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Developing Crossword Game-Based Learning Media To Improve Airline Reservation Learning Outcomes

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ABSTRACT

This study developed crossword game-based learning media for Airline Reservation instruction and evaluated its feasibility, user responses, and preliminary effectiveness among Grade XII Travel Business students at SMK Negeri 1 Singaraja. The development procedure adapted the ADDIE model through analysis, design, development, implementation, and evaluation. Product quality was examined through content-expert and media-expert reviews, followed by individual, small-group, teacher, and field trials. Learning outcomes were assessed using a one-group pretest-posttest procedure with 30 students. The content expert rated the product at 95.83% and the media expert at 91.67%, both indicating very high feasibility. Individual and small-group trials produced mean ratings of 90.74% and 90.63%, respectively; the teacher rating was 90.63%, while the field-trial response reached 90.28%. Student achievement increased from a pretest mean of 77.24 to a posttest mean of 88.48, while mastery increased from 63.33% to 100%. The original analysis also reported a statistically significant paired-samples difference ($p = .001$). These findings indicate that a curriculum-aligned crossword game can function as an engaging supplementary medium for terminology-intensive vocational content such as international city codes and aviation geography. Because the effectiveness phase used a single-group design, the gain should be interpreted as evidence of improvement after implementation rather than definitive causal superiority over other instructional media.

Keywords: ADDIE; airline reservation; crossword game; learning media; vocational education

INTRODUCTION

Vocational education is expected to connect conceptual knowledge with occupationally relevant performance. This requirement is particularly important in tourism and travel programs, where students must master specialized terminology, codes, procedural knowledge, and service-oriented competencies. Active learning and well-designed instructional media can support engagement and knowledge construction when learners must repeatedly retrieve and apply domain-specific information (Freeman et al., 2014; Prince, 2004; Chi & Wylie, 2014). Digital and game-informed learning environments may also increase participation when the mechanics are aligned with learning objectives rather than used merely as entertainment (Clark et al., 2016; Plass et al., 2015; Mayer, 2019).

In Airline Reservation instruction, students encounter International City Codes, aviation geography, freedoms of the air, airline identifiers, Official Airline Guide information, and reservation procedures. The source manuscript reports that Grade XII Travel Business students at SMK Negeri 1 Singaraja experienced difficulty with aviation terminology and code memorization, while lecture-dominated instruction and limited media variation reduced learning activity. Historical class averages were 7.58 in 2018/2019, 7.58 in 2019/2020, and 7.62 in 2020/2021, only slightly above the reported minimum standard of 7.5. These conditions motivated the development of a more interactive medium.

Crossword games are retrieval-oriented learning activities that require learners to connect clues with target concepts and terminology. Their instructional value is consistent with evidence on retrieval practice, repeated testing, feedback, and gamification: recalling information strengthens later retention, while appropriately structured game elements can improve motivation and participation (Roediger & Karpicke, 2006; Karpicke & Roediger, 2008; Dunlosky et al., 2013; Hamari et al., 2014; Sailer & Homner, 2020). In vocabulary-rich or terminology-intensive domains, crossword puzzles can therefore serve as low-cost formative learning tools when their clues are carefully mapped to curricular outcomes.

However, an educational game should be judged not only by attractiveness but also by instructional validity, usability, learner response, and evidence of learning. Research and development frameworks such as ADDIE provide a systematic sequence for needs analysis, design, development, implementation, and evaluation, while multimedia-learning research emphasizes coherence, cognitive load management, signaling, and alignment between representation and task demands (Branch, 2009; Sweller et al., 2019; Mayer, 2017; Fiorella & Mayer, 2016).

Accordingly, this study aimed to (1) develop crossword game-based Airline Reservation learning media, (2) examine content-expert, media-expert, student, and teacher responses to the developed product, and (3) evaluate changes in student learning outcomes before and after implementation. The study contributes a context-specific example of game-based instructional media development for Indonesian vocational tourism education.

