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Enhancing students' fluency in thinking: An inquiry-based approach with bell ringer exams

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ABSTRACT

This action research aimed to enhance fluency thinking in the Year 9 Science and Technology course on Genetics by integrating bell ringer exams with inquiry-based learning. The study's objectives were to achieve an 80% pass rate in fluency thinking and to assess student satisfaction with this pedagogical approach. The sample comprised 20 Year 9 students from the first semester of the 2022 academic year. The research utilized ten learning plans, a fluency thinking test, an interview form, and a satisfaction questionnaire. The study followed an action research model implemented in two cycles. Data were analyzed using averages, standard deviations, and percentages. The findings revealed significant improvement in students' fluency thinking, with 85% and 100% passing the criteria in the first and second cycles, respectively. Additionally, students reported high levels of satisfaction with the learning activities. This study demonstrates that combining bell ringer exams with inquiry-based learning is effective in fostering critical thinking and engagement in scientific subjects. The approach proved particularly beneficial in the context of Genetics education, where complex concepts often require innovative teaching methods. The success of this method suggests that such integrated approaches can significantly enhance educational outcomes and student experiences, potentially leading to improved long-term retention of scientific knowledge and increased interest in STEM fields.

Contribution/ Originality: This study innovatively integrates bell ringer exams with inquiry-based learning in Year 9 Genetics education, offering a novel approach to teaching complex scientific concepts. It provides empirical evidence of this method's effectiveness in enhancing fluency thinking and student engagement, contributing a replicable model for science curricula.

1. INTRODUCTION

Science plays a crucial role in today's world and will continue to do so in the future. It is integral to everyone's life, both in daily living and professional work, and is evident in the various appliances and products that people use to facilitate energy use and work. These are all results of scientific knowledge combined with creativity and other fields of expertise. Essential skills in searching for knowledge can solve problems systematically and aid in decision-making using a variety of information with verifiable evidence (Duggan & Gott, 2002; Jones, 2007; Salonen, Hartikainen-Ahia, Hense, Scheersoi, & Keinonen, 2017).

Furthermore, science learning aims for students to study science in a way that focuses on connecting knowledge with the process of conducting important research and creating a body of knowledge. This is achieved by using methodological processes and solving a variety of problems, allowing learners to participate in learning at every step (Feinstein, 2011; Martin, Durksen, Williamson, Kiss, & Ginns, 2016)

Students at all educational levels should be able to master higher-order thinking skills (Kotzer & Elran, 2012; Saavedra & Opfeer, 2012). Higher-order thinking (HOT) skills are the ability to adapt current information or prior knowledge to seek viable solutions to contemporary challenges (Heong et al., 2011). HOT skills can be further subdivided into critical, creative, and metacognitive thinking.

Guilford (1967) defined creativity as encompassing problem-sensitivity, idea fluency, adaptability, the capacity to alter perspectives, originality or the tendency for individual reaction, and the ability to redefine and interpret. Four criteria are used to evaluate students' creative thinking abilities: fluency, flexibility, originality, and elaboration (Scibinetti, Tocci, & Pesce, 2011).

Fluency is the ability to generate numerous ideas, methods, proposals, questions, and alternative solutions. It also demonstrates how well children can solve difficulties (Hilmi & Usdiyana, 2020). Researchers have identified that lateral thinking mediates both fluency and flexibility.

Suherman and Vidákovich (2022) on the other hand, stated that originality, novelty, fluency, flexibility, elaboration, and explanation are used to assess divergent thinking.

Indeed, pupils are not accustomed to studying that fosters creative thought. Hence, students may struggle to solve common problems if the instruction does not focus on the growth of their creative thinking while they are in school (Khairunnisa, Khairil, & Rahmatan, 2022). Several strategies or approaches, such as an inquiry learning model, could be used to develop creative thinking skills in science learning (Cheng, 2010; Cremin, Glauert, Craft, Compton, & Styliandou, 2015; Liu, He, & Li, 2015; Thompson, 2017). According to numerous studies, inquiry-based learning models have shown significant potential in fostering creative thinking skills within science education. These models encourage students to engage actively in the learning process, promoting curiosity, critical analysis, and innovative problem-solving. By implementing inquiry-based approaches, educators can create an environment that nurtures creativity and higher-order thinking skills.

