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Design, Implementation, and Effectiveness Evaluation of an Electronic Performance Support System on Teachers' Attitudes and Performance in Instructional Design

K. Taghipour[1,*]

[1] Assistant Professor, Department of Educational Sciences, University of Tabriz, Tabriz, Iran

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ABSTRACT

In recent years, with the emergence of electronic performance support systems (EPSS), the effectiveness of traditional and electronic internships for improving teachers' instructional performance has been questioned. Accordingly, the present study aimed to examine the effectiveness of an EPSS on teachers' attitudes toward the course and their performance in instructional design for science education. The study employed an experimental research method with a post-test control group design. The research population included physics education students admitted in 2013 at Shahid Sharafat Higher Education Center. Participants were randomly assigned to experimental and control groups. The effectiveness of the course was assessed through two variables: attitude and performance. Data collection instruments included an attitude assessment questionnaire and an instructional design performance checklist based on Merrill's instructional model (teaching of concepts and laws at the application level). The content validity of all instruments was confirmed through expert review. The reliability of the attitude assessment questionnaire was calculated using Cronbach's alpha coefficient ($\alpha = 0.87$), and the reliability of the instructional design performance checklist for science education at the application level was confirmed through inter-rater reliability ($r = 0.73$). The collected data were analyzed using descriptive and inferential statistics, including multivariate analysis of variance (MANOVA) and independent samples t-test. The results revealed that teachers who benefited from the electronic performance support system demonstrated more positive attitudes toward the course and performed better in instructional design for science education based on Merrill's instructional model compared to those who participated in electronic internships.

1. INTRODUCTION

In recent decades, the rapid evolution of educational technology has underscored the need for innovative tools to enhance teachers' capabilities in instructional design, addressing challenges such as limited resources and diverse learner needs [1]. Electronic Performance Support Systems (EPSS) emerge as integrated digital environments that

* Corresponding Author: taghipour@tabrizu.ac.ir
Assistant Professor, Department of Educational Sciences, University of Tabriz, Tabriz, Iran

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provide on-demand access to information, guidance, tools, and assessment to facilitate task performance with minimal external intervention, particularly beneficial for educators in curriculum development and lesson planning [2]. The design and implementation of EPSS for teachers often draw from systematic models like the Nieveen Model, which emphasizes formative evaluation, prototyping, and iterative revisions to create practical and effective instructional materials, including computer-supported systems for curriculum developers who may include practicing teachers [3].

Evaluations of such systems have highlighted their potential to positively influence teachers' attitudes toward technology integration and improve performance in instructional tasks, though factors like adult learner characteristics such as self-directedness and readiness must be considered to ensure alignment with effective pedagogy [4]. Case studies illustrate practical applications, such as designing EPSS for specific educational contexts, revealing insights into usability, adoption barriers, and outcomes on professional practice [5]. Despite these advancements, comprehensive effectiveness evaluations remain sparse, necessitating rigorous studies on how EPSS impacts teachers' attitudes, confidence, and overall instructional design performance to inform future implementations.

2. LITERATURE REVIEW

Adjust the text to match the references. In the field of educational technology, Electronic Performance Support Systems (EPSS) have been recognized as critical tools for bridging performance gaps in instructional design by providing integrated, on-demand support to educators, thereby reducing reliance on traditional training methods and enhancing real-time task execution [6]. Early research on EPSS design emphasized systematic approaches, such as the use of formative evaluation and prototyping to create computer-based systems that assist curriculum developers including practicing teachers in generating practical instructional materials through iterative processes and expert guidance [7]. These designs often incorporate elements like task structuring, resource databases, and feedback mechanisms, validated in university settings where they facilitated complex learning tasks and improved cognitive skill application among students and instructors [8].

Implementation studies have examined how EPSS are deployed in teaching contexts, revealing insights into usage patterns and integration challenges [9]. For example, an investigation into an EPSS for K-12 teachers demonstrated that high usage levels were associated with enhanced performance in instructional planning and delivery, though attitudes varied based on familiarity with technology, with positive shifts observed post-implementation [9]. Similarly, mobile EPSS implementations have shown promise in dynamic educational environments, where qualitative evaluations highlighted improvements in efficiency, accuracy, and user attitudes toward technology as a performance aid [10].

