

Play-based Andragogy through 3D Jigsaw Puzzle: Enhancing Social Engagement and Collaborative Descriptive Writing

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Abstract:

Play-based approach, traditionally associated with childhood education, has shown significant potential in higher education by fostering cognitive and social engagement among emerging adults. This study examined the effectiveness of a play-based approach using 3D jigsaw puzzles in enhancing social engagement and descriptive writing skills among first-semester students in the English for Business and Professional Communication program at State Polytechnic of Sriwijaya. Using a quasi-experimental design with total sampling ($n = 43$), students were divided into an experimental group ($n = 23$) and a control group ($n = 20$). A mixed-method approach, combining pre- and post-tests, rubric-based analysis, closed-ended questionnaire, and non-participative observation, ensured comprehensive evaluation and triangulation of findings. Results revealed that the experimental group demonstrated more positive perceptions and greater improvement in descriptive writing (+13 points, 18.31%) compared to the control group (+8 points, 11.11%). Rubric analysis indicated richer details, clearer organization, and stronger sensory language, while observation highlighted higher engagement, lower stress, and improved collaboration. The study concludes that the play-based approach using 3D jigsaw puzzles effectively enhances social engagement and descriptive writing, reaffirming its pedagogical value as an innovative andragogical framework for fostering creativity, collaboration, and holistic development in higher education.

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Introduction

Human development is a lifelong process involving physical, emotional, and cognitive growth. Although play-based approaches have been traditionally associated with childhood, they also hold promise in adult education by fostering holistic development and enhancing engagement. Through the motivational power of play, this approach creates meaningful and enjoyable learning experiences, particularly in language acquisition. Play-based approach, as well as gamification strategies, serve as innovative pedagogical tools that enhance learners' motivation and engagement through interactive and meaningful activities. It not only increases active participation but also enhances motivation and student engagement through exploratory and interactive activities (Casanova-Mata, 2023; Gusta, Putri, & Permata, 2024; Orakbaeva, 2025).

Meanwhile, emerging adulthood, defined by Arnett (2002) as ages 18–25, represents a developmental stage distinct from adolescence and full adulthood. It is marked by identity exploration, advanced cognition, and greater social capacity. While adolescence centres on basic identity formation, emerging adulthood involves complex perspective-taking, collaborative problem-solving, and self-regulated learning. These features make the play-based approach particularly relevant to university students. As Levine et al. (2021) and Khairatunni'mah & Latipah (2024) observed that this stage is characterized by the formation of autonomous personal goals through a collaborative process driven by one's self-directed autonomy and the perceived autonomy support from others, aligning with the readiness for collaborative and autonomous learning that makes play-based strategies effective in sustaining motivation, personal growth, well-being, and success. Ho (2022) and Latiff et al. (2024) further emphasised that play supports skill acquisition and reduces anxiety through enjoyment, thereby fostering learner confidence, critical thinking, and problem-solving skills.

Integrating play into adult education strengthens experiential and self-directed learning, as demonstrated by Aguilar (2024), Suwastini et al. (2022), and Tam (2023). Adapted child-centred methods, when applied in adult contexts, enhance engagement and retention, particularly in language learning. Collaborative tasks such as storytelling or problem-solving provide opportunities to improve both linguistic competence and socio-emotional skills. These benefits are further strengthened as peer and teacher feedback in collaborative writing fosters learners' writing development. This approach aligns with the priorities of Indonesian higher education, which emphasise student-centred and collaborative learning to prepare graduates for real-world challenges (Abdullah et al., 2021; Fitria et al., 2023). In practice, this means play-based andragogy not only improves classroom participation but also equips students with transferable skills needed in professional and community settings. Within this framework, engagement emerges as a key factor.

Based on the EWT (Engagement with the Task) model by Philip and Duchesne, student engagement comprises four dimensions, namely cognitive, affective, behavioural, and social (Addinna et al., 2025; Bergdahl & Bond, 2022; Bond & Bergdahl, 2022). Among these, social engagement is central to this study, as it promotes collaboration, communication, and responsibility while fostering inclusive

and supportive environments. Refining strategies to enhance social engagement is therefore essential for improving learning outcomes within andragogical contexts.