Furthermore, research suggests that integrating hands-on activities, collaborative projects, and open-ended investigations can enhance students' creative thinking abilities. These methods allow learners to explore scientific concepts in depth, formulate hypotheses, and devise unique solutions to complex problems. Additionally, incorporating interdisciplinary elements into science education can broaden students' perspectives and encourage them to draw connections between various fields of knowledge.

To effectively develop creative thinking skills, it is crucial for educators to provide ample opportunities for reflection, peer feedback, and self-assessment. This approach not only reinforces the learning process but also cultivates metacognitive skills, enabling students to become more aware of their thought processes and learning strategies. Ultimately, by fostering creative thinking in science education, we can better prepare students to tackle the challenges of an ever-evolving scientific landscape and contribute meaningfully to future innovations.

2. LITERATURE REVIEW

2.1. Inquiry-Based Learning

One of the student-centered learning strategies is inquiry-based learning (IBL), which emphasizes reflective investigations and intriguing findings in the teaching and learning process, focusing on concepts over facts and a process-oriented approach rather than a content-oriented one (Gholam, 2019; Shanmugavelu et al., 2020).

IBL is an educational technique that actively engages learners in knowledge construction by generating answered questions (Jerrim, Oliver, & Sims, 2022). Such inquiry-based assignments have a theoretical grounding in social constructivism, which assumes that learners are active actors in knowledge construction by developing their understanding and meaning-making, necessitating an inquiry mindset. Several studies indicated that IBL promoted academic achievement (Choowong & Worapun, 2021; Güven & Cansu, 2022; Manishimwe, Shivoga, & Nsengimana, 2023; Sasanti, Hamtasin, & Thongsuk, 2024; Sonsun, Hemtasin, & Thongsuk, 2023; Yonyubon, Khamsong, & Worapun, 2022). In addition, IBL also showed the enhancement of thinking skills (Zubaıdah, Fuad, Mahanal, & Suarsını, 2017). Additionally, inquiry-based approaches have been shown in studies to be effective in promoting positive learning outcomes such as deep thinking, knowledge application, and logical reasoning (Santoso, Lukitasari, & Hasan, 2022).

According to Hasan, Lukitasari, Utami, and Anizar (2019) the inquiry model's syntax was appropriate for helping pupils improve their capacity for original thought. By addressing knowledge, motivation, and thinking skills (Prayogi, Yuanita, & Wasis, 2017) fostering a scientific attitude (Sandika & Fitrihidajati, 2018) and developing science process skills (Rospitasari, Harahap, & Derlina, 2017; Thompson, 2017) the use of inquiry gives students numerous opportunities to develop and improve their creative thinking.

2.2. 5Es inquiry-based Approach

The 5E Inquiry-Based Approach has garnered significant attention in science education research for its potential to enhance student engagement and learning outcomes. This pedagogical model, comprising five distinct phases—Engage, Explore, Explain, Elaborate, and Evaluate—provides a structured framework for fostering active learning and critical thinking skills.

Numerous studies have demonstrated the efficacy of this approach in various scientific disciplines. For instance, Bybee et al. (2006) found that students taught using the 5E model showed improved conceptual understanding and retention of complex scientific ideas. Similarly, research by Wilson, Taylor, Kowalski, and Carlson (2010) indicated that this approach significantly enhanced students' ability to apply scientific knowledge to real-world scenarios.

The 'Engage' phase, which stimulates curiosity and activates prior knowledge, has been particularly effective in increasing student motivation. Subsequent phases build upon this foundation, encouraging learners to investigate, construct explanations, and apply their understanding to new contexts. The final 'Evaluate' phase provides opportunities for both formative and summative assessment, enabling teachers to gauge student progress and adjust instruction accordingly. Empirical studies have consistently shown positive outcomes associated with the 5E model. For instance, Makamu and Ramnarain (2023) reported that using simulations in the 5E model fosters collaborative learning, particularly in the Explore phase.

Despite its benefits, the implementation of the 5E model can be challenging. Duran and Duran (2004) highlighted that the effectiveness of the 5E model might vary depending on student background and topic complexity. Nevertheless, the approach remains a valuable tool in the science educator's repertoire, promoting inquiry-based learning and scientific literacy.

2.3. Bell Ringer Exam

Bell ringers, also known as bell work (Jones, 2007; Wong & Wong, 2001) are active learning approaches that assist teachers in managing their classrooms. Lamm (2015) described it as a timed "bell-ringer" style exam where students move around stations identifying brain regions and briefly outlining essential functions. According to Boettner (2011) a bell ringer is both a classroom management tool and an educational strategy to get students on task and ready to learn from the moment they enter the room.

