

# Integrated CTL with Aerospace Context in Mathematics Learning

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**Abstract.** Integrated Contextual Teaching Learning (ICTL) may not be something new, but when it involves the aerospace context, especially in high school mathematics learning, it becomes unique. This research is a literature study which aims to analyze, describe and determine the theoretical basis based on articles, books and relevant research results. The data in this study are articles, previous research notes, documentation, research reports, and reference books. Data were analyzed through Systematic Literature Review (SLR). Based on the results of the analysis, it can be concluded that ICTL with an aerospace context is new, unique, and an innovation in high school mathematics learning. So it is hoped that schools can start implementing it and researchers can start researching it further.

**Keywords:** ICTL, aerospace, mathematics.

## 1 Introduction

The integrative learning model emphasizes student-centered learning, specifically by involving or directing students to be actively involved in the learning process [1]. Aside from that, it allows students to connect their experience and knowledge, allowing them to solve problems and fulfill their knowledge needs more easily. The Integrative Model is a method of learning that employs a cross-disciplinary approach. In this model, teachers look for and select overlapping related themes at the end of the program planning stage [1].

Integrative learning places more emphasis on student involvement in active learning, so that students can gain direct experience or be trained to discover for themselves the various knowledge they learn [2]. Through direct experience, students will better understand other concepts that have been understood, and the application of learning while doing something (learning by doing). This learning theory was driven by Gestalt psychology figures, including Piaget, who emphasized that learning must be meaningful and oriented to the needs and development of children. Therefore, teachers must package and design learning experiences that show the relationship between conceptual elements that make the learning process more effective. The conceptual connection between one lesson and another will form a scheme so that students will gain completeness and completeness of knowledge [2].

The learning model is a strategy used by teachers in the classroom to manage the learning process so that students can play an active, creative, and follow-through role during the learning

process, one of which is by using the CTL (contextual teaching learning) model, in which the teacher invites students to relate what they have learned [2]. According to [3], this is the case in everyday life. The contextual learning model (contextual teaching and learning) is a holistic learning process that aims to help students understand the meaning of teaching material and relate it to their daily lives (personal, social, and cultural contexts), so that students have dynamic and flexible knowledge/skills to actively construct their own understanding.

The CTL process is more meaningful when students experience what they are learning for themselves rather than hearing about it from others. CTL learning steps prioritize students who take a more active role in constructing their knowledge (student center) with inquiry activities and teachers in the learning process as mediators, facilitators, and guides. Aside from using innovative learning models, it is also necessary to instill cultural values, ethics, and ways of behaving in the community that have noble values that are based on local wisdom in Social Sciences learning for elementary school children [3].

The first step in implementing CTL is to develop the idea that working alone, discovering for themselves, and constructing their own new knowledge and skills will help children learn more meaningfully. Following that, carry out activities that are as closely related to the topic as possible. Students' inquisitiveness can be developed by asking them questions about the lesson material [4].

According to the findings of a study conducted by [4], the learning outcomes of students in class II MIN 1 Kota Pariaman using the integrative learning model by describing CTL strategies in the theme Living in Harmony were better than using the direct learning model. According to the findings of a study conducted by [5] the contextual learning model for introducing letters is working well and is being implemented in accordance with the RKH created. Children can recognize the letters and also the real media that the teacher has prepared according to the theme and mention the letters in the themes such as work, water, air, fire, and the universe in this contextual learning to introduce letters.

[6] found that the development of integrated thematic teaching materials based on a scientific approach is very much needed by teachers in carrying out teaching and learning activities in Kindergarten, as evidenced by the results of the Focus Group Discussion, where teachers are very hopeful that learning themes can be completed more quickly, because they desperately need guidance. So far, they have not received a scientific overview of integrated thematic learning. Themes were able to be used as teaching materials for kindergarten teachers as a result of research that went through six stages of development. However, this is not ideal because there is still much work to be done, particularly in terms of teaching materials, because the first-year results are only at the stage of developing themes and learning activity processes.

