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Efficacy of 4C/ID and the variability of learning tasks on teachers' personal initiative

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ABSTRACT

The current research aimed at delving into the impact of the 4C/ID and predetermined and emergent design variability in learning tasks on teachers' personal initiative in comparison to the conventional teaching method. The subjects of the study were the instructors of the metropolitan fire department in Iran. Frese et al. (1997. The concept of personal initiative: Operationalization, reliability and validity in two German samples. *Journal of Occupational and Organizational Psychology*, 70(2), 139–161) questionnaire was used to measure personal initiative, and to measure based on performance, a lesson plan was completed by the learners at the end of the course. Statistical analysis (one-way covariance analysis) carried out using SPSS 27 software showed that education based on the 4C/ID with diverse emergent tasks ($F = 88/92$, $P < 0.001$) and 4C/ID with diverse predetermined tasks ($F = 40/12$, $P < 0.001$) are more effective in developing teachers' personal initiative than conventional education. 4C/ID with diverse emergent tasks is more effective in the development of teachers' personal initiative compared to 4C/ID with diverse predetermined tasks ($F = 9.15$, $P < 0.005$). Thus, it is suggested that the 4C/ID with emergent learning tasks be scrutinized and studied as a suitable model for cultivating personal initiative.

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Personal initiative; task-centered learning; 4C/ID; learning tasks; emergent learning

Decades of empirical evidence have been well-established the critical influence of teachers' educational quality on students' learning, academic achievement, and holistic growth (Burić & Kim, 2020; Fauth et al., 2014; Huang et al., 2023; Kunter et al., 2013; Nilsen et al., 2016). One of the factors that contributes to the educational quality of teachers is the spontaneous and conscious behavior of people in the organization (Saffariantoosi & Khaleghi, 2024) as personal initiative (Herrera Mendoza & Gutiérrez, 2014; Montoro Fernández, 2021), which stands for work behavior reflecting self-initiation, proactivity, and sustainability (Hu et al., 2019; Lisbona Bañuelos et al., 2018). Personal initiative has been recognized as one of the eight key competencies contributing to lifelong learning (European Commission: Directorate-General for Education, Youth, Sport and Culture [EC], 2019). It is of vital importance to the professional development as well as psychological, social, and emotional health of teachers (Danitz et al., 2018; Griep et al., 2022; Matsuo, 2019; Robitschek et al., 2012; Weigold et al., 2013, 2020).

Education-associated jobs are among those that are increasingly becoming more complicated with new concepts and dynamic situations requiring greater personal initiative (Alpaydın & Kültür, 2022; Taghani & Razavi, 2022). Research (Frese & Fay, 2001; Guerrero, 2014; Voogt & Roblin, 2012) links personal initiative to personal identity, highlighting that educational systems have not yet sufficiently integrated the development of this critical competency. Conventional teaching methods, such as lectures, have an inflexible structure and impose numerous restrictions on learners. This approach deprives them of intellectual development, personal initiative, and discovery while hindering their ability to connect what they learn to real-world issues. Unlike conventional teaching methods, cultivating personal initiative as a competency necessitates flexible pedagogical approach and integrative learning experiences. This complex process requires learners to synthesize knowledge, attitudes, and skills – enabling them to translate theoretical