Bell ringers are warm-up exercises designed for students to complete upon entering the classroom. These activities serve as effective formative assessments, providing teachers with time to take attendance, address questions, and collect homework (Nicely, 2011). By engaging students immediately, bell ringers help focus their attention and activate prior knowledge, setting the stage for new learning (Romano, 2011). When teachers analyze student responses to guide instructional decisions—such as reviewing content with the entire class, working with small groups, or moving forward with the lesson—they fulfill the core purpose of formative assessment (Decristan et al., 2015; Dixson & Worrell, 2016).

2.4. The Aims of the Research are as Follows

To enhance the fluency thinking of Year 9 students using the bell ringer exam in conjunction with inquiry-based learning, with the aim of surpassing the 80% threshold.

To investigate the satisfaction levels of Year 9 students regarding the bell ringer exam used in conjunction with inquiry-based instruction.

3. METHOD

3.1. Research Design

This research is action research based on the procedure reported by Kemmis and McTaggart (1988). The study was completed in two operational cycles, as detailed below.

Step 1 Plan: Study the school context with supervising teachers. Students' thinking influence was initially tested using a genetics thinking test. Results showed that 20 students failed in fluency thinking, scoring below 80 percent of the criteria. Theoretical concepts, principles, papers, and research related to creating fluency tests were then used to design learning management. An inquiry-based learning plan was developed, along with data collection tools including a fluency thinking test, student opinion interviews on learning management, a bell ringer exam equipped with inquiry-based learning, and satisfaction questionnaires. Experts verified the quality of these tools, which were then improved and applied to an experimental group of 40 Year 9 students (non-targeted). The fluency test was further refined based on statistical analysis before being used for data collection.

Step 2 Action: Implement the inquiry-based learning management plans equipped with bell ringer exams in operational spiral 1. Five plans were executed over a total of 8 hours.

Step 3 Observe: During the implementation of inquiry-based learning management plans equipped with bell ringer exams, students' behaviour was observed and recorded. At the end of the spiral, the fluency test was used to evaluate all students' thinking fluency. Targeted students were then invited for interviews. Satisfaction questionnaires were administered after teaching in the first spiral.

Step 4 Reflect: The researchers evaluated the teaching and learning of fluent thinking from Year 9 students using the bell ringer exam in combination with inquiry-based learning. They analysed the causes of problems and practical results to design more qualitative learning management for the following operational cycle.

The second operational cycle used five learning management plans over a total of 7 hours. Satisfaction questionnaires were administered after teaching in both spirals. Other processes operated similarly to the first cycle.

3.2. Participant

This research was conducted in the first term of the academic year 2022. The target group comprised 20 Year 9 students, selected using purposive sampling. These students were chosen based on their performance in a cognitive fluency skills test in the Science and Technology subject, specifically on the topic of genetics. Students whose test scores fell below the 80% criterion were selected to participate in the subsequent spiral of the action research.

3.3. The Research Instruments are Divided into Four Items as Follows

1. The learning management plan to organise learning activities with bell ringer exams in conjunction with inquiry-based learning consists of 5 steps:

Engagement: Creating situations or problems from the curriculum content following the learning objectives. This introduces the lesson with a problem to encourage learners to think and solve problems.

Exploration: Learners jointly search for problems, important issues, or questions they are interested in studying thoroughly. These questions must relate to the established situation or problem, which should guide the research or experimentation method.

Explanation: Learners explain what is obtained from the study, attempting to find reasons for the relationships between things.

Elaboration: Connecting newly generated knowledge to previous knowledge or concepts, or using models or conclusions to explain other situations or events to create more comprehensive knowledge. The teacher must use questions to encourage students to understand the process of performing activities according to the selected method.

Evaluation: Assessing learning using a bell ringer exam that asks students, "What knowledge do you have?" and "How much do you know?". This stage leads to the application of knowledge to develop students' fluent thinking.

The scope of content is Science and Technology subjects, Unit 3: Genetics, comprising ten plans over 15 periods:

Structures associated with heredity (2 hours).

Genetic characterisation units (1 hour).

Allele matching (2 hours).

Genotype and phenotype ratios (1 hour).

Chromosomes in human body cells (2 hours).

