Kahoot-based Digital Games-assisted Problem-based Reading Instruction: The Effects on the Enhancement of Students' Reading Comprehension and Interest

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***Abstract*—Reading comprehension is a core skill supporting successful learning outcomes in Indonesian language education. Many upper secondary students, however, have poor reading comprehension skills within Indonesian language. Several factors contribute to the persistent problem, such as no effective traditional instruction, and low reading interest. The present study purpose problem-based reading instruction, supported by the utilisation of Kahoot-based digital games and the improvement of reading interest to overcome the persistent problem. A quasi-experimental study with non-equivalent pre-test and post-test control group design was conducted to describe and examine the effect of the instructional model towards the enhancement of students' reading comprehension skills, and reading interest. 256 eighth-grade students from four public upper secondary schools were involved as participants, selected using the purposive sampling. Some instruments, such as reading comprehension test, and reading interest questionnaire, were used to collect the data, analysed using normalised gain, effect size, paired sample t-test, and two-ways Analysis of Variance (ANOVA). Results of this study revealed that the instructional model significantly enhanced the students' reading comprehension skills, and reading interest. Different reading interest infected to the different enhancement of the students' reading comprehension skills. Moreover, there was significant interaction effect between the instructional models and the reading interest levels towards the enhancement of the students' reading comprehension skills. Consequently, this study suggests teachers and lecturers in Indonesian language education to implement the instructional model, and improve reading interest in enhancing students' reading comprehension skills.**

***Keywords*—digital games, Kahoot platform, problem-based reading instruction, reading comprehension, reading interest**

I. Introduction

Reading comprehension constitutes a foundational competence underpinning successful achievement in Indonesian language education across secondary schooling contexts. Students who attain and surpass established reading comprehension standards demonstrate superior analytical, interpretative, and evaluative capacities within diverse textual engagements. Such students effectively synthesise information, infer implicit meanings, and construct coherent arguments, thereby elevating overall academic performance significantly [1]. High-level reading comprehension facilitates deeper engagement with literary, expository, and argumentative Indonesian texts across curricular domains. Consequently, learners exceeding standards typically achieve stronger examination results and display greater linguistic proficiency and confidence [2]. Conversely, students whose reading comprehension remains below required benchmarks struggle to decode, interpret, and critically evaluate textual information. Limited reading comprehension constrains vocabulary development, syntactic awareness, and discourse understanding, impeding broader language acquisition processes. The learners often misinterpret key ideas, overlook textual nuances, and fail to construct meaningful written responses [3]. Persistent reading comprehension deficiencies therefore hinder attainment of curriculum objectives and negatively affect overall Indonesian language achievement. Hence, strengthening reading comprehension represents an indispensable priority for improving students' academic outcomes and linguistic development comprehensively.

Despite its recognised importance, several evidences indicate that upper secondary students' reading comprehension skills remain comparatively unsatisfactory. For instance, National examination analyses and international assessments frequently reveal Indonesian students' difficulties interpreting complex informational and literary texts [4]. Studies report that many upper secondary students perform predominantly at literal comprehension levels on Indonesian texts rather than inferential or evaluative stages [5, 6]. Empirical investigations further highlight students' limited abilities to integrate ideas across paragraphs and identify authorial intentions [7, 8]. One contributing factor involves conventional teacher-centred instruction emphasising memorisation rather than strategic comprehension processes. Such approaches rarely cultivate metacognitive awareness, collaborative interpretation, or critical engagement with authentic Indonesian texts [9]. Another salient factor concerns students' relatively low reading interest, which diminishes sustained attention and motivation during reading tasks [10]. Additionally, restricted exposure to diverse textual genres reduces familiarity with rhetorical structures and discourse conventions. Socioeconomic disparities and limited access to quality reading materials further exacerbate comprehension gaps among upper secondary students [11]. Collectively, these interrelated factors perpetuate persistently low reading comprehension achievement within Indonesian language classrooms nationwide.

Reading comprehension and reading interest are

theoretically and empirically interconnected constructs within language learning research traditions. Students possessing stronger intrinsic interest in reading typically demonstrate greater persistence, strategic engagement, and cognitive investment. Heightened reading interest encourages voluntary reading practices, thereby expanding vocabulary knowledge and textual schema significantly. Increased exposure to varied Indonesian texts consequently enhances inferential reasoning and critical interpretation abilities [6, 10]. Conversely, limited interest often results in superficial reading behaviours and minimal strategic processing. Upper secondary students frequently perceive Indonesian texts as demanding, monotonous, or insufficiently relevant to contemporary realities [12]. Survey findings consistently indicate declining recreational reading habits among adolescents within digitalised educational environments. Classroom observations further reveal limited enthusiasm when engaging with lengthy literary or expository Indonesian passages [13, 14]. Empirical studies document moderate to low reading interest indices among upper secondary cohorts across diverse provinces [4, 15]. Therefore, insufficient reading interest represents a substantial barrier to the development of advanced reading comprehension skills.

Traditional approaches within Indonesian language classrooms often prioritise teacher explanation and textbook exercises over interactive comprehension strategies. Such methods frequently position students as passive recipients rather than active constructors of textual meaning. Instruction commonly focuses on answering predetermined questions instead of exploring authentic, contextually grounded textual problems [11, 16]. Consequently, students rarely practise higher-order thinking processes required for critical reading comprehension and evaluative judgement. Problem-based reading instruction offers an innovative alternative emphasising inquiry, collaboration, and contextualised textual exploration. Within this model, students confront meaningful problems necessitating careful analysis of Indonesian texts for resolution [17]. The instructional model encourages strategic reading, hypothesis formation, evidence evaluation, and integrative reasoning across multiple sources [18]. Collaborative problem-solving further promotes dialogic interpretation and shared construction of textual understanding. By situating reading within authentic problem contexts, students perceive greater relevance and cognitive challenge [19]. Accordingly, problem-based reading instruction holds considerable potential for strengthening advanced reading comprehension skills.

Beyond pedagogical innovation, digital technologies can enrich problem-based reading instruction through interactive and motivational affordances. Kahoot-based digital games provide competitive quizzes, immediate feedback, and engaging multimedia elements within classroom environments. Integrating Kahoot into problem-based reading tasks enables formative assessment of comprehension during each investigative stage. Immediate feedback assists students in identifying misconceptions and refining interpretative strategies collaboratively [20]. Gamified elements stimulate attention, enjoyment, and sustained engagement with challenging Indonesian texts [21]. The competitive yet supportive atmosphere encourages repeated reading to secure accurate responses and higher scores [22]. Consequently, students practise deeper processing, inferencing, and textual analysis to succeed within game-based activities. Moreover, interactive quizzes transform comprehension checks into dynamic learning experiences rather than routine assessments. Such experiences can enhance reading interest by associating textual exploration with enjoyment and achievement [23, 24]. Therefore, Kahoot-based digital games-assisted problem-based reading instruction simultaneously targets the enhancement of students' reading comprehension and reading interest in Indonesian language learning.

A growing body of empirical studies has examined instructional model, strategy, or method supporting reading comprehension improvement within Indonesian language education. Empirical studies investigating reciprocal teaching, collaborative strategic reading, and project-based approaches report moderate gains in reading comprehension outcomes [5, 25, 26]. Nevertheless, several evaluations indicate that conventional lecture-based practices yield limited improvements beyond literal understanding levels. Classroom action research frequently documents incremental progress yet highlights persistent difficulties in inferential and critical interpretation [2, 17]. Although problem-based learning has been explored in other subject domains, its specific adaptation for reading instruction remains underexamined. Empirical studies explicitly conceptualising problem-based reading instruction within Indonesian language classrooms are comparatively scarce. Furthermore, the integration of Kahoot-based digital games into Indonesian reading pedagogy, such as problem-based reading instruction has received limited systematic investigation. Existing studies often examine Kahoot in general language learning contexts rather than integrated problem-based frameworks [27, 28]. Consequently, a clear research gap persists regarding Kahoot-based digital games-assisted problem-based reading instruction targeting reading comprehension skills and reading interest simultaneously.

