From Classroom to Clinical Experience: The Effect of Learning Fidelity Based on the 4C/ID Model

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abstract

Background: This study evaluated the effect of the fidelity of learning tasks, based on the four-component instructional design model, on satisfaction, attitude toward the learning environment, and learning. A significant factor contributing to the quality of education is the use of methods compatible with the learning environment. ***Method:*** This study used a pretest-posttest design with a control group. One hundred nurses were divided equally (n = 25) into groups. The control group had conventional lecture-based education, and three experimental groups had group discussion, simulation, or on-the-job counseling. Questionnaires measured satisfaction, attitude toward the learning environment, and learning. ***Results:*** Statistical analysis showed that the experimental groups who had group discussion and simulation had greater satisfaction and a more positive attitude toward the learning environment. The performance of learners who had on-the-job counseling was higher than that of the control group. ***Conclusion:*** Learning tasks can increase nurses' satisfaction, improve their attitude toward the learning environment, and enhance their learning with high-fidelity training. **[*J Contin Educ Nurs*. 2025;56(5):191-199.]**

Nursing requires the application of knowledge and practical skills to improve patient health (Hengameh et al., 2015). Clinical expertise is fostered through the application of theoretical concepts (Ngozika Ugwu et al., 2023). Despite earning high grades on theoretical sections of tests, many nursing students experience stress when facing actual patients in clinical environments and critical situations and do not apply their learned skills. One of the basic challenges is a gap between theoretical and practical knowledge (Brien et al., 2017). Such a gap has decreased the quality of educational results and has made preparing students for clinical conditions insufficient (Pelin & Ayise, 2019). One way to address this issue is to match clinical learning with theoretical lessons through new educational approaches. The four-component instructional design (4C/ID) model is an approach that integrates the educational strategy of simulation with clinical learning (Ross & Carney, 2017). The 4C/ID model is designed to assist instructional designers in creating educational programs to teach complex skills and professional competencies. The model outlines these programs as including four key components: learning tasks, supportive information, procedural information, and part-task practice (Zamharir et al., 2025).

This model improves the knowledge and attitudes of nurses and nursing students and helps them to build self-confidence, participate in teamwork, and reduce anxiety (Bland et al., 2014; Kapucu, 2017; Liu et al., 2023). It also helps them understand instructions and hone their

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practical skills (Allaire, 2015; van Merriënboer & Kester, 2014). Simulation can be a supplementary learning method to advance clinical judgment in nursing education and enhance contextual learning (Chabrera et al., 2024; Lasater, 2011). However, optimal simulation fidelity (similar to what might happen in real life) is important in clinical settings because the cost of simulation is associated with its fidelity. Simulation with high or excessive fidelity may not be economically feasible. On the contrary, simulation with low or insufficient fidelity may be ineffective as an educational aid. Therefore, finding the optimal level of fidelity for a specific situation is necessary to ensure cost-effective application (Jones, 2021).

Many new theories and educational models focus on learning and fidelity to real-world tasks or problems to support the application and transfer of knowledge. Research shows that training based on the 4C/ID model is more efficient than the traditional method (Melo & Miranda, 2015; Salary et al., 2023). Insufficient use of appropriate simulations in nursing education and the need to improve the quality of nursing education highlight the importance of this study. The effectiveness of task-centered learning models has been well established, and this study examines the effect of using the 4C/ID model and simulation environments with different fidelity. We examined the effect of the fidelity of learning tasks in an educational program on cardiac arrhythmia interpretation on nurses' satisfaction, attitude toward the learning environment, and learning. We hope that the study results will lead to a better understanding of the contribution of the fidelity of learning environments to the development of students' clinical skills and the development of effective strategies to improve nursing education and help students encounter clinical challenges.

LITERATURE REVIEW

Task-Centered Learning Environments

The philosophy of task-centered learning involves motivation, effectiveness, and internal efficiency, with a gradual reduction of scaffolding (Francom & Gardner, 2013). This type of learning provides learners with a complete set of tasks that are within the scope of their development (Frerejean et al., 2021). These tasks help learners integrate their knowledge, skills, and attitudes. Moreover, they encourage them to enhance basic skills and facilitate the application of learning to new situations (Francom & Gardner, 2014), which ultimately contributes to knowledge and promotes knowledge transfer to daily life and future work situations (Hosseinzadeh et al., 2024).