LITERATURE REVIEW

Game-Based Learning, Retrieval Practice, and Crossword Activities

Game-based learning combines instructional content with rules, goals, challenge, feedback, and learner action. Meta-analytic evidence generally indicates positive effects of serious games and digital games on cognitive and motivational outcomes, although effect sizes depend on design quality, comparison conditions, duration, and learner characteristics (Wouters et al., 2013; Clark et al., 2016; Tokac et al., 2019; Bai et al., 2020). Gamification research similarly shows that points, challenges, progress cues, and competition can support motivation when they satisfy competence, autonomy, and relatedness rather than creating superficial reward dependence (Hamari et al., 2014; Sailer et al., 2017; Sailer & Homner, 2020).

Crossword activities are especially compatible with retrieval practice because learners must reconstruct target terms from semantic clues and partial letter constraints. Retrieval practice has repeatedly been shown to improve long-term retention more effectively than restudy alone (Roediger & Karpicke, 2006; Karpicke & Roediger, 2008; Rowland, 2014; Adesope et al., 2017). Feedback after retrieval further helps learners correct errors and consolidate accurate knowledge (Butler & Roediger, 2008; Hattie & Timperley, 2007). For Airline Reservation learning, these principles are relevant to the mastery of IATA-related codes, geographical names, aviation terms, and procedural concepts.

Instructional Media and Multimedia Learning

Instructional media are effective when they reduce extraneous processing and direct learner attention toward essential relationships. Cognitive load theory distinguishes intrinsic, extraneous, and germane demands, while multimedia learning emphasizes coherence, signaling, segmenting, and learner control (Sweller, 1988; Paas et al., 2003; Mayer, 2017; Sweller et al., 2019). A crossword medium is comparatively simple, but its design still requires readable typography, appropriate clue difficulty, unambiguous wording, and alignment with instructional objectives.

Vocational Learning and Active Participation

Vocational learning benefits from active participation, contextualized practice, and opportunities to connect declarative knowledge with workplace-relevant tasks. Active learning has been associated with stronger achievement than traditional lecturing in many educational contexts (Prince, 2004; Freeman et al., 2014), while constructive and interactive learning activities tend to promote deeper processing than passive reception (Chi & Wylie, 2014). For travel and tourism students, crossword tasks can be positioned as supplementary rehearsal before more authentic reservation-system simulations and service tasks.

METHOD

Research Design

The study employed research and development using the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. The original study was conducted in Grade XII Travel Business (Usaha Perjalanan Wisata/UPW) at SMK Negeri 1 Singaraja during the first semester of the 2021/2022 academic year. Product evaluation involved a content expert, a learning-media expert, individual learners, a small group, a subject teacher, and a field trial.

Development Procedure

During analysis, the developer identified instructional objectives, learner difficulties, and the content domain. The design stage mapped Airline Reservation concepts into crossword clues and grid structures.

During development, alternative visual designs were produced and reviewed. Implementation included individual, small-group, teacher, and field testing. Evaluation used expert judgments, learner responses, and achievement data to determine whether revision was needed.

Participants and Instruments

The field trial involved 30 students. Instruments included expert-validation questionnaires, user-response questionnaires, observation, and cognitive learning-outcome tests. The original manuscript states that qualitative descriptive, quantitative descriptive, and inferential statistical analyses were used.

Data Analysis

Feasibility and response data were summarized as percentages and interpreted using the qualification categories employed in the original study. Learning effectiveness was examined by comparing pretest and posttest scores. The source manuscript reports a paired-samples t-test probability of $p = .001$. Because the manuscript does not provide the complete t statistic, degrees of freedom, confidence interval, or effect size, those statistics are not reconstructed here. The primary descriptive values are taken from the field-test table and abstract: pretest $M = 77.24$ and posttest $M = 88.48$.

RESULTS

Product Feasibility and User Responses

The developed crossword game underwent expert and user evaluation. Content-expert validation reached 95.83%, while media-expert validation reached 91.67%. Individual testing produced a mean response of 90.74%, small-group testing 90.63%, teacher evaluation 90.63%, and the field-trial student response 90.28%. The source manuscript classifies these values as very feasible or very good.

Table 1. Summary of product feasibility and user-response results.