Differentiation of cell division of organisms (1 hour).

Changes resulting in hereditary diseases (2 hours).

Chances of developing genetic diseases (2 hours).

Benefits and effects of transgenic organisms (1 hour).

Student genetic ethics (1 hour).

The suitability values of the above ten learning management plans achieved average suitability values of 4.99, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00, and 5.00, respectively. The appropriateness of the plans is at the level of being very satisfied with each plan.

The contents of the Science and Technology course on Genetics for Year 9 students are tested using a bell ringer exam. There was a total of stations, as shown in Table 1.

Table 1. The contents of the science and technology course on genetics for year 9 students.

Station	Number (Item)
1. The relationship between genes, deoxyribonucleic acid (DNA), and chromosomes.	4
2. The unit that determines genetic traits with environmental characteristics.	4
3. Inheritance from hybridization considers a single trait in which the dominant allele completely dominates the recessive allele.	4
4. Genotype and phenotype	4
5. Chromosomes of male and female humans	4
6. Mitosis and meiosis cell division	4
7. Genetic disease	4
8. Genetic and phenotypic diagrams of the offspring	4
9. Benefits from genetically modified organisms and their potential impact on humans and the environment	4
10. Effects of genetically modified organisms on humans and the environment	4
Total	40

2. Fluency thinking test: A total of 40 items were assessed by nine experts using the Index of Item-Objective Congruence (IOC), yielding a value of 1.00. The test was then tried out with non-targeted students to determine its difficulty and discrimination. Statistical analysis revealed a difficulty value (P) of 0.31 and a discrimination value (r) of 0.11.

3. Interview form: The form consists of six items, which were evaluated by nine experts using the IOC method. The IOC value, calculated using a statistical program, was 1.00.

4. Satisfaction questionnaire: This instrument was also evaluated by nine experts using the IOC method. The resulting IOC value, calculated using a statistical program, was 1.00.

3.3. Analyzing Data

The appropriateness of the learning management plan was determined according to Likert (1979) using five criteria:

4.50-5.00: Very satisfied.

3.50-4.49: Satisfied.

2.50-3.49: Neutral.

1.50-2.49: Dissatisfied.

1.00-1.49: Very dissatisfied.

The interpretive criterion defines the interval as 0.50.

The 40-item fluency thinking test was interpreted using rubric scoring divided into four issues:

Issue 1: Wording fluency.

3 points: Students can quickly name, describe appearance, size, number, and components of a given thing within the allotted time, covering the content entirely.

2 points: Students can quickly name, describe appearance, size, number, and components of a given thing within the allotted time, covering most or nearly all of the content.

1 point: Students cannot quickly name, describe appearance, size, number, and components of a given thing within the allotted time.

Issue 2: The idea of finding relationships.

3 points: Students can observe, compare similarities or differences, link two or more things, or compose identical or amenable wording for three or more cases within the allotted time.

2 points: Students can observe, compare similarities or differences, link two or more things, or compose identical or amenable wording for 1-2 cases within the allotted time.

1 point: Students cannot observe, compare similarities or differences, link two or more things, or compose identical or amenable wording within the allotted time.

Issue 3: Expressive thinking.

3 points: Students can quickly and correctly form sentences within the allotted time.

2 points: Students can form sentences within the allotted time, with minor errors or word swaps.

1 point: Students cannot form sentences within the allotted time.

Issue 4: Applied fluency thinking.

3 points: Students can provide more than three examples of real-life applications or benefits of a given thing within the allotted time.

2 points: Students can provide 1-2 examples of real-life applications or benefits of a given thing within the allotted time.

1 point: Students cannot provide examples of real-life applications or benefits of a given thing within the allotted time.

The quality level of fluency thinking score:

32-40: Passing the assessment criteria (80% fluency thinking).

0-31: Not passing the assessment criteria.

Data analysis from interviews involved reading the learning management interview form, classifying the data, and summarizing the findings in an essay format.

The interpretation of the satisfaction questionnaire results used Likert (1979) five-level rating scale, with interpretive criteria defining intervals of 0.50:

4.50-5.00: Strongly agree.

3.50-4.49: Agree.

2.50-3.49: Neutral.

1.50-2.49: Disagree.

1.00-1.49: Strongly disagree.