Play-based approach, as well as game-based learning, has been widely acknowledged for motivating students and increasing engagement. When integrated with authentic materials, it immerses learners in meaningful communication and supports targeted language outcomes (Putri, 2025a; Shen, Lai, & Wang, 2024). The use of 3D jigsaw puzzles exemplifies this potential, offering challenges that combine creativity, tactile interaction, and collaboration. By assembling pieces into a coherent whole, students cultivate spatial ability as a cognitive skill while simultaneously enhancing their problem-solving and teamwork capabilities (Drouet et al., 2023; Fadzil & Osman, 2025; Sari & Haji, 2021). Moreover, emerging adulthood is also a period of refinement of advanced cognitive abilities, including Theory of Mind (ToM), visuospatial reasoning, and creativity, which remain strongly correlated with learning performance (Beloyianni et al., 2024; Cornaggia et al., 2024; Hosokawa & Kitagami, 2024). Mastery of spatial thinking skills, which include spatial reasoning and visualization, enhances descriptive writing by helping students generate ideas more effectively and reduce cognitive load through creative, visually based activities (Doherty et al., 2020; Jasrial et al., 2023). Writing further sharpens thinking, facilitates mastery of language skills, and enhances communicative competence (Nasution et al., 2024; Revutska, 2024). Collaborative writing (CW) complements this process by enabling learners to share responsibilities, co-construct knowledge, and benefit from peer scaffolding. In line with this notion, peer feedback serves as an essential component in the functioning of peer tutoring, as it provides novice learners with supportive interactions that help bridge gaps arising from the absence of equivalent grammatical structures in their first language (Li et al., 2025; Putri, 2025b).

Aligned with Outcome-Based Education (OBE), CW emphasizes collaboration and demonstrated competencies. Studies confirm its effectiveness in enhancing participation, accuracy, and writing quality (Masura & Widiati, 2020; Pham, 2023; Rezeki & Rahmani, 2021; Wonglakorn & Deerajviset, 2023). The Jigsaw strategy, as a cooperative method, extends these benefits by promoting interaction and teamwork. When adapted into 3D puzzles, it not only engages learners physically but also provides a foundation for descriptive narratives, prompting them to articulate details, visualize relationships, and construct coherent texts. The integration of tangible tasks with linguistic expression deepens learning by linking cognitive, affective, and social dimensions in a single activity. This playful yet structured activity reduces anxiety and encourages creative risk-taking. The study addresses three aims: (1) to explore students' perceptions of play-based learning in collaborative descriptive writing, (2) to identify patterns of social engagement in group interactions, and (3) to examine the extent to which play-based instruction enhances descriptive writing skills compared to conventional methods.

Research Method

This study employed a quantitative quasi-experimental research design using a non-equivalent control group pre-test-post-test design. The study aimed to examine the effectiveness of a play-based learning approach using 3D jigsaw puzzles in improving students' descriptive writing performance and to explore students'

perceptions of the approach. The population consisted of 43 first-semester students enrolled in the *Narrative & Descriptive Writing* course in the D4 English for Business and Professional Communication Study Program, State Polytechnic of Sriwijaya, academic year 2025/2026, described on Table 1. Total sampling was applied, involving all students in the cohort to ensure comprehensive data coverage.

Table 1. Participant Groups and Instructional Conditions

Class	Group	Number of Students	Instruction Type
1BKA	Control Group	20	Conventional instruction
1BKB	Experimental Group	23	Play-based learning with 3D jigsaw puzzles

The research was conducted in three main stages as illustrated in Figure 1 ensuring a systematic progression from baseline measurement to instructional intervention and outcome evaluation.



Figure 1. Research Procedure Flow

In the experimental group, students worked in 7 small groups (3–4 students). Each group assembled a 3D jigsaw puzzle representing a residential space, office building, historical building, or landmark within a one-hour session. After completing the puzzle, students collaboratively produced a descriptive text focusing on structure, appearance, and spatial arrangement, followed by a brief group presentation. In contrast, the control group received lecturer-centred instruction, including explanation of descriptive text features, examples, and individual writing tasks without interactive media. The stages of quasi experimental and instruments used for data collection were described on Table 2 and 3.

Table 2. Stages of the Quasi-Experimental Procedure

Stage	Description
Pre-test	Both groups wrote a descriptive text about a building or landmark to measure baseline ability
Treatment	Experimental group (collaborative writing through 3D jigsaw puzzles); Control group (conventional instruction)
Post-test	Both groups wrote a new descriptive text on a different building or landmark

Table 3. Instruments Used for Data Collection

Instrument	Purpose
Descriptive writing test (pre-test & post-test)	Measure improvement in descriptive writing performance
Descriptive writing rubric	Assess writing quality by two independent raters
Closed-ended questionnaire (25 items, 5-point Likert scale)	Examine students' perceptions of play-based learning
Non-participative observation sheet	Identify patterns of social engagement during collaborative writing

The questionnaire was content validated by two academic experts and piloted to ensure clarity and reliability. Quantitative data were then analysed using

descriptive statistics, including mean scores, percentages, and standard deviations. Students' writing performance was evaluated by comparing the mean pre-test and post-test scores of the experimental and control groups.

Formula for Mean Score:

$$\bar{X} = \frac{\sum X}{N}$$

Where:

\bar{X} = mean score

$\sum X$ = total score

N= number of students

Gain Score Formula:

$$\text{Gain} = \text{Post-test Mean} - \text{Pre-test Mean}$$

The thematic analysis procedure outlines a systematic process for analysing qualitative observation data in this study. The process begins with preliminary data review and familiarization, followed by coding and theme development to capture meaningful patterns of interaction. It concludes with the refinement of final themes representing students' social engagement and collaborative writing behaviour. The stage is described on Figure 2.

