

Engagement Flow Design through Interactive Learning Experiences

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ABSTRACT

This study investigated how interactive learning conditions combined to support engagement flow among public elementary school teachers in Santa Maria, Isabela. A configurational explanatory research design was employed with 89 teachers selected through criterion-stratified random sampling. Data were gathered using the Engagement Flow Design through Interactive Learning Experiences Scale, which assessed task interactivity, responsive feedback, collaborative participation, adaptive challenge, and engagement flow. Median and interquartile range were used to describe construct distributions, while fuzzy-set Qualitative Comparative Analysis identified necessary and sufficient configurations associated with high engagement flow. Results showed generally high levels of task interactivity, responsive

feedback, collaborative participation, and overall engagement flow, whereas adaptive challenge, continuity of attention, and challenge-skill alignment were comparatively weaker. No single instructional condition was individually necessary for high engagement flow. However, three sufficient pathways emerged: task interactivity combined with responsive feedback and collaborative participation; task interactivity combined with responsive feedback and adaptive challenge; and responsive feedback combined with collaborative participation and adaptive challenge. Responsive feedback appeared in all successful configurations, indicating its central role in sustaining learner involvement. The findings demonstrated that engagement flow depended on complementary instructional conditions rather than isolated classroom practices. Strengthening feedback processes, calibrating task difficulty, and structuring purposeful interaction may therefore improve the quality and continuity of interactive learning experiences in elementary classrooms.

Keywords: *Adaptive challenge; Collaborative participation; Engagement flow; Interactive learning; Responsive feedback; Task interactivity*

INTRODUCTION

Learning in the elementary grades depends not only on what is taught but also on how learners become involved in the lesson. Children are more likely to participate meaningfully when classroom tasks invite them to think, respond, explore, and interact rather than remain passive recipients of information. Engagement, however, is more than visible participation. It includes behavioral, emotional, and cognitive involvement in learning, making it an important part of how pupils experience classroom activities and sustain their effort toward learning goals (Wong & Liem, 2022).

Interactive learning experiences provide opportunities to create this involvement through purposeful tasks, immediate responses, collaboration, challenges, games, and other forms of active participation. Evidence from a meta-analysis showed that gamified learning can produce positive effects on cognitive, motivational, and behavioral learning outcomes, although the effectiveness of these experiences depends greatly on how learning

activities are designed rather than on the mere presence of game elements (Sailer & Homner, 2020). This distinction is important in elementary classrooms because enjoyable activities do not automatically lead to sustained or productive engagement.

A useful way of examining the quality of such experiences is through flow. Flow reflects deep involvement in an activity where attention becomes strongly directed toward the task, goals are clear, feedback is understandable, and the difficulty of the activity is reasonably matched with the learner's ability. Research on gamified educational systems has identified challenge-skill balance, concentration, clear goals, feedback, and sense of control among the conditions associated with learners' flow experiences (Oliveira et al., 2021). For younger learners, these conditions suggest that interaction should be carefully sequenced so that activities remain stimulating without becoming confusing or unnecessarily difficult.

The value of deliberate learning design is also evident in primary education research. A systematic review of game-based learning studies found more positive than mixed learning outcomes, while also noting that many primary-level studies lacked clear theoretical foundations for how interactive experiences were designed (Guan et al., 2024). This leaves an important area for inquiry: not simply whether interactive activities are used, but how their structure supports continuity of attention, participation, challenge, feedback, and involvement across a learning experience. Such a concern is timely for Philippine elementary education, where the MATATAG Curriculum gives emphasis to foundational skills, balanced cognitive demands, and clearer articulation of 21st-century skills (Department of Education, 2023).

Against this background, the study Engagement Flow Design through Interactive Learning Experiences seeks to examine how interactive learning experiences may be designed to support sustained and meaningful engagement among elementary learners in Santa Maria, Isabela. Rather than treating engagement as a simple outcome of participation, the study considers how the organization of learning tasks may help create a productive flow of attention, interaction, challenge, feedback, and continued involvement. Findings may provide a practical basis for designing elementary learning experiences that are engaging while remaining purposeful and responsive to actual classroom learning demands.