Effectiveness evaluations of EPSS have focused on their impact on teachers' attitudes and performance in instructional design, often employing mixed methods to assess outcomes [11]. Reviews of performance technology underscore EPSS as non-instructional interventions that promote systemic improvements in educational organizations, positively influencing educators' self-efficacy and skill sustainability when aligned with knowledge management practices [11]. Case studies further illustrate that EPSS, by capturing and disseminating expert knowledge, lead to measurable gains in professional development, such as reduced training time and better alignment with adult learning needs in design environments [12]. However, evaluations also point to limitations, including the need for addressing adult learner characteristics like self-directedness to optimize attitudes and performance [13]. Additionally, instructional design casebooks have documented real-world EPSS applications, revealing persistent challenges in adoption and long-term effectiveness, thus highlighting gaps in comprehensive, teacher-specific evaluations [14].

3. RESEARCH METHOD

The present study is classified as experimental research and employed a post-test-only control group design. The statistical population included all preservice physics teachers admitted in 2013 at the Shahid Sharafat Higher Education Center, who were enrolled in the teaching practicum course during the first semester of the 2016–2017 academic year (N = 34). Using a random number table, participants were randomly assigned into two groups of 17 members each: the Electronic Performance Support System (EPSS) group and the Electronic Internship group. In other words, the random assignment method was used to allocate individuals to groups.

For data collection, two instruments were utilized:

The standardized *Attitude Measurement Questionnaire* developed by Nguyen (2009); and A researcher-designed *Performance Assessment Checklist* for evaluating instructional design performance in science education at the application level.

The content validity of the attitude questionnaire was confirmed by two subject-matter experts, whose feedback was incorporated to finalize the instrument [15]. The reliability of the attitude questionnaire was calculated using Cronbach's alpha ($\alpha = 0.87$), compared with $\alpha = 0.81$ reported in Nguyen's (2009) study.

The content validity of the instructional design performance questionnaire was also examined. To ensure that the content adequately represented the target behavioral and performance objectives expected of teachers in designing science lessons at the application level, two content experts reviewed the items and confirmed their appropriateness. The reliability of this instrument was established through inter-rater reliability, as performance scores were assigned independently by two evaluators. The correlation coefficient between their scores, which served as the reliability index, was found to be 0.73.

Overall, the research was conducted in three main stages:

Designing the Support and Training Programs: To design the EPSS-based training course, the proposed framework of electronic performance support systems was adopted as the design foundation [16]. Considering that the participating science teachers were beginners in instructional design based on Merrill's instructional model and that instructional design is a task-oriented activity emphasizing concept and rule teaching at the application level the EPSS was designed to integrate both intrinsic and extrinsic support levels.

Accordingly, the design incorporated the following operational components:

- Job-context principles;
- Assessment and monitoring (self-assessment, general performance guidance, and provision of evidence of teachers' professional progress);
- Access to performance support resources with an individual-based approach (emphasizing both intrinsic and extrinsic support levels);
- User interface principles;
- Adaptability;
- Real-time responsiveness (enabling selection of specific strategies from a set of instructional design approaches according to the desired level of support); and
- Usability.

For comparison, the constructivist instructional design model (based on Jonassen's principles) was employed for designing the electronic internship course. The constructivist-based electronic internship included elements such as project-based activities, information resources, coaching, and related learning supports. Accordingly, the course titled "Instructional Design in Science Education Based on Merrill's Model" was developed using both approaches.

Course Implementation: Participants in the EPSS group accessed the Instructional Design Performance Support System software and carried out instructional design tasks while receiving real-time support through the system. The electronic internship group followed a two-step procedure:

1. Receiving the electronic internship content within a specified one-week period through independent study; and
2. Re-entering the course website two days after completion, selecting "Enter Instructional Design Page" from the main internship menu, and conducting their instructional design tasks in the designated workspace.