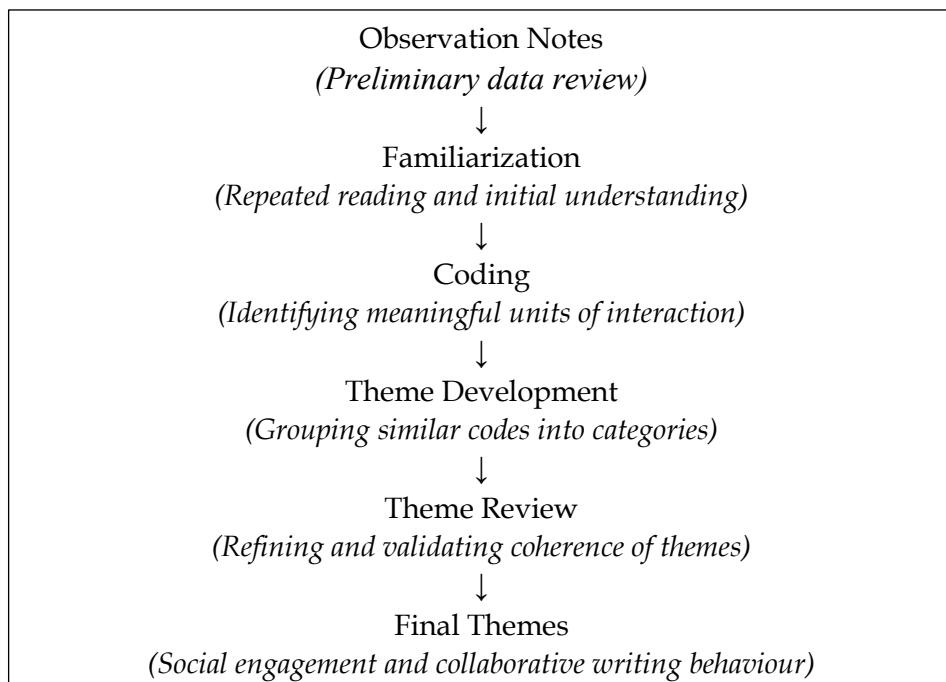


Figure 2. Thematic Analysis Procedure for Qualitative Observation Data

The study adhered to ethical standards for research involving human participants. Informed consent was obtained, participation was voluntary, and all data were anonymized to protect participants' privacy.

Results and Discussion

1. Students' Perceptions of Play-Based Learning in Collaborative Descriptive Writing

To examine how young adult students perceive the implementation of a play-based approach using 3D Jigsaw puzzles in enhancing their social engagement during collaborative descriptive writing tasks, a closed-ended questionnaire was administered. Overall, results indicated overwhelmingly positive perceptions of the play-based approach, particularly in fostering engagement, creativity, and collaborative skills in emerging adult learners.

Table 4. Young Adults' Perception of Play-based Approach for Social Engagement in Writing

Categories	Number of Students			
	SD	D	A	SA
A. Perception of the Play-Based Approach in Andragogy				
1. I feel that the play-based approach enhances my ability to retain and apply knowledge effectively in young adult learning contexts.	0 (0%)	3 (13%)	12 (52%)	8 (35%)
2. I experience heightened engagement and sustained focus throughout the learning process when play-based activities are integrated into andragogical activities.	0 (0%)	2 (9%)	10 (43%)	11 (48%)
3. I find that incorporating interactive tools not only makes the learning process enjoyable but also stimulates creative problem-solving abilities.	0 (0%)	1 (4%)	6 (26%)	16 (70%)
4. I feel that the play-based approach helps me manage stress more effectively, creating a relaxed learning environment that supports better cognitive processing.	0 (0%)	1 (4%)	17 (74%)	5 (22%)
5. I feel intrinsically motivated to participate actively and effectively when the play-based approach is applied.	0 (0%)	2 (9%)	8 (35%)	13 (57%)
B. Play-Based Approach in Andragogy Impact on Social Engagement				
1. I believe that play-based activities within an andragogical framework promote direct social interactions among adult learners.	0 (0%)	1 (4%)	11 (48%)	11 (48%)
2. I feel that play-based activities enhance my peer engagement and encourage meaningful interaction in an andragogical setting.	0 (0%)	2 (9%)	7 (30%)	14 (61%)
3. I believe that play-based activities in an andragogical context allow adult learners to take on leadership roles, promoting responsibility and influence.	0 (0%)	2 (9%)	11 (48%)	10 (43%)
4. I feel more confident communicating assertively in play-based activities, as they encourage safe and open interaction in an andragogical framework.	0 (0%)	4 (17%)	9 (39%)	10 (43%)
5. I believe that a play-based approach promotes teamwork through mutual support, shared responsibility, and problem-solving in adult learning.	0 (0%)	2 (9%)	8 (35%)	13 (57%)
C. Play-Based Approach in Andragogy Impact on Collaborative Writing				
1. I feel that the play-based approach enhances my collaboration skills, including adaptability and effective communication, which are crucial for writing tasks.	0 (0%)	2 (9%)	12 (52%)	9 (39%)