Evaluation stage	Percentage	Interpretation
Content expert	95.83%	Very feasible
Media expert	91.67%	Very feasible
Individual trial	90.74%	Very good
Small-group trial	90.63%	Very good
Teacher evaluation	90.63%	Very good
Field-trial student response	90.28%	Very good

Learning Outcomes

In the field trial, the highest score increased from 89 to 99, the lowest score from 69 to 83, and the mean from 77.24 to 88.48. Mastery increased from 63.33% to 100%. These values reproduce the main learning-outcome table in the source manuscript.

Table 2. Student learning outcomes before and after crossword-game implementation.

Indicator	Pretest	Posttest
Highest score	89	99
Lowest score	69	83
Mean	77.24	88.48
Mastery	63.33%	100.00%

DISCUSSION

The feasibility results indicate strong agreement among experts and users that the crossword medium was appropriate for Airline Reservation instruction. This pattern is plausible because crossword tasks transform terminology review into an active retrieval activity. Rather than rereading lists of city codes or aviation terms, learners must generate answers from clues, a process consistent with retrieval-practice research showing durable benefits for retention (Roediger & Karpicke, 2006; Rowland, 2014; Adesope et al., 2017).

The increase from 77.24 to 88.48, together with mastery rising from 63.33% to 100%, provides descriptive evidence of improved achievement after the intervention. The original manuscript also reports $p = .001$ for the paired comparison. These results are consistent with broader research showing that game-based learning can improve cognitive outcomes when games are integrated with instructional goals and feedback (Wouters et al., 2013; Clark et al., 2016; Tokac et al., 2019). They also align with evidence that active learning generally outperforms lecture-only approaches for student performance (Freeman et al., 2014).

The findings should nevertheless be interpreted conservatively. A one-group pretest-posttest design cannot rule out testing effects, maturation, concurrent instruction, or other time-related influences. Therefore, the present data support improvement following use of the crossword medium, but do not establish that the crossword game was superior to another instructional strategy. Future studies should include comparison groups, effect sizes, delayed retention tests, and preferably random or matched assignment where feasible.

The pedagogical value of the medium is also likely to depend on clue quality. If clues merely reproduce definitions, students may rely on surface memorization. More demanding clues can ask learners to discriminate among similar aviation codes, infer destinations from contextual information, or connect geographical and reservation concepts. This approach would move the activity toward generative learning, where learners select, organize, and integrate information (Fiorella & Mayer, 2016).

From a vocational-education perspective, crossword games should function as a supplement rather than a substitute for authentic performance. Airline Reservation competence ultimately requires procedural fluency, accurate data entry, interpretation of schedules and codes, and service communication. Accordingly, crossword practice can prepare foundational terminology before students progress to

simulations and reservation-system exercises. This sequencing is consistent with cognitive-load principles: automating basic terminology can free working-memory resources for more complex procedural tasks (Paas et al., 2003; Sweller et al., 2019).

The development process itself is another strength. Expert review, individual testing, small-group testing, and field implementation provide iterative opportunities to detect content, visual, and usability problems. Such iterative design is compatible with systematic instructional-development principles and user-centered educational technology evaluation (Branch, 2009; Reeves, 2006; McKenney & Reeves, 2018).

LIMITATIONS

Four limitations require attention. First, the effectiveness test used only one group of 30 students. Second, the manuscript reports inconsistent pretest and posttest means in its concluding section (77.52 and 87.86) compared with the abstract, results table, and main statistical discussion (77.24 and 88.48). This edited version uses 77.24 and 88.48 because those values are repeated in the abstract and principal results table. Third, the full paired-samples t-test output is not reported, preventing independent verification of the test statistic and effect size. Fourth, the study was conducted in one vocational-school program, so generalization to other schools, tourism competencies, or learner populations should be tested.

CONCLUSION

The ADDIE-based development produced a crossword game that was rated highly feasible by content and media experts and received very positive responses from students and the subject teacher. In the 30-student field trial, the mean score increased from 77.24 to 88.48 and mastery increased from 63.33% to 100%. The findings support the use of crossword games as supplementary learning media for terminology-intensive Airline Reservation content, particularly international city codes and aviation geography. Stronger causal evidence will require controlled comparative designs, complete statistical reporting, and delayed measures of retention.

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