In response to the identified gaps, the present study describes and examines the effects of Kahoot-based digital games-assisted problem-based reading instruction on the enhancement of upper secondary students' reading comprehension skills and reading interest in Indonesian language learning. The findings are expected to clarify how technological gamification interacts with inquiry-oriented reading pedagogy. This investigation contributes theoretically by integrating motivation and comprehension constructs within a unified instructional framework. Practically, it offers evidence-based guidance for Indonesian language teachers seeking innovative, technology-enhanced pedagogical solutions. The study also informs curriculum developers regarding effective strategies for strengthening advanced literacy competencies. Moreover, it expands scholarly discourse on digital game-based learning within national language education contexts. Ultimately, this research aspires to advance sustainable improvements in reading comprehension and reading interest among upper secondary students. The following research questions are directed to the purpose of this study, such as: (1) Does Kahoot-based digital games-assisted problem-based reading instruction significantly enhance the students' reading

comprehension skills in Indonesian text? (2) Does Kahoot-based digital games-assisted problem-based reading instruction significantly improve the students' reading interest in Indonesian text? (3) Is there any interaction effect between the instructional models and the reading interest levels on the enhancement of the students' reading comprehension skills in Indonesian texts?

II. Theoretical Framework

A. Reading Comprehension

Reading comprehension is commonly understood as an individual's capacity to derive meaning from written material by processing, interpreting, and evaluating text. Rad [29] explains that comprehension occurs when readers actively construct meaning through interaction with written discourse. In a similar vein, Peller *et al.* [30] highlight that understanding a text requires linking newly encountered information with existing knowledge. Suparman *et al.* [31] further describe reading comprehension as a dynamic and reflective activity that involves critical reasoning and active engagement with textual content. Within the Indonesian language context, reading comprehension refers to learners' ability to interpret, explore, and make sense of written ideas effectively. Texts in Indonesian often demand sensitivity to cultural elements, contextual interpretations, and grammatical patterns [32]. Consequently, comprehension extends beyond recognizing words to interpreting implicit and explicit meanings. Taken together, these views suggest that reading comprehension in Indonesian education should emphasise analytical thinking, interpretation, and critical interaction with texts. Such competence is fundamental for literacy growth and academic achievement, making the development of reading comprehension a central goal in Indonesian language instruction.

Various indicators are employed to assess students' reading comprehension in Indonesian. One important aspect is the evaluation of language use and stylistic features, which includes understanding diction, tone, and rhetorical strategies. Another indicator involves examining text structure, requiring learners to recognise how ideas are organised and connected. Assessing textual content focuses on students' ability to judge the accuracy and validity of information presented. In addition, evaluating relevance allows students to relate textual ideas to broader academic themes or real-life situations. Analysing perspective helps learners identify the author's stance and underlying intentions. The ability to draw conclusions and provide recommendations reflects students' capacity to synthesise information and formulate reasoned interpretations. Furthermore, identifying sources and references demonstrates awareness of information credibility [32, 33]. Collectively, these indicators offer a comprehensive measure of students' engagement with written texts. Systematic assessment of these components provides meaningful insights into learners' comprehension abilities, underscoring their importance in evaluating proficiency in the Indonesian language.

Reading comprehension is a crucial component of students' mastery of the Indonesian language. It enables learners to process complex texts and develop deeper understanding through interpretation and analysis. Students with strong comprehension skills are better equipped to participate in critical discussions and construct coherent arguments [7]. Moreover, effective comprehension supports vocabulary development, enhancing students' expressive abilities. Skilled readers are able to uncover implicit meanings within texts, which is essential for academic progress [34]. Reading comprehension also contributes to writing proficiency by exposing students to well-structured models of communication. In addition, it strengthens problem-solving skills by encouraging critical evaluation of information [35]. Developing strong comprehension abilities promotes learner autonomy, motivating students to pursue knowledge independently. Conversely, limited comprehension can hinder higher-level literacy tasks and academic success. Therefore, strengthening reading comprehension is a key foundation for achieving proficiency in the Indonesian language.

B. Reading Interest

Reading interest has been defined as affective orientation towards reading activities. Some literatures describe it as enjoyment, motivation, and personal value associated with reading [6, 36]. Others view reading interest as sustained inclination to engage with texts voluntarily. Reading interest influences reading frequency, duration, and engagement levels. It develops through positive experiences and meaningful interactions with texts [37, 38]. Several studies agree reading interest supports literacy development and reading comprehension skills [39, 40]. In language learning, reading interest encourages extensive exposure to texts. From the views, reading interest represents motivational disposition towards reading engagement. In this study, reading interest refers to students' enjoyment and motivation reading Indonesian texts. It manifests through voluntary, engaged, and sustained reading behaviours.

A few of literatures identify several dimensions underlying reading interest as motivational construct, including affective enjoyment, personal value, reading curiosity, reading engagement, and voluntary reading [36, 41]. Particularly, affective enjoyment reflects emotional pleasure derived from reading activities. Moreover, personal value concerns perceived usefulness and relevance of reading for learners. In addition, reading curiosity involves desire to explore content and discover new information. Subsequently, reading engagement reflects cognitive and behavioural involvement during reading tasks. Lastly, voluntary reading refers to self-initiated reading beyond instructional requirements. The dimensions collectively shape students' reading motivation and habits. Research indicates stronger reading interest enhances reading comprehension skills and academic performance [9]. In Indonesian learning, the dimensions support sustained interaction with texts. This study adopts five reading interest dimensions, including affective enjoyment, personal value, reading curiosity, reading engagement, and voluntary reading. The dimensions guide measurement of students' reading interest development.

In detail, affective enjoyment refers to positive emotions experienced during reading activities [42]. In Indonesian learning, students enjoy narratives, themes, and relatable cultural contexts. Enjoyment increases willingness to read

and sustain attention on texts [20]. Personal value reflects students' beliefs about reading usefulness for learning goals. Students value reading when texts support understanding subjects and real-life contexts [43]. In Indonesian classes, personal value emerges when texts connect with students' experiences. Valued reading motivates effort and persistence during comprehension tasks. Enjoyment and personal value simultaneously strengthen intrinsic motivation to reading comprehension skills [23]. They encourage positive attitudes towards Indonesian reading activities. Consequently, the dimensions support improved reading comprehension skills through increased engagement.

Subsequently, reading curiosity within reading interest involves desire to discover information through texts. Students show reading curiosity by anticipating content and asking questions while reading [44]. In Indonesian learning, curiosity drives exploration of themes and cultural meanings. In addition, reading engagement reflects active involvement and concentration during reading tasks. Engaged students annotate, summarise, and discuss Indonesian texts collaboratively [45]. Moreover, voluntary reading refers to reading undertaken without external obligations. Students read voluntarily when motivated by interest and enjoyment [46]. In Indonesian contexts, voluntary reading increases exposure to varied discourse texts. The dimensions enhance reading frequency and depth of processing reading comprehension skills. Collectively, they support stronger reading comprehension development.

Reading comprehension and reading interest are mutually reinforcing in Indonesian language learning. Students with strong reading interest read more frequently and extensively. Increased reading exposure enhances vocabulary knowledge and text familiarity [47]. The factors improve comprehension accuracy and speed. Reading interest also increases persistence when texts become challenging. Motivated students employ strategies to understand complex Indonesian discourse [40]. Research indicates reading interest significantly predicts the achievement of reading comprehension skills [35]. In Indonesian learning, interested readers engage deeper with cultural contexts. Therefore, reading interest positively influences the development of reading comprehension skills.