Categories	Number of Students			
	SD	D	A	SA
2. I find that play-based approach spark creativity and help the group brainstorm diverse ideas for collaborative writing.	0 (0%)	2 (9%)	8 (35%)	13 (57%)
3. I believe that play-based methods make collaborative writing more engaging and strengthen group cohesion, leading to a productive process.	0 (0%)	2 (9%)	14 (61%)	7 (30%)
4. I feel that the play-based approach improves role allocation, time management, and task coordination, ensuring meaningful contributions to the writing project.	0 (0%)	1 (4%)	12 (52%)	10 (43%)
5. I find that the play-based approach encourages self-reflection and group evaluation, helping us refine our collaborative writing efforts.	0 (0%)	2 (9%)	9 (39%)	12 (52%)
D. 3D Jigsaw Puzzle Impact on Descriptive Writing Skills				
1. I feel that utilizing 3D jigsaw puzzles enhances my ability to visualize ideas clearly while improving my concentration during descriptive writing tasks.	0 (0%)	1 (4%)	7 (30%)	15 (65%)
2. I feel that engaging with 3D jigsaw puzzles enhances my creativity and stimulates critical thinking in completing descriptive writing tasks.	0 (0%)	1 (4%)	12 (52%)	10 (43%)
3. I believe that working with 3D jigsaw puzzles improves my ability to organize content systematically while also encouraging logical flow in descriptive writing.	0 (0%)	2 (9%)	11 (48%)	10 (43%)
4. I feel that engaging with 3D jigsaw puzzles has enhanced my vocabulary and sharpened my attention to detail in descriptive writing tasks.	0 (0%)	1 (4%)	8 (35%)	14 (61%)
5. I have experienced a notable improvement and enjoyment in my descriptive writing since incorporating 3D jigsaw puzzles into the writing process.	0 (0%)	2 (9%)	9 (39%)	12 (52%)
E. Challenges and Limitations				
1. I feel that maintaining focus on the learning objectives can be challenging when participating in play-based activities in young adult settings.	7 (30%)	10 (43%)	6 (26%)	0 (0%)
2. I feel that the 3D jigsaw puzzles occasionally divert attention from the primary learning objectives of descriptive writing, which can affect overall effectiveness.	3 (13%)	13 (57%)	7 (30%)	0 (0%)
3. I feel that the play-based approach may not be as effective in enhancing descriptive writing skills compared to more traditional methods.	9 (39%)	10 (43%)	4 (17%)	0 (0%)
4. I find that the time allocated for play-based approach in collaborative writing activities is often insufficient to fully achieve meaningful learning outcomes.	7 (30%)	12 (52%)	4 (17%)	0 (0%)
5. I encounter difficulties in striking a balance between enjoyment and productivity during play-based approach activities in young adult settings.	5 (22%)	11 (48%)	6 (26%)	1 (4%)

Table 4 provides a detailed summary of the findings obtained from the responses to the closed-ended questionnaire discussed earlier.

a. Perception of the Play-Based Approach in Andragogy

Participants' responses indicate that the play-based approach effectively enhances knowledge retention, engagement, creativity, and intrinsic motivation within young adult learning contexts. Regarding knowledge retention and application, 52% of participants agreed and 35% strongly agreed, suggesting that the majority perceived a positive impact on their ability to retain and apply concepts. This aligns with [Al-Karadsheh et al. \(2025\)](#) and [Marceiras et al. \(2025\)](#), who argued that interactive learning supports short-term retention, while dissenting responses may reflect individual preferences for more structured or conventional methods. Such variations underscore the need to consider learner diversity when implementing play-based strategies in andragogical contexts. Engagement and sustained attention were also highly endorsed, with 43% agreeing and 48% strongly agreeing, highlighting that play-based activities can effectively capture and maintain learner focus. These findings are consistent with [Costantini et al., \(2025\)](#) and [Por et al. \(2025\)](#), who emphasised that playful learning strategies can enhance motivation and attentional engagement by fostering active learning, which is characterised by learners' intrinsic motivation, intentional engagement, and a focus on developing mastery experiences. Creativity and enjoyment were particularly notable, with 70% strongly agreeing and 26% agreeing that play-based activities stimulate creative problem-solving and make the learning process enjoyable.