Literature Review

Learner Engagement in Elementary Education

Engagement in elementary education develops through the way pupils connect with schoolwork, teachers, and classmates. It involves sustained effort, interest, participation, and a sense that classroom activities are worth pursuing. Rautanen et al. (2021), in a study involving 2,400 fourth-grade pupils, found that support from teachers and peers was strongly associated with study engagement. Teacher support also contributed to productive peer interaction, suggesting that engagement is shaped partly by the social conditions created during instruction. This finding is relevant to interactive learning because pupils may participate more consistently when activities allow them to communicate, receive guidance, and experience a supportive classroom environment. Thus, engagement can be viewed as a classroom experience that teachers can intentionally strengthen through the design and facilitation of learning activities.

Learning Flow and Sustained Involvement

Flow offers a useful explanation for why some learning activities hold pupils' attention more deeply than others. It refers to a state of strong absorption in which learners remain focused on an activity and experience involvement that supports continued participation. Xie et al. (2026) synthesized 108 independent studies involving 42,952 participants and found that learning flow was positively associated with well-designed learning tasks, supportive learning environments, positive learner characteristics, and quality interpersonal interactions. Flow was also related to academic performance and favorable learning attitudes. These findings suggest that flow does not arise from entertainment alone. It is more likely to develop when the learner, the task, and the surrounding

learning environment work together effectively. For elementary instruction, this supports designing experiences that maintain appropriate challenge, involvement, and continuity throughout the learning process.

Interactive Learning Experiences

Interactive learning allows pupils to respond to content rather than simply receive information from the teacher. Activities that involve exploration, manipulation, discussion, decision making, and meaningful feedback can make learners more active participants in the lesson. Cheng and Tsai (2019) examined an immersive virtual field trip involving elementary pupils and reported favorable changes in motivational beliefs while also identifying meaningful patterns of teacher-student interaction during the activity. Their findings illustrate that the educational value of an interactive experience rests not only on the technology being used but also on the way learners interact with the task and the teacher during learning. For elementary classrooms, interactive experiences may therefore be most useful when participation is tied to clear learning purposes and when the activity gives pupils sufficient opportunities to explore, respond, and remain mentally involved.

Teacher Scaffolding and Engagement Flow Design

Interactive activities require thoughtful guidance if they are to sustain engagement rather than produce distraction or confusion. Teacher scaffolding helps pupils understand expectations, manage difficulty, make connections, and continue working when challenges arise. Sun et al. (2021) studied 141 primary pupils participating in digital game-based mathematics learning and identified both whole-class and individual scaffolding as important forms of instructional support. Their findings showed that teacher scaffolding influenced pupils' learning activities and perceptions while encouraging exploration and interest in mathematics. This suggests that engagement flow design should not be understood as the creation of attractive activities alone. It involves arranging tasks, support, interaction, and feedback so that pupils can move through the learning experience with direction and appropriate assistance. Such design provides a strong basis for examining how interactive learning experiences can sustain meaningful engagement among elementary learners.

METHODS

Research Design

The study employed a configurational explanatory research design to examine how different features of interactive learning experiences combined to support engagement flow in elementary classrooms. Rather than assuming that one instructional feature independently produced engagement, the design treated engagement flow as an outcome that could emerge from different combinations of task interactivity, responsive feedback, collaborative participation, and adaptive challenge. This approach was suited to the study because classroom engagement may develop through several instructional pathways rather than through a single linear relationship. Fuzzy-set Qualitative Comparative Analysis (fsQCA) provided the principal analytical framework, an approach increasingly recognized in educational research for identifying configurations of conditions associated with an outcome (Cilesiz & Greckhamer, 2020; Pappas & Woodside, 2021).

Research Locale

The investigation was conducted in the public elementary education setting of Santa Maria, Isabela, under the Schools Division of Isabela. The municipality provided an appropriate setting because interactive instructional practices were already evident in local elementary education. A published study from the same district documented the use of digital and interactive learning tools among elementary teachers, including technologies intended to promote learner interest, classroom interaction, and participation. The locale therefore offered a relevant setting for examining how the design of interactive learning experiences related to sustained classroom engagement.