Evaluating the Effectiveness of the Courses: After completing the training sessions on the university's computer site, data were collected on two dependent variables:

- **Attitude:** Measured using the post-course administration of the multi-scale attitude questionnaire; and
- **Performance:** Evaluated based on the instructional design tasks created by teachers and assessed by independent raters for accuracy and quality.

Data analysis was conducted using multivariate analysis of variance (MANOVA) and independent-sample t-tests. All statistical analyses were performed using SPSS software.

4. FINDINGS

Hypothesis 1:

Using the Electronic Performance Support System (EPSS) for improving instructional design performance in science education based on Merrill's instructional model results in more positive teacher attitudes compared with electronic internship training.

Table 1 presents the descriptive findings for each group regarding the attitude variable and its subcomponents. The mean scores for the EPSS group in the three attitude dimensions perceived usefulness of training and support, amount of training and support, and satisfaction with the course were 15.58, 6.11, and 16.29, respectively. In contrast, the corresponding means for the electronic internship group were 11.11, 5.12, and 11.82. Moreover, the overall mean attitude score for the electronic internship group was 28.05, whereas the EPSS group achieved a mean score of 38.00. These indicators demonstrate that the experimental group (EPSS) achieved higher attitude scores than the control group.

Table 1. Descriptive Statistics of Attitude Variables by Experimental and Control Groups

Variable	Electronic Internship Group (N = 17)				Electronic Performance Support System (EPSS) Group (N = 17)			
	Minimum	**Maximum**	**Mean**	**SD**	**Minimum**	**Maximum**	**Mean**	**SD**
Usefulness	**8**	**13**	**11.11**	**1.45**	**14**	**18**	**15.58**	**1.17**
Value	**4**	**7**	**5.12**	**0.78**	**5**	**7**	**6.11**	**0.48**
Course Satisfaction	**10**	**14**	**11.82**	**1.07**	**14**	**18**	**16.29**	**1.04**
Overall Attitude	**23**	**31**	**28.05**	**2.07**	**36**	**42**	**38.00**	**1.50**

Source: Authors' findings

Table 1 indicates that there is a significant difference between the experimental and control groups in terms of the overall attitude scale. To examine whether the attitude subscales differed significantly between the two groups, a Multivariate Analysis of Variance (MANOVA) was conducted.

All multivariate tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root) revealed a significant group effect (for example, Wilks' Lambda = 0.099, $F(3,30) = 90.8$, $p < .01$). In other words, the groups (Electronic Performance Support System vs. Electronic Internship) significantly differed in at least one of the attitude components (usefulness, value, or course satisfaction). However, this test alone does not specify which dependent variable(s) contributed to the difference.

According to the results presented in Table 2, the Between-Subjects ANOVA for all attitude components (usefulness, value, and course satisfaction) was significant at the $p < .01$ level. Therefore, it can be concluded that the use of an Electronic Performance Support System (EPSS), compared to electronic internship training, leads to more positive attitudes among teachers toward instructional design improvement in science education based on Merrill's instructional model.

Table 2. MANOVA Results Comparing Experimental and Control Groups on Attitude Subscales

Source of Variation	Dependent Variable	Sum of Squares	df	Mean Square	F	Sig.
Group	Usefulness	169.882	1	169.882	97.280	0.001
	Value	8.500	1	8.500	20.104	0.001
	Course Satisfaction	169.882	1	169.882	151.007	0.001

Hypothesis 2:

The use of the Electronic Performance Support System (EPSS), compared to electronic internship training, enhances teachers' accuracy and precision in instructional design for science education based on Merrill's instructional model.

Table 3 presents the descriptive findings for each group in the performance variable. As shown, the mean performance score of the electronic internship group was 52.41, while that of the EPSS group was 69.14.

