with life them, such as science and technology, Response recorded affective in interview end show that learning feel more alive, contextual, and not boring, Many students state that learning with approach This give atmosphere newer one meaningful compared to method conventional which is only focus on memorization rules, Some student even disclose that they more easy understand structure arabic syntax Because presentation material associated direct with actual science themed texts, This is strengthen relatedness between function language and its use in understand phenomenon scientific.

Interestingly, several students also demonstrated initiative to continue their exploration independently by developing Arabic text projects based on STEM themes. For example, one student composed a short text about solar panel technology using the Arabic syntactic rules that had been learned. Other students designed Arabic-language dialogues about air pollution as part of their learning reflections. Students' active and

creative participation during the learning process was also evident in the observation results. They not only completed the assigned tasks but were also engaged in meaningful discussions, provided mutual feedback, and evaluated the use of Arabic syntactic structures in their peers' texts. This shows that the TBLT–STEM-based instructional design is capable of fostering learner autonomy, collaboration, and the simultaneous strengthening of linguistic competence and scientific literacy.

The results of the study showed a high level of student enthusiasm for an Arabic language learning approach based on Integrated Task-Based Language Teaching (TBLT) with STEM content. This enthusiasm can be analyzed and confirmed through several modern learning theories, particularly within the cognitive, affective, and social-constructivist domains. From a theoretical perspective, the findings are consistent with constructivist theory developed by Vygotsky, which views learning as a social and active process. In this process, students do not merely receive information but actively construct their own understanding through interaction, discussion, and the completion of meaningful tasks. Student involvement in projects such as composing Arabic texts about solar panels or designing dialogues about air pollution reflects the Zone of Proximal Development (ZPD), namely a space in which students are able to learn more optimally through assistance and collaboration. Social interaction in this learning process created an enriched context for students' linguistic understanding.

In context the TBLT approach alone, emphasize that authentic and communicative tasks more effective in develop competence Language Because put student in situation use real language, In research this, integration science and technology text become task authentic that drives student For use structure arabic syntax in a way contextual, This is Far more meaningful compared to approach traditional which is only emphasize memorization rules without application real, More furthermore, STEM integration in learning Arabic also confirms principles Content and Language Integrated Learning (CLIL), ie an approach that combines content academic with learning language, Based on CLIL theory is able to increase motivation student Because they Study Language For real and applicable goals, Students in study This feel learning more " alive " because relate direct with their world, such as science, environment, and technology, This is No only increase understanding language, but also strengthen their scientific literacy in a way simultaneous.

From an affective perspective, the Affective Filter Hypothesis is also highly relevant. When students feel comfortable, interested, and motivated, their "affective filter" is lowered, allowing language input to be absorbed more easily. Students' statements indicating that learning was no longer boring and felt more meaningful demonstrate that the TBLT–STEM approach successfully created an emotionally conducive learning environment. Students' creativity in continuing projects independently is also closely related to the principles of Self-Determination Theory, which states that learning becomes more effective when three basic psychological needs are fulfilled: competence, relatedness, and autonomy. In this learning context, students felt capable (competent), connected to real-world issues (relevance), and were given opportunities for independent exploration (autonomy). Thus, the results of this study are not only supported by strong theoretical foundations but also provide empirical contributions showing that the integration of TBLT with STEM content is an effective approach for developing functional Arabic language skills that are applicable to the demands of 21st-century learning.

Improvement of the Ability Syntax in the General Contextual

The TBLT–STEM-based learning approach has been proven not only to increase students' syntax test scores but also to strengthen their understanding of constructing Arabic sentences in contextual and meaningful ways. Students demonstrated a sharper ability to recognize and apply syntactic elements such as *mubtada–khabar, fāʿil, mafʿūl bih,* and *iḍāfah* structures, as these forms were encountered experientially within scientific texts studied in class. During the learning process, students did not merely memorize formulas or rule definitions; rather, they actively constructed meaning by understanding the functional roles of syntactic structures within authentic textual contexts. For example, in a unit discussing Newton's laws, students were required to analyze scientific sentences in Arabic and identify the syntactic elements that shaped their meaning. This process made the learning of Arabic syntax more applicable and meaning-oriented, moving beyond rote memorization toward deeper conceptual understanding.

Furthermore, students were trained to independently construct sentences and paragraphs using the syntactic rules they had learned through relevant scientific themes.

As a result, they did not remain passive users of the language but became active producers of Arabic within academic and scientific contexts. This construction process also fostered students' self-confidence and a sense of ownership over their learning outcomes. The integration of STEM content served as an important bridge that made syntactic materials feel authentic and relevant. Students perceived Arabic syntax learning as having practical value because it could be used to explain natural and social phenomena in Arabic. This, in turn, had a positive impact on their learning motivation and reshaped their perception of Arabic syntax, which had previously been viewed as boring.

By blending linguistic skills with scientific content, this approach promotes holistic and cross-disciplinary learning. Students not only understand language rules but also use them to think critically, convey arguments, and comprehend scientific information. These results indicate that the integration of TBLT and STEM in Arabic language instruction has a positive impact on students' mastery of syntax in ways that are more contextual, meaningful, and sustainable. Overall, this approach successfully transforms the experience of learning Arabic syntax from a mechanical practice into a reflective and productive process that connects language, scientific understanding, and real-life application (Kaharuddin et al., 2022).

