

The Effect of a Two-Tier-Test Approach Integrated with a Tablet IRS on University Students' Self-Efficacy and Attention

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Abstract: *Effective feedback is crucial for promoting learner engagement and improving cognitive outcomes, yet its design and delivery remain challenging. This study investigated the effects of integrating a two-tier testing approach with elaborated feedback (EF) into a tablet-based interactive response system (IRS) on university students' self-efficacy and focused attention. A quasi-experimental design with 74 participants was conducted to compare different feedback strategies. While no statistically significant improvement was observed in self-efficacy, students who received elaborated feedback demonstrated higher mean scores in focused attention. The findings suggest that promoting active reasoning through feedback design may enhance learner engagement in technology-supported environments.*

Keywords: Tablet PCs, Interactive Response System, Two-tier test, Self-efficacy, Focused attention

1. Introduction

The integration of Interactive Response Systems (IRS) into classroom teaching has been widely recognized for its ability to enhance student engagement and interaction. By utilizing the Interactive Response System (IRS), students can receive immediately feedback and information, which not only enhances their learning experience but also improves their academic performance (Fu et al., 2025). A two-tier test is a diagnostic assessment method designed to evaluate the correctness of a student's response, and their reasoning behind it as well (Hwang et al., 2023). This study investigates the impact of integrating two-tier polling with elaborated feedback on university students' self-efficacy and attention. By incorporating structured feedback into IRS, this study examines its role in enhancing learning confidence and sustaining attention in classroom settings. Accordingly, the study addresses the following research questions:

1. Does the two-tier polling strategy integrated with feedback significantly improve learners' self-efficacy?
2. Does the two-tier polling strategy integrated with feedback significantly improve learners' attention?

2. Literature review

2.1. Interactive Response System (IRS) and Two-tier test

Interactive Response Systems (IRS) provide immediate feedback, fostering an interactive learning environment while enhancing students' knowledge recall and attention (Muis et al., 2015). Effective feedback mechanisms allow learners to assess their understanding, adjust their strategies, and improve learning efficiency (Lang & Betsch, 2024). This study categorizes feedback into knowledge of correct response (KCR) and elaborated feedback (EF). KCR informs learners whether

their answers are correct, while EF provides detailed explanations, helping students refine their knowledge and correct misconceptions. Integrating both types of feedback into IRS enhances learning engagement and cognitive processing. The two-tier test further supports learning by assessing both declarative knowledge in the first tier and explanatory reasoning in the second (Hwang et al., 2023). This format enables instructors to identify misconceptions and provide targeted interventions. When combined with IRS, the two-tier test encourages deeper reflection and conceptual understanding (Yang et al., 2015). This study explores the impact of integrating IRS with two-tier testing on students' self-efficacy and attention, aiming to foster a more engaged and cognitively stimulating classroom experience.

2.2. Self-Efficacy and Attention

Self-efficacy, the belief in one's ability to complete learning tasks, significantly influences motivation and persistence (Bandura, 1977). Helping learners to set short-term and specific learning objectives, providing explicit rubrics that can help learners succeed will all improve their self-efficacy (Schunk & Mullen, 2012). It is shaped by external factors, personal competence, and prior experiences. Fortner-Wood et al. (2013) found that IRS polling activities reduce learning anxiety and promote a more interactive and engaging learning environment, thereby improving self-efficacy. Attention is another crucial factor in learning engagement, as higher sustained attention helps students stay focused, minimize distractions, and improve comprehension. Building on these insights, this study explores how integrating two-tier polling with elaborated feedback in an IRS-based learning environment enhances students' self-efficacy and attention, contributing to a more interactive and cognitively engaging learning experience.

3. Method

3.1. Participants and Experimental design

The research subjects were 74 participants of two classes: 49 from the "Introduction to Networks" class and 25 from the "Information Security" class at a university in Taiwan. There were 29 male students (39.2%), and 45 female students (60.8%). This quasi-experimental study divided students into three groups: Group A received correct answer feedback (n=25), Group B took a two-tier test with correctness feedback (n=27), and Group C took a two-tier test with elaborated feedback. Before the experiment, participants completed a pretest on self-efficacy (n=22). The intervention consisted of two 50-minute sessions over one week. Afterward, participants completed post-tests on self-efficacy and attention. During class, all groups used tablets for polling activities. Group A received single-choice questions with correctness feedback. Group B received two-tier test questions with correctness feedback, while Group C received additional explanations and reasoning. Students worked in groups of four, discussing answers but responding individually on tablets.