This corroborates [Blanche et al. \(2024\)](#) and [Lubbers et al. \(2023\)](#), who argued that adult play and playfulness constitute experiential modes often driven by positive emotions, humour, and engagement in relational activities, which not only support beneficial mental health outcomes but also facilitate deep engagement and foster creativity as central components of effective learning. Stress reduction and cognitive support were positively perceived, with 74% agreeing and 22% strongly agreeing that the approach promotes a relaxed learning environment conducive to better cognitive processing. This observation resonates with [Córdova et al. \(2023\)](#) and [Nguyen et al. \(2024\)](#), highlighting that emotional states play a crucial role in enhancing learning quality, as emotional instability and stress represent primary factors that can disrupt the learning process, affecting both educators and learners. Intrinsic motivation for active participation was endorsed by 57% strongly agreeing and 35% agreeing, indicating that while most participants were motivated to engage actively, individual differences such as prior experience, personality, and familiarity with collaborative tasks may influence outcomes. Overall, these findings confirm that play-based approaches enhance engagement, creativity, enjoyment, and application in adult learning contexts. They also suggest that enjoyment and emotional support are not ancillary effects but integral to cognitive performance and motivation, providing empirical support for the integration of playful strategies within andragogical frameworks.

b. Play-Based Andragogy Impact on Collaborative Writing

The play-based approach was reported to foster engagement, collaboration, creativity, and reflective practice in collaborative descriptive writing, while emphasizing the importance of instructional design to optimize learning outcomes. A majority of participants agreed that the approach enhanced their collaboration skills,

including adaptability and effective communication, with 52% agreeing and 39% strongly agreeing, while only 9% disagreed. Creativity was also positively endorsed, as 57% strongly agreed and 35% agreed that the play-based approach stimulated idea generation and group brainstorming. Similarly, participants highlighted that collaborative writing became more engaging and cohesive, with 61% agreeing and 30% strongly agreeing, although 9% disagreed. Role allocation, time management, and task coordination were also strengthened, with 52% agreeing and 43% strongly agreeing, while only 4% disagreed. Furthermore, reflective and evaluative practices were encouraged, as 52% strongly agreed and 39% agreed, compared to 9% who disagreed.

Observational data corroborated these perceptions: students actively engaged in discussing 3D puzzle components, connecting them to descriptive writing tasks, and providing peer feedback. One participant noted, "We divided roles based on puzzle sections, which made writing faster and more organized." At the same time, another reflected, "The puzzle helped us evaluate our story because each piece symbolized a part we needed to improve." Most participants highlighted how puzzle elements inspired narrative ideas and facilitated group brainstorming. For example, one participant explained, "I suggested describing the puzzle piece as a tower because it looks tall and narrow, which helped our story flow." At the same time, another noted, "I had not thought of using colours for mood, but my teammate's idea inspired me." These behaviours reflect that team challenge events provide fertile contexts for fostering social interactions, mutual interdependence, and relational bonds that support mental and physical well-being, reflecting the connection between social engagement and learning outcomes in adult contexts (Afrezah et al., 2024; Cohen et al., 2023).

Despite these positive outcomes, several challenges emerged. Maintaining focus on learning objectives was problematic for some participants, with 30% strongly disagreeing and 43% disagreeing that the play-based tasks consistently aligned with writing goals. Similarly, 57% disagreed and 30% agreed that 3D puzzles sometimes diverted attention away from writing, suggesting potential distractions. Concerns about effectiveness compared to traditional methods were also expressed, with 39% strongly disagreeing and 43% disagreeing that the play-based approach was superior, while only 17% agreed. Time allocation posed another limitation, as 52% disagreed and 30% strongly disagreed that the time provided was sufficient. Lastly, striking a balance between enjoyment and productivity remained an issue, with 48% disagreeing and 22% strongly disagreeing, although 26% agreed and 4% strongly agreed that they managed to achieve this balance. These findings indicate that while the play-based approach significantly enhanced creativity, teamwork, and accountability in collaborative writing, it also required careful scaffolding, sufficient time management, and alignment with objectives to minimize distraction and ensure productivity.

2. Patterns of Social Engagement during the 3D Jigsaw Puzzle Activity

To achieve the second aim, which was to identify patterns of social engagement emerging from students' interactions during the 3D jigsaw puzzle activity in collaborative writing, a non-participative observation was conducted. The observation, together with the questionnaire data presented in Table 1, revealed that

the play-based approach using 3D jigsaw puzzles had a positive impact on social engagement, collaboration, and descriptive writing in an andragogical context. The findings are presented in the following sections.

a. Play-Based Andragogy Impact on Social Engagement

Findings on the social dimension indicate that the play-based approach substantially enhanced interaction, peer engagement, leadership, communication confidence, and teamwork among participants. For direct social interactions, 48% agreed and 48% strongly agreed. In comparison, only 4% disagreed, suggesting that playful learning effectively fosters natural peer-to-peer communication, consistent with [Vygotsky's \(1978\)](#) view of social interaction as central to cognitive development. Peer engagement and meaningful interaction received the highest endorsement, with 61% strongly agreeing and 30% agreeing. Playful activities foster supportive and motivating peer relationships while enhancing motivation through a sense of accomplishment and active engagement in interactive and collaborative tasks ([Dean & Wenner, 2025](#); [Elsawah, 2025](#)). As one student expressed, "Working with puzzles made it easier to talk with others because we had something concrete to focus on together," highlighting how the activity reduced social barriers and encouraged active involvement. Leadership and responsibility were also widely acknowledged, with 48% agreeing and 43% strongly agreeing, though 9% disagreed, indicating that some learners required additional scaffolding to manage role ambiguity. Regarding this, [Chairinkam & Yawiloeng \(2021\)](#) and [Chun & Cennamo \(2022\)](#) argued that scaffolding effectively supports English as Foreign Language (EFL) learners in developing writing skills through peer learning, utilizing structured feedback, goal-oriented processes, and defined peer roles.