The finding that the TBLT–STEM approach enhances students' ability to understand and apply syntactic rules contextually aligns closely with the principles of Task-Based Language Teaching. This theory emphasizes that language is learned most effectively when it is used in meaningful, meaning-focused tasks rather than through isolated rule memorization. In this study, students did not merely memorize structures such as *mubtada'–khabar, fāʿil–mafʿūl*, or *iḍāfah*; instead, they encountered and applied these structures within Arabic scientific texts. This represents a concrete implementation of the TBLT principle of learning by doing and understanding through use.

Furthermore, the integration of STEM content as a learning material supports the theory of Content and Language Integrated Learning (CLIL), which posits that the combination of academic content and language learning within a single instructional process enhances motivation, contextualization, and cognitive engagement (Ji & Pham, 2020). In this study, students learned Arabic syntactic rules not in isolation but within

the context of explaining Newton's laws and other scientific phenomena. As a result, Arabic functioned not only as an object of linguistic study but also as a medium for scientific thinking. This approach is also consistent with the Cognitive Academic Language Learning Approach (CALLA), which integrates academic skills and learning strategies within second language instruction.

From a motivational perspective, students' increased enthusiasm and perception of Arabic syntax learning as more meaningful can be explained through Self-Determination Theory. The integration of STEM content provided students with a sense of autonomy and competence, as they were able to use Arabic to construct meaning related to real-world phenomena. This experience fostered a sense of ownership over the learning process, thereby strengthening students' emotional engagement and intrinsic motivation. Moreover, students' success in independently constructing sentences and paragraphs reflects the application of social constructivist theory, which emphasizes that learning occurs through meaningful and contextual social processes. Through projects, text analysis, and production-based tasks, students developed syntactic skills experientially within their Zone of Proximal Development, supported by challenging yet achievable tasks.

Finally, students' ability to think critically and convey ideas through Arabic structures in scientific contexts serves as an indicator of transversal learning. This goes beyond mere language mastery and reaches higher-order thinking skills, which are characteristic of holistic, interdisciplinary, and 21st-century learning models.

Final Learning Design

General Concept:

Arabic syntax learning is developed through the integration of the Task-Based Language Teaching (TBLT) approach with STEM-themed content. Students are challenged to complete problem-based tasks using Arabic texts with scientific themes, enabling them to construct grammatical meaning and syntactic rules in a contextual and meaningful manner rather than through isolated rule instruction.

The learning process is conducted in three main stages. The first stage is the introduction (pre-task), in which the instructor introduces the learning theme, activates key vocabulary, and provides a stimulus based on STEM phenomena, such as images

illustrating the process of photosynthesis or the concept of gravity. The second stage is the core activity (task cycle), where students read the text and work collaboratively in groups to complete task-based activities, including answering questions, organizing information, producing summaries, and constructing dialogues, followed by group presentations of their results. The final stage is the closing phase (language focus), during which the instructor guides students in analyzing the Arabic syntactic structures found in the discussed texts and provides focused exercises to reinforce their understanding of the grammatical rules.

Each type of evaluation in this study serves a specific purpose and is implemented through distinct procedures to ensure a comprehensive assessment of the learning design. Formative evaluation is conducted throughout the implementation of the TBLT–STEM learning units to monitor students' ongoing learning processes, using classroom observation sheets to document students' engagement, participation in task-based activities, collaboration, and responsiveness to STEM-contextualized tasks. In addition, formative assessment includes the evaluation of students' assignments, with particular attention to their ability to apply Arabic syntactic structures accurately within scientific and technological contexts. The primary purpose of formative evaluation is to provide immediate feedback, identify learning difficulties, and enable instructors to adjust instructional strategies in real time.

Summative evaluation is conducted at the end of the instructional intervention to measure overall learning outcomes. This evaluation includes a context-based Arabic syntax mastery test designed to assess students' understanding and application of syntactic rules in meaningful STEM-related texts, as well as reflective interviews to explore students' perceptions, learning experiences, and attitudes toward the TBLT–STEM learning process. The purpose of summative evaluation is to determine the overall effectiveness of the learning design while capturing both cognitive achievement and reflective learning outcomes. Additionally, the learning design is intentionally flexible, allowing for adaptation to digital learning formats and further development across different educational levels.

Conclusion

The Integrated Task-Based Language Teaching (TBLT) learning design for Arabic language instruction with STEM content has been proven to be valid and effective in improving students' syntax learning in a contextual and meaningful manner. Expert validation results indicate a high level of feasibility, while limited trial implementation demonstrates improvements in students' mastery of Arabic syntax as well as a significant increase in enthusiasm toward the learning process. This learning design facilitates students' understanding and application of Arabic syntactic rules through authentic, science-themed texts, making the learning experience more engaging and relevant. Furthermore, this approach strengthens essential 21st-century competencies, including critical thinking, collaboration, and scientific literacy.

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