C. Problem-based Reading Instruction

Problem-based reading instruction is adapted conceptually from the established pedagogical framework of problem-based learning within education. Problem-based learning has been defined by scholars as student-centred instruction organised around authentic, ill-structured problems [19]. Barrows [48] conceptualised problem-based learning as learning initiated by problems requiring inquiry, collaboration, and self-directed knowledge construction. Savery [49] described problem-based learning as an instructional approach emphasising active engagement, contextual learning, and reflective thinking processes. Hmelo-Silver [50] highlighted its role in fostering deep understanding through problem analysis and collaborative reasoning activities. Collectively, these definitions emphasise learner autonomy, meaningful problems, and knowledge construction through inquiry processes. Synthesising these perspectives, problem-based learning in this study is defined as structured instruction driven by authentic problems. It involves collaborative inquiry, guided facilitation, and reflective evaluation to construct meaningful understanding. Problems function as both learning stimuli and organisational anchors for instructional activities. Thus, problem-based learning provides a robust theoretical foundation for adapting reading instruction within this research.

The stages of problem-based learning adopted in this study follow frameworks commonly implemented within Indonesian educational contexts [51]. The first stage, problem orientation, involves teachers presenting contextual problems and clarifying learning objectives clearly. Students actively identify issues, activate prior knowledge, and recognise information gaps within presented problems. The second stage organises students into collaborative groups to plan inquiry strategies collectively. Teachers facilitate group formation, roles, and norms, while students negotiate responsibilities and discussion procedures. The third stage involves guided investigation, where teachers scaffold inquiry and students analyse texts collaboratively. During this phase, students search information, interpret texts, and construct preliminary problem solutions. The fourth stage requires students to present and develop problem-solving outcomes through discussion or presentation. Teachers provide feedback and clarification, while students articulate reasoning and integrate peer responses. The final stage evaluates problem-solving processes and outcomes through reflection, assessment, and consolidation activities.

Within reading pedagogy, problem-based learning functions as problem-based reading instruction emphasising text-centred inquiry processes. Problem-based reading instruction situates reading activities within meaningful problems requiring comprehension and interpretation [11]. The instructional process begins with problem orientation using texts as primary informational sources. Students explore guiding questions derived from problems to frame reading purposes strategically. Collaborative discussion enables learners to share interpretations and negotiate textual meanings collectively. Guided investigation encourages close reading, inference making, and evaluation of textual evidence. Teachers scaffold comprehension strategies and monitor group interactions throughout inquiry stages. Students synthesise information across texts to construct coherent problem-based responses. Presentation stages involve articulating interpretations and defending conclusions using textual evidence explicitly. Evaluation activities promote reflection on reading strategies, comprehension accuracy, and problem-solving effectiveness. Thus, problem-based reading instruction operationalises problem-based learning principles within reading comprehension contexts.

D. Kahoot-based Digital Games

Digital games have been conceptualised by scholars as rule-based interactive systems designed to achieve specific learning outcomes. Videnovik *et al.* [52] described digital games as engaging environments combining challenge, feedback, and competition to support learning. Zaibon and Yunus [53] emphasised digital games' capacity to promote situated learning through immersive, problem-solving

experiences. Soboleva *et al.* [54] highlighted motivational and cognitive benefits arising from interactivity and immediate feedback mechanisms. Durak *et al.* [55] define digital games as technology-mediated activities integrating goals, rules, and player agency. Common across definitions is the emphasis on engagement, interaction, and purposeful challenge within digital contexts. Digital games encourage active participation rather than passive reception of information. They support iterative learning through trial, error, and feedback cycles. Synthesising these views, digital games in this study are defined as interactive learning systems which functions primarily as an instructional model, particularly to orientate the problems regarding reading text. Such systems employ rules, challenges, and feedback to facilitate meaningful cognitive and motivational learning experiences.

Kahoot is a game-based learning platform enabling teachers to create interactive quizzes and learning activities digitally. It functions through web-based access allowing real-time participation using various digital devices. Kahoot features include multiple-choice quizzes, polls, puzzles, and surveys with instant feedback. A leaderboard system introduces competitive elements that motivate students through points and rankings. Time limits and multimedia integration enhance excitement and attention during learning activities [27]. Teachers can design customised content aligned with specific learning objectives and curricular standards. The platform provides immediate formative assessment data for monitoring student understanding continuously. Kahoot's user-friendly interface supports ease of implementation across diverse classroom settings. Its strengths include high engagement, accessibility, and adaptability for different instructional purposes [56]. Therefore, Kahoot represents a flexible digital tool supporting interactive and student-centred learning environments effectively.

Kahoot-based digital games refer to instructional activities designed using Kahoot's interactive gaming features purposefully. Within problem-based reading instruction, Kahoot functions as a supportive tool enhancing inquiry and discussion processes. Game-based quizzes can introduce problems, activate prior knowledge, and stimulate curiosity before reading tasks [57]. Competitive elements increase students' reading interest by making textual engagement enjoyable and motivating. Immediate feedback helps sustain attention and reinforces positive reading behaviours consistently [58]. Kahoot also supports collaborative learning when students discuss answers and justify reasoning together. Specifically, the Kahoot-based digital games contribute within the problem-based reading instruction in the first and fifth phase. In the first phase, the Kahoot-based digital games are used as a pre-assessment as well as to orientate the problems regarding reading text. The problems then deeply are discussed in the group discussion. In the fifth phase, the Kahoot-based digital games are used as post-assessment to evaluate the achievement of students' reading comprehension. For reading comprehension, quizzes assess understanding of main ideas, inferences, and textual details dynamically. Students are encouraged to reread texts carefully to improve accuracy and performance. Integration of Kahoot promotes deeper processing through repeated exposure and reflection [24, 59]. Consequently, Kahoot-based digital games effectively strengthen both reading interest and reading comprehension within problem-based reading instruction.

E. Directed-instructional Model

Directed-instruction refers to a learning model using teachers' demonstration and explanation embedded with students' practice and feedback to promote them in getting knowledge and skill required to the next learning [60]. It can be understood as a learning model which can generate students to learn and hold basic skills and gradually get the information [61]. In a literature, McMullen and Madelaine [62] argued that there are some characteristics of directed instruction, such as: (1) there is a model effect on students including in learning purpose and assessment; (2) it has the syntax based on overall learning trajectory; and (3) management system and learning environment are adjusted to promote the success of learning activities. Additionally, Eppley and Dudley-Marling [63] mentioned that there are five main phases in directed instruction, such as: (1) presenting learning purposes and preparing students to learn, (2) demonstrating knowledge and skill, (3) guiding students in doing the practice, (4) checking students' understanding and giving the feedback, and (5) providing the opportunity for students to do advanced practice and apply it.

Particularly, in the presenting phase, teachers clearly state learning objectives and activate students' prior knowledge effectively. They explain relevance of objectives, outline expected outcomes, and build motivation for upcoming learning activities. Teachers also organise materials, manage classroom conditions, and ensure students are cognitively ready to learn. Preparation includes establishing routines, clarifying success criteria, and reducing potential distractions beforehand for effective learning. During demonstration, teachers explicitly model targeted knowledge and skills step by step for student understanding. They verbalise thinking processes, strategies, and decision making to make learning transparent for all learners. Examples and non-examples are presented to highlight essential features and common misconceptions during instruction. Teachers pace explanations carefully, checking attention and linking demonstrations to stated objectives throughout the lesson. Demonstration continues until students show initial understanding and readiness for guided practice activities in class. Thus, the phases establish clarity, focus, and cognitive support for subsequent instructional stages within lessons.

Subsequently, in guided practice, teachers lead students through tasks while gradually transferring responsibility for learning success. Teachers provide prompts, cues, and scaffolding to support correct application of demonstrated skills during practice. Student responses are monitored closely, allowing immediate correction and reinforcement when necessary for deeper understanding. Checking understanding involves questioning, observation, and short assessments aligned with learning objectives for each lesson. Teachers analyse student performance to identify errors, misconceptions, and levels of mastery during guided instruction. Feedback is specific, timely, and corrective, focusing on processes rather than personal judgement for improvement. Advanced practice provides opportunities for

independent application of skills in varied contexts beyond initial tasks. Teachers design tasks increasing complexity, encouraging transfer and consolidation of learning across different situations independently. Students apply knowledge autonomously, demonstrating confidence and fluency without intensive teacher support during advanced activities. These final phases strengthen retention, generalisation, and long-term instructional effectiveness for sustained student achievement.