According to [7] the CTL learning model is a learning model that engages students in developing their knowledge and applying it to real-world contexts. Students being active in acquiring knowledge and applying it to their lives is a learning process that helps students broaden their understanding of their daily lives. CTL is a learning approach that recognizes and demonstrates the natural conditions of knowledge, and it can be used as a relevant experience in building knowledge into students' lives. While [8] stated that contextual learning is learning that activates Student activities in scientific work to solve problems related to the context of everyday life, strategies used by teachers for students in following the learning process are achieved using the CTL model, so that students will be more active and conducive in participating in the ongoing learning process.

Mathematics learning should be interesting and challenge students' thinking processes so that they can train students' creative problem solving abilities. This kind of learning can be realized by using the right context. Contextual problems are very interesting and can stimulate students' communication skills when interacting with other students or the teacher. The lack of use of students' daily context when teachers teach mathematics has an impact on further distancing students from mathematics and on students' low ability to solve math problems in the form of stories or problem solving questions.

## **2 Research Method**

As a research method, a systematic literature review with a quantitative descriptive approach was used. SLR was chosen with the goal of carrying out justification based on previous research regarding mathematical proof ability. This stage of research includes data collection, data analysis, and conclusion drawing [9]. Researchers trace and collect data in the form of primary research published in national and international articles during the data collection stage. Researchers use electronic databases such as Google Scholar, Garuda, ERIC, and Semantic. Following that, all articles are extracted, and only those that meet the inclusion criteria are analyzed.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) is the protocol used in this SLR. Process The process of selection refers to the four stages of PRISMA, which are identification, screening, eligibility, and inclusion [10]. Based on a keyword search in the search engine, 59 articles were found as samples, with 30 studies using a qualitative approach.

## **3 Result**

### **3.1 Integrated Learning Model**

Integrated Learning is a learning approach that integrates activities into all areas of development, including cognitive, social-emotional, language, moral, religious, physical-motor, and artistic aspects. All areas of development are broken down into learning activities based on a single theme [11].

Integrated learning is learning that begins with another subject, certain concepts are linked to other concepts, which is carried out spontaneously or planned, either in one or more fields of study, and learning becomes more meaningful with a variety of student learning experiences [12]. According to [13], integrated teaching is essentially defined as a teaching activity that combines material from multiple subjects into a single theme. Thus, teaching and learning activities can be implemented in this manner by teaching several lesson materials presented at each meeting.

Integrated learning is a learning approach that incorporates activities into all areas of development, such as cognitive, social-emotional, language, moral and religious values, physical-motor, and artistic aspects. All areas of development are explained as learning activities centered on a single theme, so integrated learning, particularly in kindergarten, is also known as theme learning [9]. Meanwhile, [12] define integrated learning as a learning system that allows children to actively seek to explore and discover scientific concepts and principles in a holistic, meaningful, and authentic manner, both individually and in groups.

Based on the opinions expressed above, it is possible to conclude that Integrated Learning is a learning approach that integrates activities into all areas of development, including cognitive, social emotional, language, religious moral, physical motor, and artistic aspects. All areas of development are broken down into learning activities based on a single theme.

According to [9], integrated learning has several characteristics: (a) Integrated learning is centered on the child; (b) Integrated learning can provide children with direct experience; (c) Integrated learning generates activities that can improve the thinking of all children; (d) In a learning process, integrated learning presents concepts from various areas of development; (e) Integrated learning is adaptable because teachers can choose any topic relevant to the child's life and incorporate it into learning activities; (f) The learning outcomes will be achieved so that the child's interests and needs can be met in all aspects of development.