Communication confidence was positively influenced, with 43% strongly agreeing and 39% agreeing. However, 17% disagreed, highlighting both the potential of playful approaches to reduce communication anxiety and the challenges faced by less confident learners ([Gao & Zuo, 2025](#); [Harris et al., 2024](#)). One participant explained, "The puzzle made it easier for me to speak up, because we had to discuss every piece together," illustrating how the task encouraged equal participation. Finally, teamwork and collaborative problem-solving gained strong support, with 57% strongly agreeing and 35% agreeing, underlining the capacity of play-based methods to encourage mutual support, shared responsibility, and collective problem-solving, as emphasized by [Granone & Pollarolo \(2025\)](#) and [Parker et al. \(2022\)](#). Taken together, these results demonstrate that play-based strategies in adult learning contexts nurture social interaction, leadership, communication, and collaboration, while also pointing to the need for structured facilitation and scaffolding to accommodate learners with varying levels of confidence and participation.

b. Patterns of Social Engagement

The implementation of 3D jigsaw puzzles within the play-based approach revealed distinct and observable patterns of social engagement during collaborative descriptive writing tasks. Non-participative observations indicated that active contribution, peer encouragement, and role specialization were the most salient behaviours. For example, one student explained, "I helped my teammate figure out where the pieces fit, and they explained how it could fit into our story," while another

noted, "We divided roles: one person described, one drew, and one organized the pieces." These interactions demonstrate that students naturally negotiated responsibilities and shared knowledge, consistent with Tang et al. (2020) and Xu et al. (2023), who argue that collaborative problem-solving enhances critical thinking, a key 21st-century competency. Vygotsky's (1978) Social Constructivist Theory further supports that such interactions facilitate cognitive development through negotiation and co-construction of knowledge. Additionally, Guo et al. (2024), Sappaile et al. (2025), Wahyurianto & Sylvia (2024) delivered that collaborative learning improves comprehension and analytical skills. Meanwhile, peer encouragement emerged as a prominent pattern, with confident students often delegating tasks or prompting less active peers to participate, aligning with Hou et al. (2025) and Villar et al. (2025), who highlight the influence of peer support on self-regulated motivation was evident, as it significantly enhanced intrinsic and extrinsic motivation, self-efficacy, learning satisfaction, and overall engagement.

Bandura's (1977) social learning theory further explains that observational learning shapes collaborative behaviours. Moreover, role specialization also emerged, as students assumed leadership or feedback responsibilities, promoting efficiency and collective accountability. Despite generally high engagement, a few students initially displayed passive behaviour, consistent with Becker & Börnert-Ringleb (2025) and Gao & Zuo (2025), who note that academic performance at both the individual and classroom levels was associated with corresponding levels of stress and anxiety, which, along with competitive dynamics, may impede participation. However, sustained peer support gradually enabled these students to engage actively, demonstrating the dynamic nature of social engagement. This observation aligns with questionnaire data showing that 56% of participants strongly agreed and 33% agreed that intrinsic motivation and collaborative participation increased. However, adaptation to group dynamics remained a challenge, supporting the findings of Bøgelund & Nørgaard (2025) and Wu et al. (2024), who reported that high-performing study teams are distinguished by their capacity to maintain curiosity and leverage internal differences for learning while sustaining a clear educational focus. In contrast, struggling students frequently gained advantages from engaging with expert peers, although this beneficial impact was not uniformly observed across all groups.

3. Effect of Play-Based Instruction on Descriptive Writing Skills

To examine the extent to which play-based instruction using 3D jigsaw puzzles enhances descriptive writing skills compared to conventional methods, both questionnaire responses and performance-based assessments were analyzed. Results consistently showed that the play-based approach provided greater benefits than traditional instruction, particularly in visualization, creativity, and content organization. Collectively, these outcomes underscore that play-based instruction significantly outperforms conventional methods in enhancing the descriptive writing skills of emerging adult learners.

a. 3D Jigsaw Puzzle Impact on Descriptive Writing Skills

The integration of 3D jigsaw puzzles into the learning process demonstrated notable benefits for young adult learners, particularly in terms of visualization, concentration, and cognitive engagement. According to the questionnaire data, 65% of

participants strongly agreed and 30% agreed that using 3D puzzles enhanced their ability to visualize ideas and maintain focus during descriptive writing tasks. One student commented, "Seeing the puzzle in 3D made it easier to imagine the scene in my writing," illustrating the tangible, hands-on advantage of the approach. Furthermore, 43% strongly agreed and 52% agreed that the puzzles stimulated creativity and critical thinking. These findings indicate a strong perception of the cognitive benefits of puzzle activities, which aligns with research demonstrating that 3D puzzle-based activities foster cognitive abilities by enhancing spatial reasoning, fine motor skills, and higher-order strategies like hypothesis testing, thereby improving students' capacity to model complex structures and produce precise, vivid descriptive and analytical writing (Al-Ani et al., 2024; Nazilah et al., 2022; Yoshioka et al., 2025).