Authentic tasks require many interactions between different aspects of task performance and pertinent goals. Integrated goals require learners to effectively perform each aspect of a complex task separately and coordinate different aspects while implementing authentic tasks (van Merriënboer & Kester, 2014). In such environments, instruction and assessment are aligned, which means that the learning tasks are aimed at instruction, feedback, and assessment. Also, the concept of complex learning in such an environment does not refer to the difficulty of the tasks but rather to learning that requires coordination and integration of separate skills, leading to actual performance in the clinical environment (Costa & Miranda, 2019).

Four-Component Instructional Design Model and Fidelity of Learning Tasks

In 1990, van Merriënboer et al. proposed an integrative approach to 4C/ID for educational environments where complex learning occurs (van Merriënboer et al., 2018). This approach includes: (a) learning tasks, (b) supportive information, (c) procedural information, and (d) part-task practice.

Learning tasks are well organized, comprehensive, and authentic, proceeding from easy to difficult and integrating skills, knowledge, and attitudes. Learners are scaffolded during tasks, and the support is gradually reduced. Supportive information refers to information that is helpful for learning problem-solving and focuses on reasoning aspects of learning tasks. Such information bridges what learners know and what they need to know to work on learning tasks. Procedural information refers to information that is a prerequisite for learning and performing routine aspects of learning tasks. This information is provided only at the moment it is needed and is also called just-in-time information. Part-task practice refers to tasks that learners are given to help them achieve a very high level of automaticity for selected routine aspects of a task. These four components help learners manage cognitive load and develop strategies to advance their knowledge (Melo & Miranda, 2018).

Research on simulation by the National Council of State Boards of Nursing shows that high-quality, high-fidelity simulation can equivalently substitute for half of the traditional clinical hours when nursing students learn clinical reasoning skills (Hayden et al., 2014). Fidelity in task-centered learning environments (e.g., classroom, simulation, real) comes in different degrees. In classroom learning environments, fidelity is low, with more emphasis on self-directed learning (Reigeluth, 1979). In simulation environments, the degree of fidelity is moderate, and the resources and equipment available in the real world are used in the learning situation (van Merriënboer et al., 2024); in other words, students experience clinical situations before encountering real situations on the job (Brien et al., 2017). This experience helps them to develop cogni-

tive, emotional, and psychomotor skills in a safe and nonthreatening environment using realistic equipment that mimics the actual clinical environment (Cant & Cooper, 2010; Elendu et al., 2024). This teaching method uses mannequins with accurate physiological and pharmacological responses and helps learners experience empirical and interactive learning (Nagle et al., 2009). A natural environment (as an experience) with high-fidelity, full-scale computerized simulators provides a high level of interactivity and realism (Hanshaw & Dickerson, 2020).

Peahl et al. (2019) found that the 4C/ID model has a positive effect on knowledge, awareness, and decision-making performance. Melo (2018) used the 4C/ID model to design a digital learning environment and found that this model was more efficient than the conventional teaching method. Larmuseau et al. (2018) found that the online educational environment based on the 4C/ID model contributes to cognitive and motivational development. Similarly, Eyikara and Baykara (2018) showed that high-fidelity simulation in nursing education can positively affect learners' knowledge, skills, and attitudes. Also, high-fidelity situational simulation may positively influence student self-efficacy, learning satisfaction, psychomotor skills, and critical thinking (Aebersold, 2018).

Norman (2012) systematically reviewed the literature on nursing simulation between 2000 and 2010 and found that situational simulation education can improve nurses' communication skills and prevent medication errors, thereby increasing their knowledge, skills, safety, and self-confidence, enhancing patient safety. Jones (2021) noted that simulations for novices should be simple and focus on basic skills, and the difficulty level should match the overall demonstrated skill level. As the difficulty level of a practical simulation increases, it better matches the real-world environment. Hence, an increase in difficulty is equivalent to an increase in fidelity, but simulations with unrealistically high difficulty may show reduced fidelity.