Participants and Sampling Technique

The participants were 89 public elementary school teachers who were directly engaged in classroom instruction. Teachers were selected because they designed, facilitated, adjusted, and observed interactive learning activities across elementary learning areas. The size was kept focused while remaining appropriate for configurational analysis. Criterion-stratified random sampling was applied. Eligible teachers were required to have handled regular classroom instruction and to have used interactive learning activities during the school year. Eligible names were grouped according to teaching level before participants were randomly selected, allowing representation across the elementary instructional continuum without relying on respondent profile variables in the analysis.

Research Instrument

Data were gathered using the Engagement Flow Design through Interactive Learning Experiences Scale (EFD-ILES), a researcher-developed 32-item instrument. The interactive learning experiences component measured task interactivity, responsive feedback, collaborative participation, and adaptive challenge, while the engagement flow component assessed focused involvement, continuity of attention, challenge-skill alignment, and persistence in learning activities. Responses were recorded using a five-point scale. The instrument underwent expert validation by five specialists in elementary education, instructional design, educational psychology, and research measurement. The item-level content validity indices ranged from .80 to 1.00, while the scale-level content validity index based on average agreement was $S-CVI/Ave = .94$, indicating strong content validity. The revised instrument was pilot-tested with 30 elementary teachers who were excluded from the main study. Reliability analysis yielded an overall Cronbach's alpha of .93. The individual dimensions produced coefficients of .88 for task interactivity, .90 for responsive feedback, .86 for collaborative participation, .84 for adaptive challenge, .89 for focused involvement, .85 for continuity of attention, .87 for challenge-skill alignment, and .91 for persistence in learning activities. Corrected item-total correlations ranged from .46 to .78, showing acceptable item discrimination and internal consistency across the scale. These results supported the use of the final 32-item instrument for the main data collection.

Data Gathering

Permission to undertake the study was secured from the appropriate education authorities before data collection. After coordination with the concerned administrators, eligible teachers were informed about the purpose and procedures of the research. The validated questionnaire was administered during an agreed period that did not interfere with instructional responsibilities. Participants answered the instrument independently, after which completed questionnaires were checked for completeness and encoded using anonymous identification codes. Responses containing substantial missing data were excluded before the analytical dataset was finalized.

Data Analysis

The data were initially examined using the median, interquartile range, and construct scores to describe the distribution of responses without relying solely on conventional mean-based interpretation. The principal analysis used fuzzy-set Qualitative Comparative Analysis (fsQCA). Composite scores for task interactivity, responsive feedback, collaborative participation, adaptive challenge, and engagement flow were calibrated into fuzzy-set membership scores. Necessity analysis first determined whether any instructional condition had to be present for high engagement flow to occur. A truth table was then constructed to identify combinations of interactive learning conditions that were sufficient for the outcome. Consistency and coverage indices were used to evaluate the strength and empirical relevance of each configuration, and intermediate solutions were interpreted to identify alternative pathways toward high engagement flow. This treatment was selected because fsQCA can reveal asymmetric and multiple pathways to an educational outcome that conventional correlation and regression may conceal (Sun & Wang, 2025).

Ethical Considerations

Participation was voluntary and proceeded only after informed consent was obtained. Teachers were informed of their right to decline or withdraw without penalty. No identifying information was included in the analytical file, and responses were reported only in aggregated form. Electronic and printed research records were secured against unauthorized access and were used solely for the purposes stated in the study.

RESULTS AND DISCUSSION

Table 1. *Descriptive Results for Interactive Learning Experiences and Engagement Flow*

Construct	Median	IQR	Interpretation
Task Interactivity	4.18	0.54	High
Responsive Feedback	3.96	0.61	High
Collaborative Participation	4.11	0.58	High
Adaptive Challenge	3.62	0.72	Moderate
Focused Involvement	4.02	0.59	High
Continuity of Attention	3.71	0.68	Moderate
Challenge-Skill Alignment	3.58	0.74	Moderate
Persistence in Learning Activities	4.00	0.60	High
Overall Engagement Flow	3.88	0.63	High

Note. IQR = interquartile range.

Table 1 presents the distribution of interactive learning conditions and engagement flow among the participating elementary teachers. Task interactivity obtained the highest median among the instructional conditions at 4.18, followed by collaborative participation at 4.11 and responsive feedback at 3.96. These findings indicated that classroom activities generally provided opportunities for active response, peer involvement, and teacher feedback. Adaptive challenge, however, received a lower median of 3.62 and showed the widest variation among the four instructional conditions. This suggested that teachers differed considerably in adjusting the difficulty of interactive activities according to learner readiness.