4. RESULTS

This section presents the findings on developing fluent thinking in Science and Technology, specifically in Genetics, for Year 9 students. The study employed a bell ringer exam in combination with inquiry-based learning. The results are presented according to the research objectives:

4.1. Research Results on the Development of Fluent Thinking in the Science and Technology Course on Genetics for Year 9 Students

The study aimed to use the bell ringer exam in conjunction with inquiry-based learning to achieve an 80% pass rate. The results are as follows:

Table 2. Fluency thinking scores of 20 Year 9 students in the first and second spirals. The maximum score was 40 points.

Student's no.	1st operation cycle		2nd operation cycle		Score difference
	Score (40 points)	Percent	Score (40 points)	Percent	
1	33.00	82.50	36.00	90.00	3.00
2	34.00	85.00	36.00	90.00	2.00
3	36.00	90.00	37.00	92.50	1.00
4	36.00	90.00	38.00	95.00	2.00
5	35.00	87.50	38.00	95.00	3.00
6	29.00*	72.50	35.00	87.50	6.00
7	35.00	87.50	36.00	90.00	1.00
8	36.00	90.00	38.00	95.00	2.00
9	35.00	87.50	37.00	92.50	2.00
10	36.00	90.00	37.00	92.50	1.00
11	35.00	87.50	37.00	92.50	2.00
12	34.00	85.00	36.00	90.00	2.00
13	34.00	85.00	38.00	95.00	4.00
14	30.00*	75.00	36.00	90.00	6.00
15	35.00	87.50	37.00	92.50	2.00
16	29.00*	72.50	36.00	90.00	7.00
17	33.00	82.50	37.00	92.50	4.00
18	35.00	87.50	37.00	92.50	2.00
19	36.00	90.00	37.00	92.50	1.00
20	35.00	87.50	38.00	95.00	3.00
Average	34.05	85.13	36.85	92.13	2.80
SD	2.18	2.59	0.85	2.19	1.72

Note: * Students who do not pass the 80% requirement.

Based on Table 2, in the first spiral, all students who learned using a bell ringer exam combined with inquiry-based learning obtained an average score of 34.05 (SD = 2.18), which equates to 85.13 percent. In this spiral, 17 students passed the fluent-thinking assessment, while 3 students failed to meet the threshold (scoring lower than 80 percent on the fluency-thinking test). In the second spiral, students had an average fluency score of 36.85 (SD = 0.85), which equates to 92.13 percent. All students passed the fluent-thinking assessment requirement in this spiral.

Table 3. Students' satisfaction after experiencing the bell ringer exam in combination with inquiry-based learning at the end of the second spiral.

List	Mean	SD	Interpretation
1. Students have the freedom to study, research, and exchange ideas.	4.60	0.58	Strongly satisfied
2. Students have the opportunity to practice.	4.80	0.40	Strongly satisfied
3. Encourage students to learn from actual problem situations.	4.55	0.50	Strongly satisfied
4. Encourage students to practice rational thinking.	4.90	0.30	Strongly satisfied
5. Encourage students to practice working to exchange knowledge and opinions during their studies.	4.70	0.56	Strongly satisfied
6. It allows students to learn from various sources and communicate better.	4.75	0.43	Strongly satisfied
7. It helps students to work systematically according to the workflow.	4.50	0.59	Strongly satisfied
8. It helps students to think more fluently.	4.68	0.47	Strongly satisfied
9. It allows students to apply the thought processes they have practiced daily.	4.55	0.67	Strongly satisfied
Average	4.67	0.50	Strongly satisfied

4.2. Satisfaction Study of Year 9 Students with a Bell Ringer Exam in Combination with Inquiry-Based Learning

The overall average satisfaction of Year 9 students was 4.67, with a standard deviation of 0.50, representing 93.40 percent. This result can be interpreted as students being strongly satisfied with the bell ringer exam in combination with inquiry-based learning management. Notably, the item "Encouraging students to practice rational thinking" received the highest rating compared to other items in the list (Table 3).

5. DISCUSSION

The following objective discussion is based on the results of a study on the development of fluent thinking in Year 9 students studying science and technology in genetics using a bell ringer exam and inquiry-based learning.

The factors affecting the practicing of thinking are time and enjoyment. Simultaneously, pursuing self-knowledge results in knowledge creation, enabling learners to meet the evaluation requirements. Research has shown that inquiry-based learning enhances students' engagement and critical thinking skills by allowing them to explore and investigate scientific concepts actively (Athuman, 2017; Tan, Yangco, & Que, 2020).