Study Goals and Hypotheses

This study examined the effect of the fidelity of learning tasks on learning and satisfaction with the learning environment. It also examined nurses' attitude toward the quality of the learning environment. We hope that the results will contribute to applying the 4C/ID model in specialized training environments. Aligned with the research goals, the following hypotheses were developed:

1. The fidelity of learning tasks affects nurses' satisfaction with the learning environment.
2. The fidelity of learning tasks affects nurses' attitude toward the quality of the learning environment.
3. The fidelity of learning tasks affects nurses' learning.

METHOD

Research Design

This study used a pretest and posttest design with one control group to examine the effect of the fidelity of learning tasks based on the 4C/ID model on nurses' satisfaction, attitude toward the learning environment, and learning.

Participants

This research was conducted in one of the largest hospitals in Mashad, Iran. The participants recruited in this study were nurses working in the cardiac department and coronary care unit. The training course selected was Common Cardiac Arrhythmias Interpretation. Of all the nurses who enrolled in this training program, 100 were randomly placed into four groups of 25 (three experimental groups and one control group). The experimental groups were trained in three learning environments (group discussion, simulation, and on-the-job counseling), and the control group received traditional lecture-based education.

Intervention

The Common Cardiac Arrhythmias Interpretation course was developed for nurses based on the 4C/ID model. The duration of the training program was 4 hours and was the same for all groups. Learners in the control group received conventional instruction through a lecture, and those in the experimental groups were placed in three learning environments (**Table 1**).

Instruments

The variables of this study, satisfaction, attitude toward the learning environment, and learning, were measured with the following questionnaires.

Satisfaction Questionnaire. The satisfaction questionnaire included 18 questions evaluating satisfaction with instructors, course content, organization, and the facility and was scored on a Likert scale (where 1 is the lowest score and 4 is the highest score). Ten experts in curriculum planning, health education, and medical science education (two each in the following categories: faculty member at the school of nursing, PhD in nursing education, faculty member at the school of educational sciences and psychology, PhD in curriculum planning, master's student in education and human resources improvement) approved the content validity to calculate the validity of the satisfaction questionnaire. In addition, a content validity index and content validity ratio were used to assess the validity of the questionnaire, and the mean score of the indices was greater than 7. Karami (2008, 2011) examined the reliability of all questions

TABLE 1

STAGES OF INTERVENTIONAL RESEARCH

Phase	Method	Implementation
Planning	Selecting the topic	Using simulator learning tasks in nursing education to create a bridge between theoretical and practical training
	Designing the educational environment	Tasks: Preparing content aligned with the course objectives and the hierarchy of skills, compiling the table of contents based on the course objectives, specifying the task category based on the hierarchy of skills, specifying tasks for each assignment category
		Support: Providing learners with the information needed to complete assignments, completing assignments electronically
		Method: Explaining the key points to learners
		Part-tasks: Not presented because of time limits
	Designing the training course	Forming a team of experts in content, teaching, and curriculum planning to address problems with tasks and interactions with the learning environment
Implementation	Dividing the learners into experimental and control groups	Experimental group: Training in one of three learning environments (group discussion, simulator, and on-the-job counseling) based on the 4C/ID model
		Control group: Conventional training (lecture)
	Educating the instructor on the 4C/ID model	Experimental group 1 (group discussion): Arranging the classroom in groups, dividing learners into five groups of five, providing assignments
		Experimental group 2 (simulators in the clinical skills center): Meeting in the hospital's clinical skills center, dividing learners into groups of five, sending the profile of a hypothetical patient to the device, distributing the electrocardiogram according to assigned tasks, changing some tasks based on the facilities
		Experimental group 3 (counseling during work in the coronary care unit): Holding a training session in the coronary care unit, dividing learners into two groups of eight and one group of nine on 3 consecutive days to observe the patients and examine the electrocardiograms based on the course objectives
	Administering the pretest	Administering the learning questionnaire to three experimental groups and the control group before the start of the course
	Executing the training course based on the 4C/ID model (intervention)	Informing the nurses about the educational model and its steps, providing complete tasks at the beginning of each class, offering support and addressing problems before completion of each step, giving nurses procedural information based on the electrocardiogram
	Executing the training course in conventional form (lecture)	Administering the pretest at the beginning of the class, delivering a lecture, distributing the survey forms and posttest at the end of the session
Analyzing the effectiveness of instruction	Administering the posttest	Administering related questionnaires (satisfaction, attitude toward the quality of the learning environment, and learning)
	Variable: Learning	Administering the posttest

Note. 4C/ID = four-component instructional design.

with Cronbach's alpha coefficient and reported a coefficient of .93. Similarly, Ebrahimi Koushak-Mehdi et al. (2014) reported an alpha coefficient of .93. In this study, the reliability of this instrument was .85 (**Table 2**).