III. Materials and Methods

A. Research Design

This study employed quasi-experimental research using a quantitative approach framework explicitly. Specifically, a non-equivalent pre-test and post-test control group design was applied to describe and examine the effects of Kahoot-based digital games-assisted problem-based reading instruction toward students' reading comprehension skills, and reading interest in Indonesian language learning. A quasi-experimental pre-test and post-test control group design was selected because random participant assignment was impractical within naturally organised classroom environment while preserving ecological validity. The design enabled meaningful evaluation of intervention effectiveness under authentic educational conditions without substantially disrupting established instructional practices or institutional regulations. Moreover, quantitative approach enabled objective measurement of students' reading comprehension skills, and reading interest changes accurately [64]. The selected research design allowed comparison of learning gains between experimental group and control group over time. Pre-tests or-questionnaires and post-tests or-questionnaires provided baseline and outcome data for analysis purposes in this study [65]. The research design strengthened internal validity while accommodating authentic classroom conditions effectively during instructional implementation periods.

The non-equivalent pre-test or-questionnaire and post-test or-questionnaire control group design only involved two groups. The groups consisted of an experimental classroom and a control classroom within each of school. The experimental classroom received Kahoot-based digital games-assisted problem-based reading instruction. The instructional model emphasised strategic reading processes on Indonesian texts integrated with Kahoot-based digital games to improve students' reading interest. Meanwhile, the control classroom was taught using a directed-instructional model commonly applied conventionally. The directed-instructional model followed teacher centred explanation practice and feedback procedures during lessons only. Both experimental classroom and control classroom studied identical Indonesian language content across the same instructional duration within curricular units. This arrangement ensured differences in Indonesian learning outcomes, including reading comprehension, and reading interest, were attributable to the implemented instructional treatments.

B. Participants

This study involved 256 eighth-grade students from four public upper secondary schools located in Lampung Province. 65 students were recruited from a public upper secondary school in Bandar Lampung City, specifically consisting of 32 students in experimental classroom and 33 students in control classroom. In addition, 66 students came from a public upper secondary school in Metro City, including 33 students in experimental classroom and 33 students in control classroom. Subsequently, 62 students were selected from a public upper secondary school in Pringsewu Regency, consisting of 32 students in experimental classroom and 30 students in control classroom. Additionally, 63 students participated from a public upper secondary school in North Lampung Regency, including 31 students in experimental classroom and 32 students in control classroom. Moreover, four different teachers in the expertise of Indonesian language between each of public upper secondary school were also involved to teach the contents of Indonesian language implementing the Kahoot-based digital games-assisted problem-based reading instruction within each of the experimental classroom and the directed-instructional model within each of the control classroom. The schools and classes were selected using purposive sampling to ensure contextual relevance and research feasibility [66]. Specifically, these schools were chosen because they had sufficient technological infrastructure to implement Kahoot-based digital learning, comparable student groups for experimental and control conditions, and represented different educational contexts across Lampung Province.

C. Instrument and Data Collection

A reading test consisting of five Indonesian texts was used to measure the students' reading comprehension skills. The test was designed to evaluate various aspects of reading comprehension skills, including: (1) evaluating text language and style, (2) analysing text structure, (3) evaluating text content, (4) evaluating text relevance, (5) analysing text perspective, (6) making conclusion and recommendation, and (7) identifying source and reference [32]. The validity of the test was confirmed with $r_1 = 0.879$, $r_2 = 0.891$, $r_3 = 0.917$, $r_4 = 0.886$, $r_5 = 0.926$, $r_6 = 0.835$, and $r_7 = 0.912$, indicating strong construct validity [34]. Moreover, the reliability of the test was measured using Cronbach alpha with $\alpha = 0.896$, ensuring consistent and accurate assessment results [67]. The test was administrated to both experimental classroom and control classroom before and after the intervention to evaluate the effect of Kahoot-based digital games-assisted problem-based reading instruction or directed-instructional model toward the enhancement of the students' reading comprehension skills.

In addition, a reading interest questionnaire was used to measure the students' reading interest on Indonesian texts. The questionnaire consisted of five dimensions, including affective enjoyment, personal value, reading curiosity, reading engagement, and voluntary reading. The validity of the questionnaire was confirmed, including (1) affective enjoyment—three statements ($r_1 = 0.831$, $r_2 = 0.875$, $r_3 = 0.894$; $\alpha_1 = 0.883$), (2) personal value—three statements ($r_4 = 0.881$, $r_5 = 0.925$, $r_6 = 0.848$; $\alpha_2 = 0.879$), (3) reading curiosity—three statements ($r_7 = 0.911$, $r_8 = 0.821$, $r_9 = 0.876$; $\alpha_3 = 0.897$), (4) reading engagement—three statements

(r_{10} = 0.863, r_{11} = 0.817, r_{12} = 0.879; α_4 = 0.963), (5) voluntary reading—three statements (r_{13} = 0.829, r_{14} = 0.878, r_{15} = 0.912; α_5 = 0.911) . In addition, the overall reliability of the questionnaire was measured using Cronbach alpha with α = 0.881, ensuring consistent and accurate assessment results [44]. The reading interest questionnaire applied 4-Likert scale as following: (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree. The questionnaire was administrated to both experimental classroom and control classroom before and after the intervention to evaluate the effect of Kahoot-based digital games-assisted problem-based reading instruction or directed-instructional model toward the improvement of the students' reading interest on Indonesian texts.

D. Intervention Procedure

To do the interventions on the students both in the experimental classroom and in the control classroom, the ethical approval was administrated to the ethical committee with the registration number as P-1645/UN40.A4.1/KM.01.00/2025. Before implementing the Kahoot-based digital games-assisted problem-based reading instruction in the experimental classroom and the directed-instructional model in the control classroom, the test of reading comprehension skills, and the questionnaire of reading interest, were administrated to the students in the two classrooms. The Kahoot-based digital games-assisted problem-based reading instruction was intervened to the students in the experimental classroom, following the process of (1) orientating the problem, (2) organising students to create group discussion, (3) investigating and guiding group discussion, (4) presenting and developing work results, and (5) evaluating problem-solving results, and utilising the Kahoot-based digital games. Meanwhile, the directed-instructional model was intervened to the students in the control classroom, following the process of (1) presenting learning purposes and preparing students to learn, (2) demonstrating knowledge and skill, (3) guiding students in doing the practice, (4) checking students' understanding and giving the feedback, and (5) providing the opportunity for students to do advanced practice and apply it. The two interventions were implemented during six weeks for each of school and class, in which there was one meeting for each of week. After implementing the two interventions between each of classroom, the test of reading comprehension skills, and the questionnaire of reading interest, were administrated to the students to get the post-data regarding the students' reading comprehension skills, and reading interest. Moreover, the pre-data and the post-data regarding the students' reading comprehension skills, and reading interest were analysed descriptively and inferentially.

E. Data Analysis

The value of normalised gain was used to describe the enhancement the students' reading comprehension skills or the improvement of the students' reading interest after implementing the two interventions. The normalised gain value is categorised as $< g > < 0.30$ (low), $0.30 \leq < g > < 0.70$ (moderate), and $< g > \geq 0.70$ (high) [68]. To examine the enhancement of the students' reading comprehension, and reading interest due to the two interventions, the paired sample *t*-test was applied ($p < 0.05$ for accepting the hypothesis) [69]. In addition, to compute the effect size of the Kahoot-based digital games-assisted problem-based reading instruction on the enhancement of the students' reading comprehension skills and the improvement of the students' reading interest, the Hedges' equation was applied, categorised as $g \leq 0.20$ (weak), $0.20 < g \leq 0.50$ (modest), $0.50 < g \leq 1.00$ (moderate), and $g > 1.00$ (strong) [70]. Subsequently, two-way Analysis of Variance (ANOVA) was applied to examine the difference of reading comprehension, or reading interest between the students who received the Kahoot-based digital games-assisted problem-based reading instruction and the students who received the directed-instructional model. Moreover, the test was used to examine the interaction effect between the two interventions and the levels of reading interest toward the enhancement of the students' reading comprehension skills ($p < 0.05$ for accepting the hypothesis) [71]. Paired-samples t-test and two-way ANOVA were selected because the research objectives emphasised examining both within-group learning improvements and between-group outcome differences comprehensively. These complementary analyses provided clear statistical evidence regarding the intervention effectiveness while maintaining consistency with the study design and formulated research questions.