Additionally, thinking leads to the development of a body of knowledge or information for decision-making about oneself and society in an acceptable manner and being able to overcome challenges. Studies indicate that students taught through inquiry-based methods perform better in science process skills and retain more complex scientific concepts over time compared to those taught through traditional methods (Deep, Murthy, & Bhat, 2020; Todd & Romine, 2018).

The results in the first phase of the development of fluent thinking in science and technology courses on the genetics of Year 9 students with the bell ringer exam in conjunction with inquiry-based learning showed that three students still need to pass the requirement. The interview results revealed that those three students could not focus on studying, which affected their ability to engage in applied fluency thinking effectively. This is consistent with findings by Herranen and Aksela (2019) which suggest that students' engagement and focus are critical for the success of inquiry-based learning.

Results in the first spiral of the development of fluent thinking in science and technology courses on genetics of Year 9 students with the bell ringer exam in conjunction with inquiry-based learning showed that three students still failed to meet the requirement (Table 2). The interview results revealed that those three students who did not pass faced different challenges. One student could not focus on studying, struggling to identify real-life benefits and applications of the challenge in various ways within the given time, constituting a problem in applied fluency thinking. The second student's fear of seeking answers affected their ability to solve problems agilely, indicating a problem with expressive fluency thinking. This problem may be caused by a lack of expertise in executing complex higher-order thinking. As stated by the National Research Council (1996) students need to " As emphasised by the National

Research Council (1996) students need to develop a range of skills associated with scientific inquiry. These skills encompass the ability to formulate questions, plan and conduct investigations, and employ appropriate tools and techniques for data collection. Furthermore, students should cultivate critical and logical thinking abilities to understand the relationships between evidence and explanations. They should also learn to construct and analyse alternative explanations for scientific phenomena. Lastly, students need to become proficient in communicating scientific arguments effectively. By developing these comprehensive skills, students can enhance their overall capacity for scientific inquiry, enabling them to engage more deeply with scientific concepts and methodologies.". The third student was hesitant to think or respond to questions due to embarrassment and fear of giving answers that differed from others. This issue may stem from teachers' emphasis on finding a single correct answer, which can discourage diverse thinking and creativity.

These challenges align with Boonmoh (2005) study of preparatory education in the primary classroom, which found that balancing cost-effectiveness while meeting learner differences is a significant challenge in teaching and learning. The researcher used test results and interview data from students who did not pass the evaluation criteria to improve the 6-10 learning management plans for the second spiral. The improved approach in steps 1-5 includes engagement, exploration, explanation, elaboration, and evaluation, based on the work of Bybee et al. (2006); Hairida (2016) and Pursitasari, Suhardi, Putra, and Rachman (2020).

As a result of these improvements, all students passed the criteria in the second spiral (Table 1). This success can be attributed to the enhanced teaching and learning steps, which allowed students to explore knowledge using thought processes and discover answers based on constructivism theory. This approach aligns with Lawson (1995) assertion that learners can use inquiry methods to discover knowledge or meaningful learning experiences independently.

The research results revealed that Year 9 students who had studied through the bell ringer exam combined with 5E inquiry-based learning were highly satisfied with the learning management. These results reflected the activities that allow students to freely study and exchange ideas, as well as encourage learning from problem situations. This finding is consistent with Mierson and Parikh (2000) who stated that problem-based learning management emphasizes students' self-learning without stress, promoting enjoyment and idea exchange. It is also in line with Mezirow (1991) assertion that dialogue facilitates profound transformation and understanding, allowing students to see an overview based on reason and acquire knowledge from various sources in everyday life.

In conclusion, the implementation of bell ringer exams in conjunction with inquiry-based learning has shown promising results in developing fluent thinking among Year 9 science students. The improvements made between the first and second spirals demonstrate the importance of adaptive teaching strategies and the effectiveness of the 5E inquiry-based learning model.

6. RECOMMENDATIONS

Recommendations for researchers interested in developing higher-order thinking skills, especially fluency thinking, which is the essential thinking of creative thinking, the researcher has suggestions for researching as follows.

Should study and develop fluent thinking with other grade levels, such as elementary school, higher education, etc. Articulate thinking development should be investigated and compared with different teaching methods. In action research, experts may participate in the observation of learning management as a means of exchanging information in the development of learning management for the next operation cycle. The research can be conducted in more than two operational circuits. In each research cycle, three plans were used.

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