Attitude Toward the Learning Environment Questionnaire. To measure the quality of the learning environment, the quality of life in school questionnaire by Ainley and Bourke (1992) was adapted for the learning environment in the study. This questionnaire contained 39 items answered based on a 4-point scale (where 1 is the lowest score and 4 is the highest score) that evaluate seven components (success, negative experience, instructor, spontaneity in learning, opportunity, social solidarity, and overall satisfaction). To calculate the content validity of the attitude questionnaire, this instrument was approved by 10 experts in curriculum planning, health education, and medical science education. Also, this tool was evalu-

TABLE 2

COMPONENTS OF THE SATISFACTION QUESTIONNAIRE

Component	Definition	Sample topic
Instructor	Satisfaction with the instruction	Successful class management
Content	Satisfaction with the course content	Matching of the content with the educational program goals
Organization and facilities	Satisfaction with the delivery and execution of the course	Delivery of the program based on the schedule

TABLE 3

COMPONENTS OF THE ATTITUDE TOWARD THE LEARNING ENVIRONMENT QUESTIONNAIRE

Component	Definition	Sample item
Success	Confidence in the ability to succeed in the coursework	I felt successful
Negative experience	Overall negative experience with the training course	I got angry
Instructor	Positive mutual relationship between the learners and the course instructor	The instructor helped me do my work in the best way
Spontaneous learning	Sense that learning is enjoyable in itself	I enjoy the things I do
Opportunity	Positive attitude about the usefulness and relevance of the course	The course and the related tasks have prepared me for success
Social solidarity	Sense of belonging and worth; ability to get along with others	I could get along well with my fellow students
Overall satisfaction	Overall sense of relaxation and pleasure from the course	I felt happy

ated with content validity index and content validity ratio indicators. The mean score of the indicators was greater than .75, and the validity of all questions was greater than .8. The reliability of the attitude questionnaire was reported by Karami (2008, 2011) with a Cronbach's alpha coefficient of .92 and by Ebrahimi Koushak-Mehdi et al. (2014) with a coefficient of .94. In this study, the questionnaire was calculated to have a Cronbach's alpha coefficient of .94 (**Table 3**).

Learning Questionnaire. The learning questionnaire measured the knowledge, principles, concepts, content, facts, and skills that participants acquired during instruction. It included 10 open-ended questions aligned with the goals and content of the education. It was prepared as a pretest and posttest with the help of the course instructor. The face and content validity method was used, and 10 nursing experts approved its validity.

Data Collection

Instruction was carried out in accordance with the study goals. Nurses' satisfaction and attitude toward the learning environment were assessed with the questionnaires described earlier, and learning was assessed with the pretest and posttest.

Data Analysis

All statistical operations were performed with SPSS software, version 22 (IBM). The descriptive statistics of the variables were examined first, and then the research hypotheses were examined with multivariate analysis.

RESULTS

This research examined the effect of the fidelity of learning tasks in the educational program on cardiac arrhythmia interpretation on nurses' satisfaction, attitude toward the learning environment, and learning. **Table 4** shows descriptive data such as *M*, *SD*, and research components for the pretest and posttest.

Hypothesis 1. The fidelity of learning tasks affects nurses' satisfaction with the learning environment.