3.2. Instruments

Self-efficacy was measured using an adapted version of the Self-Efficacy for Learning and Performance subscale from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993), consisting of eight items rated on a 6-point Likert scale ($\alpha = .68$), indicating acceptable reliability (Nunnally, 1967). Attention was assessed using a translated version of the Focused Attention Scale (Christakou et al., 2012), which included ten items—three of which were reverse-

coded—rated on an 8-point Likert scale ($\alpha = .81$), showing good internal consistency (Nunnally, 1978). The tablet-based IRS employed in this study was the Interactive Feedback-Based In-Class Teaching System (iFIT) (Sung et al., 2016). Feedback varied across groups: Group A received knowledge of correct response (KCR); Group B completed a two-tier test with KCR and response summaries; and Group C completed a two-tier test with both KCR and elaborated feedback (EF), which provided detailed explanations to reinforce conceptual understanding. Figure 1 illustrates the tablet interface used in each condition.

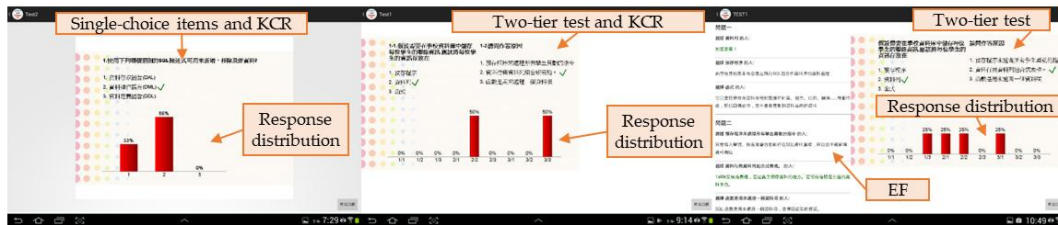


Fig.1 Examples of the tablet interface for each group

4. Result

After accounting for pretest scores, the differences in posttest self-efficacy among the groups were not statistically significant ($F = 2.67, p = .08, \eta^2 = .07$). Although both the elaborated feedback (EF) and correctness feedback groups had higher adjusted means than the correct answer group, the overall group effect *did* not reach significance. This outcome suggests that while two-tier polling may reflect a positive trend in enhancing students' self-efficacy, the differences observed were not strong enough to support a clear conclusion under the current study conditions. For focused attention, Levene's test indicated unequal variances across groups ($F = 7.46, p = .001$). As a result, a Brown-Forsythe test was conducted and showed a statistically significant overall group effect ($F = 3.40, p = .042$). However, the follow-up Dunnett T3 comparisons did not reveal any significant pairwise differences. Although the mean score for the elaborated feedback group ($M = 46.15$) was descriptively higher than that of the correctness feedback group ($M = 42.15$), the difference was not statistically significant. These findings imply that while elaborated feedback may be linked to better attention outcomes, high variability and limited sample size may have reduced the ability to detect significant differences.

5. Discussion and conclusion

Although This study found that, contrary to earlier findings suggesting that two-tier testing combined with elaborated feedback (EF) promotes learning confidence and cognitive engagement (Yang et al., 2015), no statistically significant improvements in self-efficacy were observed. A plausible explanation concerns the short duration of intervention. Yang et al. (2017) emphasized that reflective thinking and the development of self-beliefs rely on sustained and repeated exposure to diagnostic feedback. In the present case, the limited time frame may not have allowed sufficient opportunities for meaningful internalization, especially given that self-efficacy typically grows through mastery experiences, deliberate practice, and self-regulated reflection (Bandura, 1977). Beyond the issue of duration, the way learners engaged with the feedback may have further

constrained its impact. Gajos and Mamykina (2022) demonstrated that when learners are simply presented with correct answers and explanations, they often engage passively, completing tasks without activating the deeper cognitive processes needed for long-term learning. In this study, despite the provision of detailed feedback, the absence of active reasoning tasks may have limited the opportunities for students to reconstruct their understanding or to critically evaluate their own thinking. Passive acceptance of information facilitates surface-level task completion but rarely promotes integration, reflection, or the strengthening of self-efficacy over time. Future designs should aim to require learners to articulate their reasoning processes, predict outcomes, or self-explain responses after receiving feedback. Embedding such reasoning-based activities can promote deeper cognitive engagement, facilitate knowledge construction, and ultimately support more enduring gains in self-efficacy.

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