Table 3. Descriptive Statistics of Performance Variable by Group

Variable	Electronic Internship Group (N = 17)				Electronic Performance Support System Group (N = 17)			
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD
Performance	**47**	**55.5**	**52.41**	**2.42**	**64**	**74**	**69.14**	**2.81**
Maximum possible performance score: 90								

To test the second hypothesis, an Independent Samples t-test was performed. As shown in Table 4, the difference in mean performance between the EPSS group and the electronic internship group was statistically significant (t(32) = 18.58, p = 0.001). Therefore, it can be concluded that using the Electronic Performance Support System significantly improves teachers' accuracy and precision in instructional design for science education compared to electronic internship training.

Table 4. Independent *t*-Test Results Comparing Mean Performance between Experimental and Control Groups

Variable	Levene's Test for Equality of Variances		*t*-Test for Equality of Means		
	F	Sig.	*t*	df	Sig.
Performance	**0.105**	**0.748**	**18.58**	**32**	**0.001**

Considering that this study employed attitude and performance variables (Levels 1 and 3 of Kirkpatrick's Evaluation Model) to assess effectiveness, the results shown in Table 5 confirm that based on these two determinants the implementation of an Electronic Performance Support System (EPSS) is effective for improving teachers' performance in instructional design.

Table 5. Impact of the Electronic Performance Support System on the Effectiveness of the Instructional Design Improvement Program

Source of Variation	Dependent Variable	Sum of Squares	df	Mean Square	*F*	Sig.
Group	**Performance**	**2380.596**	**1**	**2380.596**	**345.483**	**0.000**
	Attitude	**840.029**	**1**	**840.029**	**256.152**	**0.000**

5. DISCUSSION AND CONCLUSION

The findings of this study provide compelling evidence supporting the effectiveness of the Electronic Performance Support System (EPSS) in enhancing teachers' attitudes and performance toward instructional design in science education based on Merrill's instructional model. The results of the MANOVA test demonstrated that teachers in the EPSS group developed significantly more positive attitudes than those in the electronic internship group across all three attitude components usefulness, value, and course satisfaction. This suggests that access to real-time guidance, resources, and performance feedback during task execution fosters a deeper sense of engagement and perceived relevance, thereby improving overall attitudes toward professional learning systems.

Furthermore, the results of the independent samples t-test revealed that teachers trained through the EPSS achieved higher accuracy and precision in designing instructional materials compared to those who participated in traditional electronic internship programs. This improvement in performance can be attributed to the EPSS's ability to integrate contextual learning aids, just-in-time information delivery, and adaptive feedback, which collectively enhance learners' problem-solving and task performance. These findings are consistent with previous research emphasizing the value of performance-centered learning environments and support systems in improving instructional design competencies.

According to Kirkpatrick's model of training evaluation, this study assessed Level 1 (reaction) and Level 3 (behavior), represented by the attitude and performance variables, respectively. The significant results in both levels confirm that the use of EPSS not only increases teachers' satisfaction and perceived usefulness (Level 1) but also enhances the transfer of learning into actual instructional design performance (Level 3). Therefore, the EPSS can be considered an effective and practical framework for continuous professional development, particularly in teacher education programs where the application of theoretical knowledge to real-world instructional tasks is critical.

In summary, the implementation of an Electronic Performance Support System proved to be superior to traditional electronic internship methods in improving both the attitudinal and behavioral outcomes of teachers. By integrating EPSS tools into instructional design training, educational institutions can bridge the gap between theory and practice, leading to more efficient, autonomous, and motivated teachers capable of designing higher-quality learning experiences.

6. RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies are encouraged to extend this line of inquiry by exploring:

1. The long-term retention effects of EPSS-based training on instructional design performance.
2. The integration of adaptive learning analytics within EPSS environments to provide personalized support.
3. The replication of this study across different subject areas and educational levels to generalize the findings.

Overall, the results underscore the transformative potential of EPSS as a strategic tool for enhancing teacher performance, promoting active learning, and ensuring the effective implementation of instructional design principles in science education.

Transparency Statement

The data supporting this study are available upon reasonable request to the corresponding author, subject to ethical and confidentiality considerations.

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Declaration of Interest

The authors declare that they have no competing interests.

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