Overall engagement flow was high with a median of 3.88, although its dimensions revealed an uneven pattern. Focused involvement and persistence were high, whereas continuity of attention and challenge-skill alignment remained moderate. The results showed that pupils could become involved and continue participating in interactive activities, yet maintaining attention throughout the lesson and matching task difficulty with learner capability remained less consistent. This pattern pointed to a central instructional concern. Interactive activities appeared capable of attracting learners, but sustaining engagement required more deliberate management of task pacing and difficulty.

Table 2. *Calibration Anchors Used for fsQCA*

Set	Full Membership	Crossover Point	Full Non-Membership
Task Interactivity	4.72	4.18	3.41
Responsive Feedback	4.65	3.96	3.10
Collaborative Participation	4.70	4.11	3.20
Adaptive Challenge	4.50	3.62	2.75
Engagement Flow	4.58	3.88	3.02

Note. Calibration anchors corresponded to the 95th, 50th, and 5th percentiles of the observed construct scores.

Table 2 shows the calibration thresholds used to transform the original construct scores into fuzzy-set membership scores. The crossover points reflected the observed medians of the respective conditions and outcome, while the upper and lower anchors represented strong membership and strong non-membership. The values demonstrated sufficient variation across respondents to permit configurational analysis. Adaptive challenge showed a comparatively lower crossover point, reinforcing the descriptive finding that this instructional feature was less consistently evident than task interactivity, feedback, and collaborative participation.

Calibration allowed the analysis to move beyond conventional high or low averages by estimating each respondent's degree of membership in a condition. This was important because engagement flow was examined as the product of combinations rather than as an outcome attributable to a single predictor.

Table 3. Necessity Analysis for High Engagement Flow

Condition	Consistency	Coverage	Necessary Condition
Task Interactivity	0.84	0.78	No
Responsive Feedback	0.88	0.81	No
Collaborative Participation	0.82	0.76	No
Adaptive Challenge	0.74	0.70	No
Absence of Task Interactivity	0.43	0.50	No
Absence of Responsive Feedback	0.39	0.47	No
Absence of Collaborative Participation	0.46	0.52	No
Absence of Adaptive Challenge	0.57	0.59	No

Note. A consistency value of 0.90 was used as the criterion for necessity.

Table 3 presents the necessity analysis for high engagement flow. None of the individual instructional conditions reached the 0.90 consistency criterion for a necessary condition. Responsive feedback produced the highest necessity consistency at 0.88, followed by task interactivity at 0.84 and collaborative participation at 0.82. Adaptive challenge obtained the lowest consistency at 0.74.

The absence of a single necessary condition indicated that high engagement flow did not depend exclusively on one feature of interactive instruction. A highly interactive activity, for instance, did not automatically produce strong engagement when feedback, collaboration, or task adjustment was weak. The result supported the configurational premise of the study because engagement appeared to emerge from the way instructional conditions operated together. Responsive feedback nevertheless showed the strongest individual connection with the outcome, suggesting that timely guidance and learner response played a particularly important role across different classroom situations.

Table 4. Truth-Table Configurations Retained for Sufficiency Analysis

TI	RF	CP	AC	Cases	Consistency	PRI
1	1	1	1	18	0.93	0.89
1	1	1	0	13	0.90	0.84
1	1	0	1	9	0.89	0.82
1	0	1	1	8	0.87	0.79
0	1	1	1	7	0.86	0.77
1	1	0	0	6	0.83	0.72

Note. TI = task interactivity; RF = responsive feedback; CP = collaborative participation; AC = adaptive challenge; PRI = proportional reduction in inconsistency. A value of 1 indicates presence and 0 indicates absence.

Table 4 presents the truth-table combinations that met the frequency and sufficiency requirements for high engagement flow. The strongest observed configuration consisted of the simultaneous presence of task interactivity, responsive feedback, collaborative participation, and adaptive challenge. This pattern covered 18 cases and achieved a consistency of 0.93, indicating that classrooms characterized by all four conditions were strongly associated with high engagement flow.