The combination of structured challenge and playful engagement encouraged students to experiment with ideas in a low-stakes context, promoting both divergent and methodical thinking necessary for effective collaborative and individual writing. Improvements were observed in content organization, with 48% agreeing and 43% strongly agreeing that their ability to structure ideas systematically improved, and 61% strongly agreed and 35% agreed that their vocabulary had been enhanced. Participants also reported greater enjoyment and intrinsic motivation, with 52% strongly agreeing and 39% agreeing that their descriptive writing became more engaging, which aligns with Adipat et al. (2021), Lee et al. (2025), and Zakaria & Zakaria (2025), who argue that game-based activities, potentially combined with digital tools, enhance both skill acquisition and learner intrinsic and extrinsic motivation while strengthening logical flow, conceptual structuring, and engagement in descriptive writing tasks. Although a small minority ($\approx 9\%$) expressed dissent, the overall positive feedback underscores the potential of physical 3D puzzles.

b. Pre-test and Post-test of Descriptive Writing Comparison

The findings from Table 1 reveal that young adult learners expressed predominantly positive perceptions of the play-based approach across dimensions of andragogy, social engagement, collaborative writing, and the use of 3D jigsaw puzzles. For instance, a large proportion of participants either agreed or strongly agreed that interactive tools stimulated creativity (96%, A3), that play-based methods enhanced peer engagement (91%, B2), and that 3D jigsaw puzzles supported visualization and concentration in descriptive writing (95%, D1). These responses indicate that the approach was not only perceived as engaging and enjoyable but also as conducive to fostering collaboration, problem-solving, and motivation in adult learning contexts. It aligns with Bagley et al. (2022), Costantini et al. (2025), and Heljakka (2023), who discovered that playful approaches in higher education integrate varied tools and activities that enhance imagination, innovation, and resilience through active engagement, fostering proactive learning and enriching both practical and metacognitive thinking through peer interactions. Nevertheless, the Challenges and Limitations section (Part E) highlights certain constraints. A majority of participants acknowledged difficulties in maintaining focus on learning objectives (73%, E1) and noted that limited time allocation restricted the achievement of optimal learning outcomes (82%, E4). Such responses suggest that while play-based methods are highly

valued, their effectiveness depends on careful instructional design and time management.

The results in Table 2 provide empirical support for the effectiveness of the play-based approach. At the pre-test stage, both the experimental group ($M = 71$) and the control group ($M = 72$) performed at nearly identical levels of descriptive writing proficiency, confirming baseline equivalence between the two cohorts. This comparability is crucial, as it establishes that subsequent improvements can be attributed to the intervention rather than to pre-existing differences in ability. Following the intervention, the experimental group achieved a mean post-test score of 84, reflecting a gain of 13 points (+18.31%). By contrast, the control group, taught through conventional instruction, reached a mean score of 80, with a smaller gain of 8 points (+11.11%). While both groups demonstrated progress, the magnitude of improvement was notably greater in the experimental group, suggesting that the play-based approach accelerated descriptive writing development more effectively than traditional methods. This finding aligns with evidence that the genre-based approach (Dzukhriyah & Rini, 2023), combined with game-based (Carmona et al., 2025) motivating interventions, effectively enhances students' writing skills by developing their ability to organize ideas, maintain coherence, adapt language to various contexts and audiences, and engage in the complex cognitive processes essential for writing development.

Table 5. Comparison of Pre-test and Post-test Scores

Group	Pre-test Average	Post-test Average	Gain (%)
Experimental (n=23)	71	84	+13 (18.31%)
Control (n=20)	72	80	+8 (11.11%)

When examined alongside the perception data in Table 1, this outcome becomes more compelling. The learners' reported experiences of heightened engagement (91%, A2), enhanced creativity (96%, A3), and improved collaboration (91%, C1) directly align with the experimental group's superior performance gains. In particular, the use of 3D jigsaw puzzles appeared instrumental in supporting visualisation (95%, D1) and creativity (95%, D2), which plausibly contributed to their ability to organise ideas more coherently and produce richer descriptive texts. Thus, Table 2 does not merely present score differences; it triangulates with learners' self-reported perceptions to confirm that the play-based approach is both subjectively valued and objectively effective. This dual evidence underscores its pedagogical merit in adult andragogical contexts, while also highlighting the importance of addressing limitations noted in Table 1, such as time constraints and maintaining focus on learning objectives, to maximize its instructional potential.