Aside from that, [13] lists the following characteristics of integrated learning: (a) Holistic, integrated learning enables students to comprehend a phenomenon from all perspectives; (b) Meaningful, enables the formation of a type of intertwining of related concepts known as schemata, which has an impact on the material to be studied's meaningfulness; (c) Through direct learning activities, authentic, integrated learning allows students to directly experience the principles and concepts they wish to learn; (d) Active, integrated learning emphasizes student activity in learning, both physically, mentally, intellectually, and emotionally, in order to achieve optimal learning outcomes by taking into account students' desires, interests, and abilities, so that they are motivated to learn continuously.

The Benefits of Integrated Learning: (a) Learning experiences and activities will always be relevant to the child's developmental level; (b) The activities chosen for learning implementation based on the child's interests and needs; (c) All learning activities are more meaningful for children, resulting in longer-lasting learning outcomes; (d) Integrated learning can help children develop thinking skills; (e) Presenting pragmatic activities based on problems that children frequently encounter in their environment; (f) Foster social skills in children, such as work equality, tolerance, communication, and respect for other people's ideas; (g) The lesson material becomes more relevant to the child's life, making it easier for the child to understand and apply; (h) Students can easily connect material relationships lessons from one subject to another; (i) Working in groups allows students to develop their learning abilities in affective and psychomotor aspects as well as cognitive aspects; (j) Integrated learning accommodates different types of intelligence in students; (k) Teachers can easily use active student learning as a learning method when using an integrated learning approach.

#### The Obstacles of Integrated Learning

1. Teacher Qualities: Teachers must be open-minded, creative, have dependable methodological skills, be self-confident, and have the courage to package and develop material.
2. Student aspects: Integrated learning necessitates that students' learning abilities be relatively "good," in terms of both academic ability and creativity.
3. Aspects of learning facilities and resources: Integrated learning necessitates a wide range of reading materials or information sources, as well as access to the internet.
4. Curriculum aspect: The curriculum must be flexible and geared toward achieving complete student understanding.
5. Assessment: A comprehensive assessment method is required for integrated learning.

6. Learning environment: Integrated learning tends to prioritize one area of study while 'submerging' other areas of study.

When implementing integrated learning, the following principles must be considered:

- a. Themes should be age-related, individual differences, and children's socio-cultural characteristics.
- b. Themes must be directly related to children's real-life experiences and developed based on what they already know and what they want to know.
- c. Each theme should present concepts that children can investigate.
- d. Each theme must be supported by carefully researched existing knowledge.
- e. The theme must incorporate material as well as activities.
- f. Theme-related information must be conveyed to children through direct experiences involving active discovery.
- g. Thematic activities should reflect various areas of development.
- h. The theme must be applicable to project activities initiated by the child.
- i. Themes should give children opportunities to reflect on what they already know.
- j. Themes should be expanded or refined based on the child's demonstrated interest and comprehension.
- k. Meet the needs of children for movement, social interaction, independence, and positive self-esteem.
- l. Provide opportunities for play in order to translate experiences into understanding.
- m. Value the differences, cultural backgrounds, and family experiences that children bring to the classroom.

There are numerous advantages to integrated learning for both children and teachers, including the following:

- a. Allows children to experiment with and express their knowledge and skills through a variety of activities.
- b. Improve the conceptual development of children.
- c. Improve children's ability to interact with their peers and their surroundings.
- d. Integrated learning can improve children's thinking skills.
- e. Integrated learning can help teachers become more professional.
- f. Integrated learning teaches students to make increasingly complex connections between and among subjects.
- g. Integrated learning helps students solve problems and develop critical thinking skills by putting them in real-world situations.
- h. By presenting topics in various situations and conditions, students' memory for the material studied can be improved.

- i. Learning transfer can occur easily in integrated learning if the learning situation is similar to real-life situations.
- j. Increase the number of social interactions between children.
- k. Increasing the professionalism of teachers.

### **3.2 CTL Model**

Contextual learning is a learning concept that assists teachers in connecting the material they teach to students' real-world situations and encourages students to make connections between their knowledge and its application in their daily lives [14]. Contextual learning is a learning concept that helps teachers link the material they teach with students' real-world situations and encourages students to make connections between the knowledge they have and its application in their daily lives. According to [15] contextual learning is an educational process that aims to help students see the meaning and subject matter they study by connecting it with the context of their daily lives, namely with the context of their personal, social and cultural environments.