Multivariate analysis of variance was used to examine whether the fidelity of learning affected satisfaction. The Wilks lambda test ($F = 1796/59$, $p < .001$) showed a significant difference in at least one component of learner satisfaction between the 4C/ID groups and the control group. This finding suggests that the fidelity of learning tasks significantly affected nurses' satisfaction with the quality of the learning environment. Also, the post hoc test showed that among the three components of nurses'

TABLE 4

COMPARISON OF EXPERIMENTAL AND CONTROL GROUP RESULTS (MEAN ± *SD*)

Variable	Component	Experimental groups: Pretest: Group discussion	Experimental groups: Pretest: Simulation	Experimental groups: Pretest: On-the-job counseling	Experimental groups: Posttest: Group discussion	Experimental groups: Posttest: Simulation	Experimental groups: Posttest: On-the-job counseling	Control group: Pretest	Control group: Posttest
Learning		21.13 ± 12.04	21.97 ± 14.53	25.92 ± 10.26	61.16 ± 19.65	64.48 ± 18.16	76.25 ± 6.69	21.97 ± 14.53	65.75 ± 15.68
Satisfaction	Instructor				29.48 ± 5.34	30.2 ± 2.99	27.2 ± 4.88		26.81 ± 4.28
	Content				25.12 ± 5.05	25.66 ± 3.84	25.16 ± 4.07		24.04 ± 4.92
	Organization				21.04 ± 3.55	21.66 ± 3.19	19.92 ± 3.13		19.95 ± 2.29
Attitude	Success				12.8 ± 2.66	13.45 ± 1.69	12.68 ± 1.34		12.81 ± 1.94
	Negative experience				13.84 ± 3.38	15.91 ± 1.61	14.76 ± 1.76		14.72 ± 2.27
	Instructor				15.72 ± 3.33	16.7 ± 2.78	16.08 ± 2.28		14.63 ± 2.73
	Spontaneous learning				15.68 ± 3.85	16.33 ± 2.91	16.12 ± 1.98		14.22 ± 3.06
	Opportunity				19.16 ± 4.1	19.7 ± 2.92	19.4 ± 2.43		17.45 ± 4.06
	Social solidarity				15.52 ± 3.78	16.37 ± 2.41	16.08 ± 1.86		14.86 ± 2.47
	Overall satisfaction				11 ± 5.15	10.83 ± 5.09	11.76 ± 3.64		11.54 ± 2.75

satisfaction, a significant difference was observed in the instructors' scores on the subscale of negative experience between the two groups of lecture and group discussion (p = .04) and lecture with simulation (p = .01). However, other subscales showed no significant relationship with the group variable ($p < .05$).

Hypothesis 2. The fidelity of learning tasks affects nurses' attitude toward the quality of the learning environment.

Multivariate analysis of variance was used to examine whether the fidelity of learning affected nurses' attitude toward the learning environment. The Wilks lambda test (F = 2/39, $p < .02$) showed a significant difference in at least one component of quality of the learning environment between the 4C/ID groups and the control group. This finding suggests that the fidelity of learning tasks significantly affected nurses' attitude toward the quality of the learning environment. Also, the post hoc test showed that among the three components of the nurses' attitude toward the learning environment, a significant difference was observed in the instructors' scores on the subscale of negative emotion between the two groups of simulation and group discussion (p = .01) and lecture with simulation (p = .01). However, other subscales showed no significant relationship with the group variable ($p > .05$).

Hypothesis 3. The fidelity of learning tasks affects nurses' learning.

Parametric (one-way analysis of covariance and t test) and nonparametric (Kruskal–Wallis and Mann–Whitney tests) statistical tests were performed to determine which teaching methods made a difference in the experimental and control groups. A difference was found between the experimental group who received on-the-job counseling and the control group ($p < .001$). Comparison of learning performance between the experimental group who received on-the-job counseling and the control group who received instruction through lecture showed a significant difference. The higher mean score of the experimental group (M = 75/65) compared with the control group showed that after the intervention, learning performance in the experimental group increased (8/43) compared with the control group. Comparison of learning performance between the experimental group who participated in group discussion and the control group who received instruction through conventional lecture showed no significant difference in learning rate ($p > .39$, F = 0.85). Comparison of mean learning in the group who had group discussion (M = 16/61) with the mean score of the control group showed that the intervention did not cause a significant difference in learning performance.

Also, no significant difference was found between the simulation group and the control group in terms of learn-

ing performance ($p > .31$, $t = -1.02$) Comparison of mean learning in the simulation group with the mean score of the control group ($M = 65/75$) showed that after the intervention, the scores for these two groups were not significantly different.