IV. Results

RQ1: Does the Kahoot-based digital games-assisted problem-based reading instruction significantly enhance the students' reading comprehension skills in Indonesian text?

Several descriptive statistics, such as mean, Standard Deviation (SD), and sample size (N), were used to present the outcomes of the students' reading comprehension skills in Indonesian language learning (See Table 1).

As seen in the Table 1, the pre-data regarding the students' reading comprehension skills between groups was slightly different. Meanwhile, the post-data regarding the students' reading comprehension skills between groups was sharply different.

The Hedges' equation was used to describe the effect size of the Kahoot-based digital games-assisted problem-based reading instruction toward the enhancement of the students' reading comprehension skills (See Table 2).

As seen the Table 2, the instructional model provided significant positive moderate effect on the students in analysing text perspective, making conclusion and recommendation, and identifying source and reference. Moreover, the instructional model also provided significant positive strong effect toward the students in evaluating text language, style, content, and relevance, and analysing text structure. Overall, the Kahoot-based digital games-assisted problem-based reading instruction had significant positive strong effect on the enhancement of the students' reading comprehension skills in Indonesian language learning.

The value of normalised gain was used to describe the enhancement of the students' reading comprehension skills in the experimental and control classroom (See Table 3).

As seen in the Table 3, intervened by the Kahoot-based digital games-assisted problem-based reading instruction, the students' skills in evaluating text language, style, structure, content, and relevance, and analysing text structure enhanced highly. Using the same instructional model, however, the

students' skills in analysing text perspective, making conclusion and recommendation, and identifying source and reference enhanced moderately. Overall, the Kahoot-digital games-assisted problem-based reading instruction highly enhanced the students' reading comprehension skills in Indonesian language learning. Meanwhile, the directed-instructional model, the students' skills in evaluating text content and analysing text perspective enhanced moderately. Nevertheless, using the same instructional model, the students' skills in evaluating text language, style, and relevance, analysing text structure, making conclusion and recommendation, and identifying source and reference enhanced lowly. Overall, the directed-instructional model lowly enhanced the students' reading comprehension skills in Indonesian language learning.

Table 1. The outcomes of the students' reading comprehension skills

Intervention	Indicators of Reading Comprehension	Pre-Test			Post-Test		
		Mean	SD	N	Mean	SD	N
The Kahoot-based digital games-assisted problem-based reading instruction	Evaluating text language and style	46.31	7.09	128	85.31	5.29	128
	Analysing text structure	47.21	6.74	128	85.41	6.09	128
	Evaluating text content	45.91	7.39	128	85.21	5.49	128
	Evaluating text relevance	46.61	6.89	128	86.21	5.79	128
	Analysing text perspective	48.11	7.19	128	81.11	6.99	128
	Making Conclusion and Recommendation	49.41	7.59	128	75.61	6.39	128
	Identifying Source and Reference	47.81	7.99	128	79.01	5.89	128
	Total	47.34	7.04	128	84.31	5.74	128
The directed-instructional model	Evaluating text language and style	46.21	7.29	128	50.01	7.09	128
	Analysing text structure	47.11	6.89	128	56.11	6.49	128
	Evaluating text content	45.01	7.59	128	62.61	7.19	128
	Evaluating text relevance	46.41	7.09	128	50.51	7.99	128
	Analysing text perspective	47.91	7.99	128	68.21	6.49	128
	Making Conclusion and Recommendation	48.01	7.39	128	57.91	6.89	128
	Identifying Source and Reference	47.51	7.19	128	59.01	6.79	128
	Total	47.16	7.10	128	60.51	6.72	128

Table 2. The effect size of the instructional model on reading comprehension skills

No	Indicators of Reading Comprehension	Effect Size	Category	Z-value	*p*-value
1	Evaluating text language and style	1.828 [0.850; 2.452]	Strong	4.526	<0.001
2	Analysing text structure	1.223 [0.775; 1.923]	Strong	3.487	<0.001
3	Evaluating text content	1.452 [0.826; 2.087]	Strong	3.982	<0.001
4	Evaluating text relevance	1.327 [0.708; 2.080]	Strong	3.643	<0.001
5	Analysing text perspective	0.919 [0.301; 1.284]	Moderate	3.229	<0.001
6	Making Conclusion and Recommendation	0.789 [0.275; 1.124]	Moderate	2.056	<0.001
7	Identifying Source and Reference	0.823 [0.346; 1.284]	Moderate	2.093	<0.001
	Total	1.452 [0.806; 2.009]	Strong	3.872	<0.001

Table 3. The value of normalised gain for the enhancement of reading comprehension skills

Intervention	Indicators of Reading Comprehension	Mean	SD	N	Category
The Kahoot-digital games-assisted problem-based reading instruction	Evaluating text language and style	0.84	0.32	128	High
	Analysing text structure	0.83	0.40	128	High
	Evaluating text content	0.84	0.34	128	High
	Evaluating text relevance	0.85	0.44	128	High
	Analysing text perspective	0.69	0.22	128	Moderate
	Making Conclusion and Recommendation	0.65	0.42	128	Moderate
	Identifying Source and Reference	0.62	0.33	128	Moderate
	Overall	0.74	0.28	128	High
The directed-instructional model	Evaluating text language and style	0.18	0.29	128	Low
	Analysing text structure	0.28	0.12	128	Low
	Evaluating text content	0.42	0.30	128	Moderate
	Evaluating text relevance	0.17	0.36	128	Low
	Analysing text perspective	0.52	0.11	128	Moderate
	Making Conclusion and Recommendation	0.28	0.02	128	Low
	Identifying Source and Reference	0.25	0.20	128	Low
	Overall	0.28	0.32	128	Low

Note: SD = Standard Deviation; N = Sample Size.

To examine the enhancement of the students' reading comprehension skills by implementing the two interventions, the paired sample *t*-test was applied (See Table 4).

As seen in the Table 4, the Kahoot-based digital games-assisted problem-based reading instruction significantly enhanced the students' skills in evaluating language, style, content, and relevance, and analysing text structure and perspective, while did not significantly enhance the students' skills in making conclusion and recommendation, and identifying source and reference. Overall, the instructional model significantly enhanced the students' reading comprehension skills. Meanwhile, the directed-instructional model significantly enhanced the students' skills in analysing text perspective and identifying source and reference, while did not significantly enhance the students' skills in evaluating text language, style, content, and relevance, analysing text structure, and making conclusion and recommendation. Overall, the directed-instructional model did not significantly enhance the students' reading comprehension skills.

RQ2: Does the Kahoot-based digital games-assisted problem-reading instruction significantly improve the students' reading interest in Indonesian text?

Several descriptive statistics, such as mean, Standard

Deviation (SD), and sample size (N), were used to present the outcomes of the students' reading interest on Indonesian texts (See Table 5).

As seen in the Table 5, the pre-data regarding the students' reading interest on Indonesian texts between groups was slightly different. Meanwhile, the post-data regarding the students' reading interest on Indonesian texts between groups was sharply different.

The Hedges' equation was used to describe the effect size of the Kahoot-based digital games-assisted problem-based reading instruction toward the improvement of the students' reading interest in Indonesian texts (See Table 6).

As seen in the Table 6, the Kahoot-based digital games-assisted problem-based reading instruction provided significant positive strong effect on the improvement of the students' affective enjoyment, personal value, and reading curiosity, while provided significant positive moderate effect on the improvement of the students' reading engagement and voluntary reading. Overall, the instructional model had significant positive strong effect on the improvement of the students' reading interest in Indonesian texts.