According to [16], contextual learning is a system that stimulates the brain to build patterns that create meaning. Elaine went on to say that contextual learning is a brain-friendly learning system that generates meaning by connecting academic content with the context of students' daily lives, and that contextual learning is an effort to engage students in developing their own abilities without sacrificing benefits. because students attempt to learn concepts while applying and relating them to the real world.

Contextual learning, according to [17], is a learning process in which students use their understanding and academic abilities in various contexts inside and outside of school to solve simulative or real problems, both individually and collaboratively. Contextual Teaching and Learning is a learning approach that connects the material studied with the context of students' daily lives. According [16], contextual learning is a learning concept that can assist teachers in connecting the material they teach with students' real-world situations and encouraging students to make connections between their knowledge and its application in their lives as family and community members.

Contextual learning is very synchronous with efforts to develop students' critical thinking skills, particularly in the components of asking, discovering, and reflecting. It is hoped that by incorporating these three components, students will be able to construct their own understanding (constructivist) of what they learn [18]. Contextual learning is a learning approach that connects the material studied with children's real everyday lives, both in the family, school, community, and citizen environments, with the goal of discovering the subject matter's meaning for children's lives.

Contextual learning prioritizes knowledge and experience from the real world, high-level thinking, student-centered, students are active, critical, creative, solve problems, students learn in a fun, exciting, and non-boring environment, and students use a variety of learning resources. There are several factors to consider in contextual learning, including the following: having eight main characteristics, making meaningful connections, doing meaningful work, self-regulated learning, working together, thinking critically and creatively, assisting individuals to grow and develop, achieving high standards, and using authentic assessment. It is hoped that in the future, the learning system will be more focused on students' real-life experiences, assisting students in discovering the meaning of learning. Because the development of learning in the

global world is accelerating, class teachers must have special competencies in creating creative and innovative activities that are fun, effective, and efficient and can be carried out well [19].

According to the opinions expressed above, contextual learning is a learning strategy that emphasizes the process of full student involvement in order to discover the material being studied and relate it to real life, thereby encouraging students to be able to apply it in their lives.

According to [20], the CTL Model has the following characteristics:

- a. Learning occurs in an authentic context (this learning occurs in a real-life setting).
- b. Learning allows students to work on meaningful tasks (meaningful learning).
- c. Learning is accomplished by providing students with meaningful experiences (learning by doing).
- d. Learning is provided by group work, discussion, and mutual correction among friends (group learning).
- e. Learning fosters togetherness, cooperation, and a deep understanding of one another (getting to know one another well).
- f. Learning is done actively, creatively, and productively, with a focus on cooperation ((learning to ask, inquire, and collaborate)).
- g. Learning takes place in a pleasant environment (learning as a pleasurable activity).

Meanwhile, [15] defines contextual learning as follows: (a) There is cooperation between all parties, (b) Emphasizes the importance of problem solving, (c) It boils down to the diversity of different student life contexts, (d) Support each other, (e) Fun, not boring, (f) Learn with passion, (g) Integrated learning, (h) Reports to parents include more than just report cards; they also include student work results, practicum results reports, student essays, and other information.

So, in this contextual learning model, it includes: feedback, the use of various tools, group learning, a democratic model, increased student understanding, evaluation based on authentic assessment, learning is formatted based on the place and time available, and the information provided is relevant to students' needs.

According to [21], the CTL syntax is as follows: (a) The teacher connects concepts to students' prior knowledge (relating), (b) Teachers and students learn by exploring (experimenting), (c) Teachers and students apply what they've learned in the classroom to real-world situations (applying), (d) Teachers and students work together to solve problems (collaboration), (e) Transferring previously acquired knowledge (transferring).