DISCUSSION

The current research examined the effect of the fidelity of learning tasks in the educational program on cardiac arrhythmia interpretation on nurses' satisfaction, attitude toward the learning environment, and learning. The impetus behind this study was to understand whether the creation of 4C/ID learning environments and high-fidelity simulations that resemble the authentic learning environment can fill the gap between theoretical knowledge and practical experience. The results showed that the use of tasks with high fidelity in the cardiac arrhythmias training program significantly increased satisfaction, attitude toward the learning environment, and learning. Several studies have shown that use of the 4C/ID model in task-oriented learning environments has been effective for complex learning (coherence and integration of expressive learning; procedural learning, including perceptual and psychomotor skills; and emotional learning) (Francom & Gardner, 2013; Peahl et al., 2019; van Merriënboer et al., 2024). Also, in many studies, this model has been introduced successfully in holistic learning environments (Dolmans et al., 2013; Frerejean et al., 2021; Susilo et al., 2013). The current findings showed that those who benefited from learning environments based on the 4C/ID model (group discussion and simulation groups) were more satisfied than their counterparts in the on-the-job counseling group and the control group. In particular, the group who used simulators reported the highest level of satisfaction. The study found that, unlike the groups participating in group discussions and on-the-job counseling, nurses placed in an environment with optimal or moderate fidelity reported satisfaction and effective learning because learning through simulation empowered them to reconcile theory with practice and assisted them in making clinical decisions. These findings are consistent with other research (Holtslander et al., 2012; Maggio et al., 2015; Postma & White, 2015; Verheyden et al., 2011). All studies have shown that using the 4C/ID model and learning tasks increased nurses' satisfaction with the learning environment. The 4C/ID model improves the learning experience and increases satisfaction and the quality of education by focusing on practical and applied exercises in educational processes.

The current study showed that the fidelity of the learning tasks improves nurses' attitude toward the learning environment. Among all the components of the attitude toward the learning environment questionnaire, the simulation group had the highest score in the negative emotion subscale. This group reported that negative experiences, such as boredom, often occurred during classroom instruction, and they expressed greater satisfaction with simulation learning. This finding is in line with the studies of Cónsul-Giribet and Medina-Moya (2014) and Larmuseau et al. (2018), which examined the application and effect of the four-component model on learning outcomes, including attitude and motivation to learn. Their research found that this model positively affected attitudes and motivation to learn compared with conventional instructional methods. This finding suggests that increasing the fidelity of the learning environment by creating experimental and interactive learning conditions using mannequins with actual physiological and pharmacological responses increases the skill performance of learners and improves their attitude toward the learning environment.

Limitations and Future Studies

Because the medical field deals with human lives, conducting any training in an authentic environment is impossible. For example, patients hospitalized in the special care department are not in good health, and entrance to those environments is restricted. Therefore, simulation exposes nurses to situations that they might not encounter otherwise. This experience can enhance the quality of teaching and learning and improve their professional performance. The use of high-fidelity simulations in nursing education helps nurses practice the skills required to manage critical situations in a safe and controlled environment.

Despite the positive effects of using the 4C/ID model, this research has some limitations. For instance, in training the nurses who received on-the-job counseling, a small number of tasks were not included because of time limitations. Moreover, because of the inclusion criteria for the study, caution should be taken when generalizing the results. To increase the generalizability of the results, the 4C/ID model can be used to deliver educational courses for staff as well as clinical courses. Simulation can be incorporated into learning tasks to help students enhance learning and satisfaction with the learning environment.

CONCLUSION

The current study examined the effect of the fidelity of tasks on the satisfaction, attitude toward the learning environment, and learning performance of nurses participating in the cardiac arrhythmias interpretation course. The findings of this research show that learning tasks had a positive effect on instruction and increased nurses' satisfaction, attitude toward the learning environment, and learning compared with conventional educational methods. Among

these learning environments (group discussion, simulation, and on-the-job counseling), simulation was most effective. Simulations offer greater control over the sequence of tasks presented and the speed and process of performing tasks as well as accessibility to tasks that may rarely occur in the clinical environment. In addition, simulations can reduce costs and provide more favorable opportunities for learning than natural work environments.

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