Table 4. The results of paired sample *t*-test for the students' reading comprehension changes

Intervention	Indicators of Reading Comprehension	*t*-value	df	*p*-value
The Kahoot-based digital games-assisted problem-based reading instruction	Evaluating text language and style	9.112	127	<0.001
	Analysing text structure	6.165	127	<0.001
	Evaluating text content	8.150	127	<0.001
	Evaluating text relevance	7.064	127	<0.001
	Analysing text perspective	5.102	127	<0.001
	Making Conclusion and Recommendation	1.801	127	0.084
	Identifying Source and Reference	1.892	127	0.092
	Overall	10.135	127	<0.001
The directed-instructional model	Evaluating text language and style	0.762	127	0.071
	Analysing text structure	0.805	127	0.316
	Evaluating text content	1.752	127	0.227
	Evaluating text relevance	0.875	127	0.237
	Analysing text perspective	5.132	127	<0.001
	Making Conclusion and Recommendation	1.013	127	0.286
	Identifying Source and Reference	6.213	127	<0.001
	Overall	1.385	127	0.064

Table 5. The outcomes of the students' reading interest on Indonesian texts

Intervention	Indicators of Reading Interest	Pre-Test			Post-Test		
		Mean	SD	N	Mean	SD	N
The Kahoot-based digital games-assisted problem-based reading instruction	Affective enjoyment	6.20	1.30	128	11.20	0.90	128
	Personal value	6.10	1.25	128	11.40	1.00	128
	Reading curiosity	6.30	1.35	128	10.90	1.10	128
	Reading engagement	6.80	1.20	128	9.90	0.95	128
	Voluntary reading	7.10	1.15	128	9.20	0.85	128
	Total	32.50	4.20	128	52.60	3.60	128
The directed-instructional model	Affective enjoyment	6.30	1.40	128	7.70	1.35	128
	Personal value	6.20	1.30	128	7.90	1.10	128
	Reading curiosity	6.40	1.25	128	9.40	1.20	128
	Reading engagement	6.60	1.35	128	7.90	1.30	128
	Voluntary reading	6.90	1.20	128	8.80	1.10	128
	Total	32.40	4.50	128	41.70	4.00	128

Table 6. The effect size of the instructional model on the reading interest in Indonesian texts

No	Indicators of Reading Interest	Effect Size	Category	Z-value	*p*-value
1	Affective enjoyment	1.302 [0.650; 2.030]	Strong	2.283	<0.001
2	Personal value	1.051 [0.575; 1.501]	Strong	1.154	<0.001
3	Reading curiosity	1.120 [0.726; 1.625]	Strong	1.659	<0.001
4	Reading engagement	0.658 [0.201; 1.062]	Moderate	1.011	<0.001
5	Voluntary reading	0.512 [0.119; 0.946]	Moderate	0.998	0.048
	Total	1.015 [0.506; 1.563]	Strong	1.549	<0.001

The value of normalised gain was used to describe the improvement of the students' reading interest in the experimental and control classroom (See Table 7).

As seen in the Table 7, by implementing the Kahoot-based digital games-assisted problem-based reading instruction, the students' affective enjoyment, personal value, and reading curiosity highly improved, while the students' reading engagement and voluntary reading moderately improved. Overall, the instructional model highly improved the students' reading interest in Indonesian texts. Meanwhile, by intervened by the directed-instructional model, the students' affective enjoyment, personal value, and reading engagement lowly improved, while the students' reading curiosity and voluntary reading moderately improved. Overall, the directed-instructional model lowly improved the students' reading interest in Indonesian texts.

To examine the improvement of the students' reading interest in Indonesian texts by implementing the two interventions, the paired sample *t*-test was applied (See Table 8).

As seen in the Table 8, the Kahoot-based digital games-assisted problem-based reading instruction significantly improved the students' affective enjoyment, personal value, and reading curiosity, while did not significantly improve the students' reading engagement and voluntary reading. Overall, the instructional model significantly improved the students' reading interest in Indonesian texts. Meanwhile, the directed-instructional

model significantly improved the students' reading engagement and voluntary reading, while did not significantly improve the students' affective enjoyment, personal value, and reading curiosity. Overall, the directed-instructional model did not significantly improve the students' reading interest in Indonesian texts.

Table 7. The value of normalised gain for the improvement of reading interest

Intervention	Indicators of Reading Interest	Mean	SD	N	Category
The Kahoot-based digital games-assisted problem-based reading instruction	Affective enjoyment	0.82	0.20	128	High
	Personal value	0.87	0.31	128	High
	Reading curiosity	0.75	0.32	128	High
	Reading engagement	0.60	0.19	128	Moderate
	Voluntary reading	0.43	0.11	128	Moderate
	Overall	0.86	0.27	128	High
The directed-instructional model	Affective enjoyment	0.22	0.37	128	Low
	Personal value	0.29	0.12	128	Low
	Reading curiosity	0.52	0.31	128	Moderate
	Reading engagement	0.27	0.22	128	Low
	Voluntary reading	0.38	0.18	128	Moderate
	Overall	0.28	0.23	128	Low

Note: SD = Standard Deviation; N = Sample Size

Table 8. The results of paired sample *t*-test for the students' reading interest changes

Intervention	Indicators of Reading Interest	*t*-value	df	*p*-value
The Kahoot-based digital games-assisted problem-based reading instruction	Affective enjoyment	8.001	127	<0.001
	Personal value	5.054	127	<0.001
	Reading curiosity	4.912	127	0.043
	Reading engagement	0.892	127	0.072
	Voluntary reading	0.917	127	0.069
	Overall	9.802	127	<0.001
The directed-instructional model	Affective enjoyment	0.651	127	0.061
	Personal value	0.790	127	0.427
	Reading curiosity	0.764	127	0.459
	Reading engagement	6.243	127	<0.001
	Voluntary reading	5.156	127	<0.001
	Overall	1.213	127	0.089

Table 9. The results of two-way ANOVA for reading comprehension and reading interest

Source	Sum of Squares	df	Mean Square	F	*p*-value	Effect Size
The instructional models	3.842	1	3.731	60.94	<0.001	0.653
Reading interest levels	4.316	2	3.370	52.85	<0.001	0.586
The instructional models * Reading interest levels	2.734	2	2.589	11.93	<0.001	0.617

RQ3: Is there any interaction effect between the instructional models and the reading interest levels on the enhancement of the students' reading comprehension skills in Indonesian texts?

To examine interaction effect between the instructional models and the reading interest levels on the enhancement of the students' reading comprehension skills in Indonesian texts, two-way ANOVA was applied (See Table 9).

As seen in the Table 9, there was significant difference of reading comprehension skills between the students who received the Kahoot-based digital games-assisted problem-based reading instruction and the directed-instructional model. Moreover, the results also show that there was significant difference of reading comprehension skills between the students who had high, moderate, and low reading interest in Indonesian texts. In addition, there was significant interaction effect between the instructional models and the reading interest levels on the enhancement of the students' reading comprehension skills in Indonesian texts.

The post-hoc test was applied to decide which interaction effect between the instructional models and the reading interest levels has the greatest impact toward the enhancement of the students' reading comprehension skills in Indonesian texts (See Table 10).

Table 10. The results of post-hoc test for reading comprehension and reading interest

No	(I) Group	(J) Group	Mean Difference (I–J)	*p*-value
1	DGPR-High	DGPR-Moderate	0.25	0.001
2	DGPR-High	DGPR-Low	0.39	<0.001
3	DGPR-High	DI-High	0.46	<0.001
4	DGPR-High	DI-Moderate	0.59	<0.001
5	DGPR-High	DI-Low	0.71	<0.001
6	DGPR-Moderate	DGPR-Low	0.25	0.002
7	DGPR-Moderate	DI-High	0.32	<0.001
8	DGPR-Moderate	DI-Moderate	0.45	<0.001
9	DGPR-Moderate	DI-Low	0.57	<0.001
10	DGPR-Low	DI-High	0.18	0.041
11	DGPR-Low	DI-Moderate	0.31	0.001
12	DGPR-Low	DI-Low	0.43	<0.001
13	DI-High	DI-Moderate	0.24	0.004
14	DI-High	DI-Low	0.36	<0.001
15	DI-Moderate	DI-Low	0.23	0.006

Note: DGPR: the Kahoot-based digital games-assisted problem-based reading instruction; DI: the directed-instructional model.