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concepts into practical applications (Moghadam & Razavi, 2022; Susilo et al., 2013). Modern pedagogical theories have delved into real-world learning tasks to enhance the transfer and application of knowledge (Salary et al., 2023). Several influential frameworks support this approach, including cognitive training theory (Brown et al., 1989), complexity theory (Reigeluth, 1979, 2013), the basic principles of education (Merrill, 2002; Merrill & Gilbert, 2008), and the 4-Component Instructional Design model(4C/ID) (Van Merriënboer et al., 1992; Van Merriënboer & Kester, 2014). Unlike traditional approach that exclusively focus on learning (Francom & Gardner, 2013), the 4C/ID model specifically emphasizes transferable learning outcomes (Frerejean et al., 2019; Zamharir et al., 2025) by incorporating carefully designed authentic tasks into the curriculum. The 4C/ID model achieves this through two fundamental mechanisms: (1) task variability in terms of time constraints, presentation formats, and structural characteristics (Van Merriënboer & Kirschner, 2017); and (2) flexible control approaches ranging from instructor-led to learner-directed or collaborative task execution (Corbalan et al., 2008, 2009). It has been assumed that these strategic variations significantly enhance learning transfer (Van Merriënboer & Kirschner, 2017). The 4C/ID model traditionally emphasizes predetermined task variability, where instructional designers specify both surface features (e.g. context, presentation format) and structural elements (e.g. problem types, complexity levels) of learning tasks (van Merriënboer & Kirschner, 2017). Tasks that appear different based on surface features might seem unique but can often be tackled using similar strategies. For example, a medical student learning to diagnose a particular condition, such as disease X, benefits most from practice with a variety of patients. These patients should represent diverse socio-economic and cultural backgrounds, including both genders, to ensure exposure to a wide range of scenarios. Conversely, tasks that differ in their structural features may look alike on the surface but demand completely distinct approaches. For instance, when a medical student is learning to differentiate between disease X and disease Y, the most effective method involves comparing and contrasting cases. This requires analyzing patients' presenting symptoms specific to either disease X or disease Y, enabling the student to refine their diagnostic proficiency. Therefore, in this conventional approach, learners engage solely in executing pre-designed problem-solving activities (Frerejean et al., 2021). However, an alternative extends this framework by incorporating learners' participation not only in the process of completing tasks but also in the process of designing them by identifying real-world problems. In this type of task design, which is the focus of this study, learners are provided with a group of diverse tasks in which they are encouraged to participate in both problem-finding and problem-solving. In problem-solving (pre-designed learning tasks), the learners or teachers seek to solve a specific and predetermined problem, but in problem-solving with problem-finding (emergent learning tasks), the learners bring relevant problems to the learning environment and engage in both problem formulation and solution development (Goodyear & Dimitriadis, 2013). Learning can be of two types: prescriptive and emergent. Prescriptive learning is stable and predictable and is based on prescriptive knowledge for learners. Emergent learning refers to learning that is unpredictable and results from the interaction between learners and their context. Since emergent learning is open and flexible, it is responsive to the context and can be quickly adapted (Williams et al., 2011). Emergent learning always goes beyond defined boundaries and anticipated outcomes and moves along unanticipated currents. Such learning includes spontaneous memories and speculation and places participant projects in the center, no matter if they correspond to the prescriptive final goals or not (Nemirovsky, 2018).

It is assumed that the 4C/ID model might contribute to the development of personal initiative in several ways: First, the model's emphasis on whole-task practice and cognitive strategy analysis (Van Merriënboer & Kirschner, 2017) aligns with the creative problem-solving demands of personal initiative. By requiring learners to navigate complex and variable tasks, 4C/ID stimulates the divergent thinking and mental flexibility central to initiative (Frese & Fay, 2001). Second, the model's use of real-world tasks (Frerejean et al., 2021) mirrors the unpredictable challenges where initiative emerges. When learners encounter job-like obstacles and conditions (e.g. time constraints, ambiguous information), they practice initiative-driven behaviors such as self-starting and persistence (Baer & Frese, 2003). Third, the manifestation of self-initiation and being active, two fundamental aspects of the initiative in this model, can occur by involving the person in the problem-solving process which requires complete independence. The model's fading support structure (van Merriënboer, 2019) gradually transfers task control to learners, fostering proactive behavior. Moreover, group tasks create social contexts for exercising initiative, as seen in shared problem-solving (De Jong & Den Hartog, 2010).