According to [22], the CTL learning model system includes the following components: (a) Establish meaningful connections, (b) Engaging in meaningful work, (c) Work together, (d) Be critical and creative in your thinking, (e) Assisting individuals in their growth and development, (f) Maintain high standards, (g) Make use of genuine evaluation.

### **3.3 Aerospace Education**

Teachers can create a context for teaching mathematics by connecting mathematics to students' daily lives and technological developments that students can understand. This context can be presented in the form of problems, examples, or practice questions, both routine and non-

routine. The use of such a context has a positive effect on student learning activities and can train students to think critically and creatively when solving mathematical problems.

Contextual problems are very interesting and can stimulate students' communication skills when interacting with other students or the teacher. The aerospace context was chosen for this research because there has never been any research that has used the aerospace context in teaching mathematics using the ICTL model. Despite the fact that aerospace is closely related to mathematics. Many aerospace contexts can be incorporated into mathematics learning through questions, media, and even teaching materials.

For example, in the early stages of mathematics learning, the teacher could use an aerospace context in the form of a video of the Rafale fighter plane. Teachers can investigate students' prior knowledge in relation to the material being studied. Teachers can also use airplane drawing media to model problems with airplane seats and baggage for business class and economy class passengers.

[23] research on comparative material uses the context of a plane taking off in mathematics learning. Andinasari used a video of a plane taking off to explore students' preliminary knowledge of comparisons. The use of this context appears to help students understand concepts. In this context, he also develops questions to test students' problem-solving abilities.

### **3.4 ICTL With Aerospace Context in Mathematics Learning**

Contextual Integrated Thematic Learning is a learning approach that integrates different competencies from different areas of child development into different themes. This integration occurs in two stages: the incorporation of attitudes, skills, and knowledge in the learning process, and the incorporation of various related basic concepts [6]. Learning that allows children to actively interact with their surroundings by exploring them. Learning that provides a sense of security and learning that is integrated, as well as learning outcomes that can bridge children so that they can adapt to the next development environment [18].

ICTL learning is a learning process plan that uses the aerospace context to link specific subjects that are carried out with contextual concepts, namely linking the material taught with students' real-world situations in order to improve student performance.

The steps of the Integrative model in describing the CTL Strategy in classroom learning are as follows: the educator shows a video and a picture with an aerospace context in front of the students, and the students are asked to pay attention and explain what they know. The educator explains the video or image to the students in front of the class.

Students are given assignments in the form of LKPD, which were also developed using the ICTL approach and have an aerospace context. Each student responds to the teacher's questions in accordance with the instructions given. After the students have finished working on the LKPD assignment, the teacher asks one of them to come forward and present the results of their work. Following that, the educator evaluates the assignment.

[24] mentions several steps for implementing the ICTL model in learning:

- a. Develop the idea that working alone, discovering for themselves, and constructing their own new knowledge and skills will help children learn more meaningfully.
- b. Implement as many inquiry activities as possible for all topics.
- c. Encourage students' curiosity by asking probing questions.



- d. Form a learning community (study in small groups).
- e. Use the model as an example of learning.
- f. Reflect at the conclusion of the meeting.
- g. Conduct real-world assessments in a variety of ways.

The first step in the ICTL learning process is to choose a theme, which is adapted from [25]. At the theme selection stage, sub-themes are developed that are combined with the surrounding environment in accordance with the Contextual Teaching and Learning (CTL) approach. A product in the form of a network of sub themes is created during the development stage. The next step is to conduct a curriculum analysis. The third step involves developing a mapping relationship between KD and indicators in order to generate a linkage table between KD and indicators. The final step is to build a KD network. At this point, in addition to developing the KD network, we are also developing an indicator network, which will eventually produce KD and Indicator network products. The fifth step is to compile a syllabus, which results in a syllabus, and the final step is to compile a lesson plan, which results in a lesson plan. There are stages to develop material in the steps of preparing the RPP, so developing material is required. Because the developed material is organized in Student Books, it is necessary to prepare student books.