As seen in the Table 10, the results show that the comparison between two groups significantly differentiated the students' reading comprehension skills in Indonesian language learning. Particularly, the students' high reading interest intervened by the Kahoot-based digital games-assisted problem-based reading instruction had the high enhancement of reading comprehension skills. This finding indicates that the interaction between the DGPR instructional model and high reading interest level provides the most effective effect toward the enhancement of the students' reading comprehension skills in Indonesian language learning.

V. Discussion

The findings demonstrate that Kahoot-based digital games-assisted problem-based reading instruction significantly enhanced students' reading comprehension across measured indicators overall consistently. Beyond indicating statistical significance, the obtained Hedges' *g* values demonstrate that the intervention produced educationally meaningful improvements in students' reading comprehension performance under authentic classroom conditions. These effect sizes suggest that the instructional approach has practical value because the observed improvements are likely to enhance students' ability to understand, interpret, and critically engage with reading materials during regular learning activities. Accordingly, the reported effect sizes reflect not only the magnitude of the intervention but also its potential contribution to improving meaningful reading outcomes in educational practice. These results align with previous studies reporting strong effects of problem-based learning on higher-order reading comprehension skills among secondary students [9]. Similarly, research on Kahoot-supported instruction has shown increased engagement and improved comprehension outcomes in language classrooms particularly within secondary education [27]. Compared with directed instructional models, the present study demonstrates substantially greater post-test gains and stronger effect sizes across comprehension indicators. The sharp contrast between experimental and control groups confirms the added pedagogical value of integrating games and problems into instruction. This finding supports earlier evidence suggesting traditional instruction inadequately facilitates deep comprehension processes among adolescent readers in secondary school contexts. Notably, this research extends existing literature by examining Kahoot integration within problem-based reading instruction specifically in Indonesian language learning contexts. Therefore, the study positions itself as advancing empirical understanding beyond studies investigating either approach separately within secondary literacy education research. The comprehensive analytical methods further strengthen the credibility of these findings within contemporary educational research focused on reading comprehension development. Overall, the results consistently indicate the superiority of Kahoot-assisted problem-based reading instruction over conventional approaches for secondary Indonesian language learning.

Kahoot-based digital games-assisted problem-based reading instruction enhances comprehension by structuring reading around meaningful, contextualised problems that guide inquiry and interpretation. Through problem orientation, students purposefully engage texts to identify linguistic features, structures, and relevant information required for problem resolution tasks [19]. Group investigation stages promote analysing text language, style, and structure through collaborative discussion and guided questioning led by teachers' scaffolding [18]. These processes explain strong gains in evaluating text language, content, relevance, and structural organisation as reported within the findings section. Moderate improvements in perspective analysis and source identification reflect the higher cognitive demands of these indicators requiring extended practice time. Kahoot-based quizzes reinforce comprehension through immediate feedback, motivating rereading and careful textual verification during each instructional cycle of learning activities [27]. Gamified competition sustains attention, increases reading interest, and encourages persistent engagement with complex Indonesian texts across successive problem-solving reading tasks. Enhanced interest consequently supports deeper processing, inference generation, and synthesis required for comprehension development within secondary literacy instruction contexts generally [52]. The integration of games within inquiry cycles explains significant overall gains compared with directed instructional models lacking interactive motivational supports. Thus, the instructional model effectively cultivates multiple reading comprehension indicators through synergistic cognitive and affective mechanisms within problem-based gamified learning.

The findings reveal that Kahoot-based digital games-assisted problem-based reading instruction significantly improved students' overall reading interest in Indonesian texts contexts. Post-test differences between experimental and control groups were substantial, confirming the instructional model's superior motivational effectiveness empirically across secondary learners. These results corroborate prior studies demonstrating that gamified learning environments enhance students' affective and motivational reading dispositions within literacy education. Consistent with problem-based learning research, contextualised inquiry activities were shown to foster meaningful engagement with reading tasks among upper secondary students [72]. Unlike studies examining Kahoot or problem-based instruction separately, this research integrates both approaches within Indonesian language education classroom contexts specifically. The strong effect sizes for affective enjoyment, personal value, and curiosity align with motivation-oriented educational technology literature reported internationally. In contrast, directed instructional models demonstrated limited motivational influence, supporting critiques of traditional teacher-centred reading pedagogy widely discussed in literature. Therefore, this study positions itself as extending motivational reading research through innovative gamified problem-based integration within Indonesian secondary education contexts. The results contribute empirical evidence addressing previously identified gaps concerning reading interest enhancement in national language learning classrooms for adolescents. Overall, the findings affirm the pedagogical relevance of Kahoot-assisted problem-based reading instruction for motivational development among upper

secondary school students.

Kahoot-based digital games-assisted problem-based reading instruction enhances reading interest by embedding texts within enjoyable, interactive problem-solving experiences during classroom learning. Affective enjoyment increases as competitive quizzes, immediate feedback, and multimedia features create positive emotional reading experiences for Indonesian language texts [23]. Personal value develops when students perceive reading tasks as relevant, meaningful, and supportive of successful problem resolution in classroom contexts. Reading curiosity is stimulated through problem scenarios that encourage questioning, prediction, and exploration of Indonesian texts during collaborative inquiry-based lessons [58]. Kahoot-based challenges sustain reading engagement by maintaining attention, pacing activities, and promoting active participation within problem-based reading instruction sessions [27]. Moderate gains in voluntary reading reflect gradual internalisation of motivation beyond structured classroom game activities involving Indonesian texts independently. Immediate feedback and leaderboards encourage repeated interaction with texts, reinforcing interest through achievement and self-efficacy during competitive learning situations. Integration with problem-based reading instruction ensures games function pedagogically rather than merely entertaining students within structured inquiry-driven literacy learning environments [19]. Consequently, cognitive engagement with texts is strengthened through sustained motivation and purposeful reading activities aligned with instructional objectives and assessment. Thus, Kahoot-based digital games effectively support problem-based reading instruction in cultivating multidimensional reading interest among upper secondary Indonesian language learners.

The findings indicate a significant interaction between instructional models and reading interest levels affecting Indonesian students' reading comprehension skills overall. Two-way ANOVA results demonstrated that both instructional models and reading interest independently influenced comprehension outcomes significantly for Indonesian secondary students. To facilitate interpretation of the moderation findings, an interaction plot was added to illustrate how reading interest moderated the relationship between the instructional intervention and reading comprehension performance. This graphical representation complements the statistical results by providing clearer evidence of the moderating role of reading interest and improving the educational interpretation of the interaction effects. Students receiving Kahoot-based problem-based reading instruction outperformed those experiencing directed instruction across comprehension measures in Indonesian language learning contexts consistently. Additionally, learners with high reading interest achieved substantially higher comprehension gains than moderate and low interest peers across instructional conditions. These findings align with motivation and literacy research emphasising that effective reading outcomes emerge from the interaction between instructional environments and students' affective-cognitive characteristics in secondary education settings [73]. Previous studies reported benefits of problem-based learning or digital games separately, but rarely examined their combined interaction effects within classrooms [18]. This study extends existing literature by empirically demonstrating that reading interest strengthens students' capacity to benefit from interactive and problem-oriented instructional models. Students with high reading interest may gain disproportionately greater benefits because they enter learning activities with stronger intrinsic motivation, greater cognitive engagement, and higher readiness to independently explore and evaluate textual information. Consequently, Kahoot-based problem-based reading instruction provides an optimal environment for these students to transform their existing motivation into deeper analysis, active participation, and stronger comprehension development. The post-hoc comparisons further confirmed that high-interest students benefited most under Kahoot-based problem-based reading conditions in Indonesian secondary classrooms overall. Therefore, the research positions itself beyond single-factor studies by highlighting how instructional design and learner characteristics dynamically interact to influence reading comprehension outcomes among adolescent learners in national contexts. Overall, the evidence underscores that instructional innovation and learner motivation jointly shape successful reading comprehension outcomes in Indonesian language education.