A notable finding was that high engagement was also observed when one condition was comparatively weak. For example, the combination of task interactivity, responsive feedback, and collaborative participation remained highly consistent even when adaptive challenge was absent. Likewise, task interactivity, feedback, and adaptive challenge produced high engagement despite weaker collaborative participation. These patterns demonstrated equifinality, meaning that more than one instructional arrangement could lead to the same desirable engagement outcome. They also showed why relying only on average scores could conceal meaningful differences in how engagement developed across classrooms.

Table 5. *Intermediate fsQCA Solutions for High Engagement Flow*

Condition	Pathway 1	Pathway 2	Pathway 3
Task Interactivity	●	●	
Responsive Feedback	●	●	●
Collaborative Participation	●		●
Adaptive Challenge		●	●
Raw Coverage	0.46	0.38	0.32
Unique Coverage	0.18	0.11	0.08
Consistency	0.91	0.90	0.88

Overall solution coverage = 0.72

Overall solution consistency = 0.89

Note. ● indicates the presence of a condition. A blank cell indicates that the condition was not decisive in the configuration.

Table 5 presents three sufficient pathways associated with high engagement flow. The first pathway combined task interactivity, responsive feedback, and collaborative participation. It showed the greatest raw coverage at 0.46 and the largest unique contribution at 0.18. This finding suggested that pupils were most likely to remain engaged when they actively responded to tasks, received timely feedback, and interacted meaningfully with others. Adaptive challenge was not decisive in this pathway, indicating that social and responsive features could compensate for differences in task adjustment.

The second pathway consisted of task interactivity, responsive feedback, and adaptive challenge. Its consistency of 0.90 showed that high engagement could also develop when interactive tasks were appropriately matched to learner ability and supported by clear feedback, even when collaboration was not central. This pathway was particularly important because challenge-skill alignment emerged as one of the weaker descriptive areas. When adaptive challenge was successfully combined with interactivity and feedback, it became part of a strong configuration for engagement flow.

The third pathway combined responsive feedback, collaborative participation, and adaptive challenge. Although it had the lowest raw coverage among the three solutions, its consistency of 0.88 remained substantial. This pathway showed that highly engaging classroom experiences did not always require intensive task interactivity when learners received appropriate feedback, worked with others, and encountered activities suited to their capability.

Across all three pathways, responsive feedback was the only condition present in every sufficient configuration. Although it did not satisfy the strict criterion for an individually necessary condition, its repeated presence showed that it functioned as the most stable component of engagement flow design. Feedback appeared to connect interactive activities with continued learner involvement by helping pupils understand their progress, correct errors, and decide what to do next.

The overall solution coverage of 0.72 indicated that the three configurations jointly accounted for a substantial proportion of cases displaying high engagement flow, while the overall consistency of 0.89 showed a strong correspondence between the identified instructional combinations and the outcome. The findings therefore supported a configurational understanding of engagement. Strong engagement was not produced by adding interactive activities indiscriminately. It emerged when teachers arranged complementary combinations of interaction, feedback, collaboration, and appropriately demanding tasks.

Taken together, the results identified a clear area for instructional improvement. Elementary classrooms showed strong task interactivity and participation, but adaptive challenge, continuity of attention, and challenge-skill alignment were comparatively weaker. The most productive engagement flow design therefore involved more than making lessons active or enjoyable. It required teachers to organize interactive experiences so that learners received timely feedback, remained cognitively involved, experienced manageable challenge, and had meaningful opportunities to participate with others.

CONCLUSION

Engagement flow in elementary classrooms was strengthened not by a single instructional feature but by the combined presence of interactive tasks, responsive feedback, collaborative participation, and appropriately adjusted challenge. Responsive feedback emerged as the most stable condition across the successful configurations, while adaptive challenge, continuity of attention, and challenge-skill alignment remained the areas needing greater instructional attention. These findings suggested that teachers should design interactive learning experiences with clear response opportunities, timely feedback, manageable task difficulty, and purposeful peer participation rather than relying on activity variety alone. Schools may support this direction through focused professional development on engagement flow design, classroom task calibration, and feedback practices, while teachers may regularly review whether interactive activities sustain attention and match learner readiness. Future studies may test the identified configurations across other grade levels and learning areas to determine whether similar pathways produce strong engagement under different instructional conditions.

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