### **3.5 Relevant Research**

[26] conducted an analysis of thematic learning implementation in developing independence in children. The findings of the study revealed that learning planning refers to Ministerial Regulation No. 58 of 2009, RKM, RKH, indicator collection, center guide, annual activity program, parent guide and teachers, and working meeting results. Teachers use the following teaching methods: storytelling, conversations, demonstrations, assigning homework, projects, and field trips. Storybooks, television, game equipment, used goods, blackboards, and other learning media are used. Teachers face challenges such as limited time, media exposure, and parental cooperation.

According to the findings of [27] research, the implementation of contextual integrated thematic learning at RA Mutiara Miftahul Jannah Sabah Balau South Lampung was carried out by class B teachers in accordance with procedures. However, it has not yet reached 100%, with details reaching a percentage of 61.54% implemented. This is because some items, such as child-centered learning, providing direct experience to children, presenting concepts from various subject content (flexible), using the principles of learning while playing and having fun, and learning in an authentic and scientific context, have not been implemented or have not been maximized.

[28] concluded that there was progress in student learning and student grades were quite good in the learning process in class with the implementation of the CTL (Contextual Teaching Learning) model. Based on the data presented, it proved that at the evaluation stage student grades were quite good. The implementation of the Contextual Teaching and Learning (CTL) learning model in class V thematic learning at MI Muhammadiyah Kalipetung has implemented the seven main components of effective learning found in CTL learning through three stages, namely the learning planning stage, the learning implementation stage, and the learning evaluation stage, according to [19]. Constructivism, discovery, questioning, learning community, modeling, reflection, and actual assessment are the seven components. Supporting factors include the fact that the material presented is interesting, relevant to the students'

experiences, and the learning resources are helpful. Meanwhile, students lack enthusiasm for learning, are afraid to express their opinions, and prefer to be listeners.

The research results of [29] show that there is an increase in each cycle which shows better results for each action. Student completeness in the initial stage only reached 31% with an average student score of 65.76. The results obtained experienced an increase in cycle I, namely student completeness reached 87.87% with an average student score of 76.48. The results obtained in cycle II also increased, namely student completeness reached 100% with an average student score of 88.36. The implementation of integrated thematic learning with a contextual approach at State Elementary School 16 Banda Aceh has shown appropriate thematic learning characteristics, namely being able to increase students' enthusiasm while participating in the learning process both in the classroom and outside the classroom.

According to the findings of [12] research, the form of applying the contextual teaching and learning approach in thematic learning at State Elementary School (SDN) 2 Parigi is that students link the subject matter and their respective experiences, and students find their own solutions to problems based on experience. daily, encourage students' curiosity so that they always ask questions, collaborate and use friends as a source of learning through experience, use media or tools to convey lesson material, repeat or remember previous material, and conduct assessments to determine each student's achievement. Obstacles and solutions include a lack of learning media and thematic books; the solution is to provide learning media and thematic books to teachers and students.

The findings of a study [30] on integrative thematic learning design based on the CTL approach for grade 4 elementary schools were found to be effective based on the difference between pretest and posttest at a 0.000 significance level. The result is less than 0.05 when tested with a confidence level of 0.05. This means that the competency of learning outcomes produced by the Integrative Thematic Learning Design Based on the CTL Approach is higher than that of the Government's Integrative Thematic Learning Design.

#### **4 Conclusion**

It can be concluded that integrated contextual teaching learning is theme-based learning in which one theme can develop six aspects of children's development at once, as well as involving children directly in the learning process so that children receive learning in the form of a complete and meaningful experience for the child rather than learning in the form of imagination. The context referred to in this study is the use of the aerospace context in mathematics learning.

Based on the explanation above, it is possible to conclude that more research into ICTL in the aerospace context in mathematics learning is required. This is due to the fact that there is still little research on ICTL in the aerospace context, particularly in secondary schools. ICTL is primarily studied in elementary schools. Meanwhile, the aerospace context is still used infrequently.

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