(1) Building on the established role of personal initiative in teachers' professional development and mental, social, and emotional well-being (Danitz et al., 2018; Robitschek et al., 2012; Weigold et al., 2020), the present study aims to compare the efficacy of the 4C/ID model with conventional teaching methods in fostering teachers' personal initiative. This study attempts to evaluate how task variability (predetermined learning tasks versus emergent and teacher-initiated tasks) impacts personal initiative development. Based on theoretical frameworks of 4C/ID (van Merriënboer & Kirschner, 2017) and personal initiative (Frese & Fay, 2001), this study aims to examine three hypotheses including (1) Teachers exposed to 4C/ID with predetermined task variability will demonstrate significantly higher personal initiative than those trained via conventional methods; (2) Teachers using 4C/ID with emergent, self-initiated tasks will show greater personal initiative than those using conventional methods; (3) Emergent-task 4C/ID will outperform predetermined-task 4C/ID in fostering personal initiative of teachers. This study provides several contributions. First, it bridges instructional design and proactive behavior by integrating the 4C/ID model's task variability principles with personal initiative theory to demonstrate how structured yet flexible learning environments can cultivate teachers' active mentality. Second, it advances this integration by proposing a framework that uses emergent tasks to better simulate real-world challenges, moving beyond the limitations of traditional predetermined task designs. Third, distinguishing between designer-controlled variability (predetermined tasks) and learner-driven variability (emergent tasks), offering empirical evidence for their differential impacts on initiative development. Fourth, this study may empower educational organizations by providing evidence-based strategies to design training programs that replicate real-life situational demands, fostering teachers' problem-finding and adaptive problem-solving skills. As well as by demonstrating how variability in learning tasks can activate proactive behaviors in professional settings. Three hypotheses guide this research:4C/ID with diverse emergent tasks significantly increases learners' personal initiative scores compared to conventional education.
(2) 4C/ID with diverse pre-determined tasks significantly increases learners' personal initiative scores compared to conventional education.
(3) 4C/ID with diverse emergent tasks significantly increases learners' personal initiative scores compared to pre-determined tasks.

Task-centered learning and 4C/ID model

The underlying philosophy of task-centered learning underlines motivation, effectiveness, and internal efficiency. It helps learners develop practical skills and knowledge by gradually reducing instructional scaffolding and facilitating the transition of learning into real-world applications (Chang & Chen, 2022; Francom & Gardner, 2013). This approach aims to enable learners to integrate knowledge, skills, and attitudes while mastering fundamental competencies (Francom & Gardner, 2014). By developing these core capacities, learners achieve a deeper understanding and enhanced ability to transfer their learning to real-world contexts (Hosseinzadeh et al., 2023), ultimately optimizing the learning process (Francom & Gardner, 2014). This approach emphasizes authentic tasks that demand dynamic interaction between multiple performance dimensions and their associated goals. These integrated goals serve two critical functions: (1) they support the development of discrete task components, while (2) simultaneously fostering the ability to synthesize and coordinate these elements for successful task completion (Van Merriënboer & Kester, 2014). As real tasks play an important role in learning transfer, task-centered approaches have been developed to promote learning transfer (Van Merriënboer & Kirschner, 2017).

Developed in the 1990s by van Merriënboer and colleagues, the Four-Component Instructional Design (4C/ID) model employs a holistic approach to teaching complex professional competencies. The model's foundational principle posits that effective instruction for complex learning requires four interrelated components, each addressing the integration of knowledge, skills, and attitudes, along with the coordination of their constituent elements (Frerejean et al., 2019; Nasrollahi et al., 2025). The 4C/ID model comprises four essential components: (1) *Learning tasks*: complete and authentic tasks designed to integrate skills, knowledge, and attitudes. These tasks are structured in increasing complexity while instructional scaffolding is systematically faded as learners gain proficiency. (2) *Supportive information (theory):* This component provides the conceptual foundation for problem-solving and reasoning within learning tasks. It bridges learners' prior

knowledge with new knowledge, enhancing task relevance and applicability (Merrill, 2017). (3) *Procedural Information:* A teacher or user guide supports the learner and explains how to deal with routine aspects of the task while doing it. This information is always specified at the basic level and learners with minimal prior ability can understand it (Van Merriënboer, 2019) (4) *Part-task exercise*: Targeted exercises help learners manage cognitive load and develop cognitive strategies to improve knowledge (Melo & Miranda, 2018). Their goal is to strengthen cognitive rules through extensive repetition, which eventually leads to fully automatic cognitive schemas (Güney, 2019; Van Merriënboer, 2019).

Due to its inflexible structure, conventional education has failed to meet the needs of modern society. Critics argue that this approach not only fails to impart relevant skill sets but also stifles personal initiative, acting as a barrier to development (Campos et al., 2017). In contrast, task-centered environments design activities around real-world contexts, enabling learners to construct cognitive schemas for generalizing practical experiences (Van Merriënboer & Kester, 2014; Frerejean et al., 2019). Learning tasks of equal complexity are grouped to form task categories sequenced from simple to complex. At each level of complexity, there should be a variety of tasks. Tasks with a low level of complexity are the simplest tasks that learners start with and tasks with a high level of complexity are the most difficult tasks that a professional and a newly graduated student can do (Frerejean et al., 2019). As a result of being exposed to a high variety of work-related tasks, learners can more effectively deal with complex problems in a specific domain (Birnbaum et al., 2013; Froehlich et al., 2019).