c. Rubric-based Analysis of Descriptive Writing Performance

The rubric-based analysis demonstrated that the experimental group achieved greater gains than the control group, with an overall improvement of +18.31% compared to +11.11% (Table 2). This gap suggests that the observed progress cannot be attributed solely to practice effects or repeated exposure, but rather to the distinct affordances of the play-based intervention. Table 3 provides crucial detail, showing that the experimental group's strongest gains occurred in sensory and atmosphere

features (+3 vs. +1) and exterior and interior details (+3 vs. +2). These aspects demand not only factual description but also the ability to evoke imagery, employ sensory language, and integrate multiple perspectives of the object described. Such qualitative improvements resonate with questionnaire findings (Table 1), where students reported that the play-based approach enhanced visualization (95%), creativity (95%), and social interaction (87%). The alignment between perception data and rubric gains underscores that increased engagement and collaborative idea generation directly supported the depth and richness of descriptive writing. A closer reading of Table 3 also reveals the pedagogical mechanisms through which play-based learning fostered improvement. For example, the gains in structural and physical features (+2 vs. +1) indicate that the puzzle activity trained students to attend systematically to size, shape, and organization, which transferred into more logically sequenced writing.

Table 6. Rubric Analysis of Descriptive Writing about A Building

Aspect	Experimental Group			Control Group			Notable Findings
	Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	
Overall Building Description	14	17	+3	14	16	+2	Experimental group gave more precise identification of the building's name, location, and function; control group mentioned only basic information.
Structural & Physical Features	13	15	+2	13	14	+1	Experimental group added more details about size, shape, and structure; control group stayed limited to general forms.
Exterior & Interior Details	14	17	+3	14	16	+2	Experimental group described both façade and interior more vividly; control group focused mainly on one side (exterior or interior only).
Sensory & Atmosphere Features	15	18	+3	15	16	+1	Experimental group incorporated sensory elements (color, light, smell, atmosphere); control group gave minimal sensory description.
Coherence & Language Quality	15	17	+2	16	17	+1	Experimental group showed better sequencing and richer vocabulary; control group improved slightly but remained repetitive.
Total Score	71	84	+13 (18.31%)	72	80	+8 (11.11%)	Both groups improved, but the experimental group demonstrated more substantial progress, particularly in descriptive richness and sensory detail.

Similarly, the improvement in coherence and language quality (+2 vs. +1) reflects not only lexical expansion but also the impact of peer scaffolding, evident in role specialization and collective drafting. The experimental group's balanced gains

across multiple categories suggest that play-based learning fostered both creativity and discipline. Students became more imaginative in describing sensory details while also organizing content into cohesive texts. In contrast, the control group, working primarily individually or with minimal interaction, produced more fragmented outputs. Facilitating student development through small-group learning is crucial (Grijpma et al., 2024). While greater social engagement enhances text complexity, coherence, and richness (Afrezah et al., 2024), students still tend to interact with familiar peers, especially friends, with more talkative or high-literacy students engaging more and gravitating toward similar peers (Lintner et al., 2024). Participant reflections corroborated these findings; one student noted, "Even though I was shy at first, listening to others helped me write a better paragraph," highlighting the role of peer interaction in fostering both creativity and confidence. Taken together, Tables 2 and 3 show that the play-based approach is practical in enriching descriptive richness and strengthening the structural integrity of writing, if facilitation adequately addresses challenges such as focus and time management identified in the questionnaire.

Conclusion

This study provides evidence that a play-based approach using 3D jigsaw puzzles can strengthen young adult learners' social engagement and collaborative descriptive writing. Beyond students' positive perceptions of communication, collaboration, creativity, and reduced stress, the quasi-experimental results confirm measurable learning benefits: the experimental group achieved significantly greater gains (+18.31%) compared to the control group (+11.11%), with powerful improvements in sensory detail, atmosphere, and interior-exterior description. Observational data further revealed that active peer support, role specialization, and shared problem-solving contributed to more cohesive group writing, while fragmented engagement constrained performance. These insights highlight the pedagogical value of integrating structured play into higher education, particularly in andragagogical settings where teamwork and motivation are essential. Nevertheless, certain limitations must be acknowledged. Time constraints, occasional distraction from writing objectives, and challenges in balancing enjoyment with productivity tempered the effectiveness of the intervention.

Additionally, while rubric-based assessments and multi-source data triangulation support the findings, the study was limited to a single cohort in one institution, which constrains generalizability. Future research should therefore expand to larger and more diverse samples, employ longitudinal designs, and further refine task scaffolding to ensure alignment with learning objectives. By addressing these gaps, subsequent studies can more rigorously determine not only the effectiveness but also the sustainability and scalability of play-based strategies in adult education.

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