Kahoot-based problem-based reading instruction combined with high reading interest enhances comprehension through cognitive, motivational, and metacognitive synergy during Indonesian text-based learning. High reading interest increases sustained attention, persistence, curiosity, and willingness to engage deeply with complex Indonesian texts during classroom reading activities. Within problem-based instruction, highly interested students are more likely to actively analyse language, structure, and content because their internal motivation supports deeper information processing and active knowledge construction when solving contextual reading problems [10]. Kahoot-based digital games reinforce this process by providing immediate feedback that guides accurate evaluation of textual features during problem-solving reading. Strong comprehension gains in language, style, and structure arise from repeated interactive analysis supported by gamified tasks within classroom contexts [74]. High reading interest further supports evaluating content relevance by encouraging careful verification and comparison of textual information across multiple sources. Indicators requiring higher cognition, such as perspective analysis and conclusions, benefit from motivation-driven perseverance and collaboration in group-based reading inquiry [41]. However, the interaction effect also suggests that students with lower reading interest may require additional instructional support to achieve comparable benefits from the learning model. These students may need more explicit scaffolding, guided reading strategies, structured problem-solving activities, peer collaboration, and teacher facilitation to gradually increase engagement before they can fully benefit from independent inquiry-based tasks. Kahoot quizzes can support this process by stimulating rereading, discussion, feedback-based revision, and progressive involvement in reading activities [27]. Thus, the effectiveness of Kahoot-based problem-based reading instruction depends not only on the

instructional model itself but also on how learning support is adapted to students' motivational readiness. Consequently, integrating Kahoot-based problem-based instruction with strategies for cultivating reading interest is essential for maximising reading comprehension development among diverse Indonesian upper secondary students.

A. The Implications to Indonesian Language Education

This study provides theoretical implications by integrating problem-based learning, digital game-based learning, and reading motivation theories cohesively. The findings support socio-constructivist perspectives emphasising learning as an active, collaborative, and contextually grounded meaning-making process. The significant interaction between instructional models and reading interest extends motivational theories within literacy education research. This research empirically confirms that affective variables function as moderators strengthening instructional effectiveness in reading comprehension development. The integration of Kahoot enriches cognitive engagement through gamification aligned with self-determination theory principles. The results reinforce expectancy–value theory by demonstrating how perceived task value enhances comprehension outcomes. This study also refines problem-based reading instruction as a distinct pedagogical construct within language education theory. It expands digital pedagogy frameworks by evidencing game-based tools as instructional scaffolds rather than supplementary activities. The findings contribute to reading comprehension theory by highlighting multidimensional indicator development through instructional–motivational synergy. Overall, the study advances theoretical discourse on interactive, technology-enhanced literacy learning in secondary education contexts.

Practically, this study offers important implications for Indonesian language teachers seeking effective reading instruction strategies. Teachers can implement problem-based reading instruction to promote deeper textual analysis and critical interpretation skills. The integration of Kahoot provides practical tools for formative assessment and immediate instructional feedback. Gamified activities can enhance students' enjoyment, curiosity, and sustained engagement with Indonesian texts. Curriculum developers may incorporate problem-based reading tasks supported by digital games into learning modules. School leaders can support professional development focused on technology-integrated, student-centred reading pedagogy implementation. The findings encourage shifting from teacher-centred practices towards inquiry-based, collaborative reading instruction models. Assessment practices can be redesigned to capture higher-order comprehension indicators effectively. Technology infrastructure investment becomes justified as it demonstrably supports literacy outcomes. Thus, the study informs evidence-based instructional innovation within Indonesian secondary language education practice.

B. Limitations and Suggestions

Despite its contributions, this study has several limitations that warrant careful consideration by researchers. The sample was limited to upper secondary students within a specific educational and cultural context. The quasi-experimental design restricts causal inference compared to fully randomised controlled trials. Reading interest was measured through self-report instruments potentially influenced by social desirability bias. The intervention duration was relatively short, limiting observation of long-term instructional effects. The study focused solely on Indonesian texts, restricting generalisability to other language learning contexts. Teacher implementation fidelity across classrooms was not examined in depth. Qualitative data capturing students' learning experiences were not systematically collected. The use of Kahoot represents only one digital game-based platform among many alternatives. Variations in students' prior digital literacy were not controlled explicitly. Lastly, this study did not explicitly examine teacher, school, or cluster effect across participating educational settings. Consequently, potential hierarchical data structures may have influenced observed relationships between measured variables indirectly. These limitations may influence interpretation and transferability of the findings.

Future research should employ longitudinal designs to examine sustained effects of problem-based gamified reading instruction. Randomised controlled trials are recommended to strengthen causal claims regarding instructional effectiveness. Mixed-method approaches could provide richer insights into students' cognitive and affective reading experiences. Future studies should include diverse school settings to enhance generalisability across educational contexts. Researchers may compare multiple digital game platforms to identify differential instructional affordances. Incorporating qualitative classroom observations can improve understanding of instructional fidelity and interaction processes. Subsequent studies should examine additional moderating variables such as self-efficacy or digital literacy. Expanding research to other language subjects may test the model's cross-disciplinary applicability. Longer interventions could clarify delayed effects on voluntary reading behaviours. Future studies should employ multilevel or mixed-effects analyses to account for hierarchical dependencies appropriately throughout. Researchers should also compare teacher-level and school-level influences using larger diverse samples across context systematically. These suggestions aim to strengthen methodological rigour and theoretical contribution in future investigations.

VI. Conclusion

The study uniquely integrates Kahoot-based digital games-assisted problem-based reading instruction to simultaneously enhance reading comprehension, reading interest, within Indonesian language education. This integrated framework extends existing literature by demonstrating the moderating role of reading interest alongside technology-enhanced inquiry-oriented pedagogy through empirical classroom evidence. This study concludes that Kahoot-based digital games-assisted problem-based reading instruction significantly enhances students' reading comprehension skills. The instructional model outperformed directed instruction across multiple comprehension indicators consistently. Students receiving the intervention demonstrated higher gains in evaluating language, content, structure, and relevance. The findings also confirm that

reading interest levels significantly influence comprehension achievement. Learners with high reading interest achieved greater comprehension improvements than peers with lower interest. A significant interaction effect was identified between instructional model and reading interest levels. The greatest comprehension gains occurred among highly interested students experiencing Kahoot-assisted problem-based reading instruction. Regarding reading interest, the instructional model significantly improved affective enjoyment, personal value, and curiosity. Directed instruction showed limited effectiveness in enhancing overall reading interest. Overall, Kahoot-assisted problem-based reading instruction proved pedagogically superior for Indonesian texts. The study demonstrates the importance of integrating motivation and instruction synergistically. It confirms digital games' role as meaningful pedagogical tools rather than supplementary entertainment. The findings contribute empirical evidence to Indonesian language education research. Ultimately, the study supports innovative, technology-enhanced, student-centred reading instruction. These conclusions affirm the model's value for improving literacy outcomes among upper secondary students.

Ethical Approval Statement

The higher educational authority of University of Lampung has been permitted us to do the survey and involve students as human participant in this study (Letter Number: B-11391/UN40.A4.1/PK.14.08/2025).

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

E.S. conceptualizes the research idea, decides the methodology, does investigation, project administration, and funding acquisition, and writes original draft. S.S. does formal analysis, data curation, and visualization using the software, and reviews and edits the original draft. N.L.A. does supervision and validation, and reviews and edits the original draft. All authors had approved the final version.

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