Personal initiative

Recent scholarship has increasingly recognized personal initiative as a critical competency for lifelong learning within educational contexts (Martín-Gutiérrez et al., 2023). Personal initiative refers to proactive, self-directed behavior that aligns with an organization's mission. It is characterized by a long-term perspective, goal-oriented action, and pragmatic problem-solving to overcome obstacles, often extending beyond formal job responsibilities (Frese & Fay, 2001).

Personal initiative serves as a critical performance metric, reflecting both an individual's professional effectiveness and entrepreneurial potential (Frese, 2020). The significance of personal initiative is underscored by its dual role in human-environment interaction: while individuals are shaped by their surroundings, they also actively modify their environment through purposeful action (Tornau & Frese, 2013). This proactive orientation enables individuals to identify and capitalize on opportunities by maintaining cognitive openness to novel ideas and unexplored possibilities that others may overlook (DeShon & Gillespie, 2005). This may ultimately lead to environmental transformation (Frese & Fay, 2001).

Frese and Gielnik's (2023) research demonstrates that personal initiative significantly enhances job performance, particularly when employees actively seek feedback and cultivate meaningful work experiences. This effect occurs because personal initiative fosters both skill development and effective career self-management. Research by Lisbona Bañuelos et al. (2018) demonstrates that work engagement and self-efficacy positively influence personal initiative. This relationship is further supported by Kagan et al. (2021), who found that work engagement correlates strongly with proactive behaviors, including creative problem-solving, innovation, receptiveness to feedback, obstacle identification, and data-driven planning to anticipate challenges while adapting to future opportunities.

The impact of personal initiative extends across domains. Liando and Lumettu (2017) identified it as a key factor in student development, particularly in enhancing speaking skills. In organizational contexts, Campos et al. (2017) revealed that targeted personal initiative training boosted company earnings by 30% – nearly triple the 11% improvement observed with conventional training methods.

Method

Research design

This study used a pre-test-post-test design with a control group to compare the effect of the 4C/ID and the variability component of learning tasks on the teachers' personal initiative with the conventional teaching method (Figure 1).

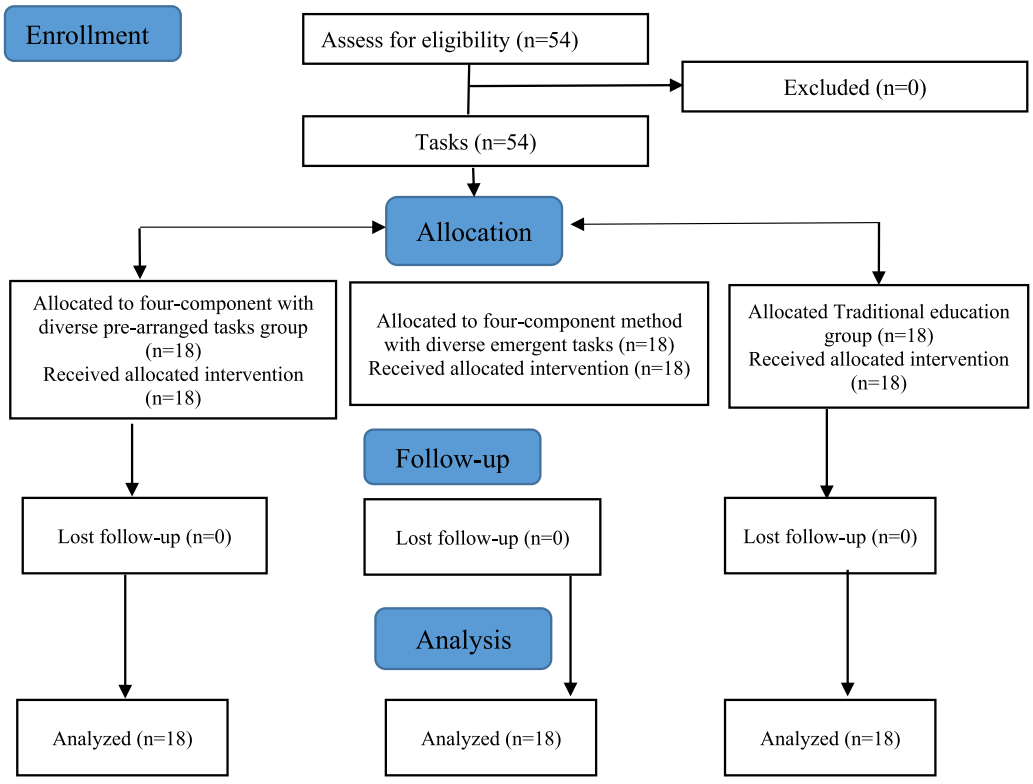

Figure 1. CONSORT flowchart.

Participants

The subjects of this study were the instructors in the fire department in a large city in Iran. The diagnosis criteria were having an official teaching certificate from the Human Resources Department of the municipality. Since one of the issues faced by the instructors of this organization was increasing the motivation of the learners, a training program titled Motivational Teaching Design based on the ARCS model was designed and held for 4 h to develop teaching skills. Out of 75 available instructors, 54 registered in the program. The inclusion criteria were having at least three years of teaching experience and completing an introductory training program in teaching methods. The exclusion criteria were not attending the program fully and not wanting to continue participating in the study. Subjects were randomly placed into three groups of 18 people. Two experimental groups (four-component training with diverse predetermined tasks and diverse emergent tasks) and a control group were trained with the conventional method. The training course for the three groups was held for three consecutive days.

Learning intervention

Before carrying out the research, a meeting was held with the vice president of education of the fire department in Mashhad. After exchanging views on the educational needs of the organization, "Motivational Teaching Design" was selected as the subject of the training course, and then two different types of design were selected: The four-component method (including predetermined tasks) and the four-component method (including emergent tasks). The description of each is presented in the Table 1.

Instruments

In this research, personal initiative was a dependent variable. Since personal initiative is considered a skill, to measure this variable more comprehensively and accurately, a sample lesson plan was completed by the learners at the end of the course. To measure personal initiative based on performance (lesson plan), a researcher-made tool was used with the coding method by an expert. The evaluation criteria of personal

initiative behavior in the teachers' lesson plans based on the ARCS model were developed on a 5-point Likert scale based on the standards of personal initiative. The aspect of self-initiation in developing the lesson plan was measured by the appropriateness of set goals (in the three dimensions of knowledge, attitude, and skill) to the level of the course, the target group, and the number of goals that are aligned with the nature of the program and learners and in accordance with the goal-setting principles. The aspect of being active was evaluated by the quality of the lesson plan but beyond the conventional form. Active behaviors included overcoming obstacles by considering the conditions and implementation barriers, the practicality of the plans, and preparing an alternative plan for problems (Appendix 1).

To guarantee the validity of the instrument, the assessment criteria and the varying performance levels associated with each specific criterion were meticulously defined. Detailed descriptions outlining what qualifies as excellent, good, average, or poor work were established. Content validity served as the foundation for assessing validity, with experts reviewing the test items to ensure their relevance and representativeness. To assess inter-rater reliability, 50% of the motivational lesson plan, selected and coded by one more coder. The average of all Kappa values per category was between .81 and .89 ($M = .86$).

Frese et al. (1997) questionnaire was used to measure this variable in the stage of the pre-test phase. This questionnaire is self-reported and contains seven statements on a 7 Likert scale (1 stands for completely disagree and 7 stands for agree). The validity of this tool was measured by Van der Drift (2019) using the KMO test and reported to be 0.853, and Bartlett's test with values of approximate Chi-square = 624.647, df = 21, sig = .000 was reported, and the reliability for this test using Cronbach's alpha was reported to be 0.88.

Data collection procedure

The instructors were divided into three groups of 18 in a face-to-face training course and a personal initiative questionnaire was distributed among them at the pre-test stage and explanations on how to complete the questionnaire were provided. The control group (the first group) received the lessons through the conventional method in which the instructor delivered the material to them through a lecture. During the lecture, the instructor used examples to answer the students' questions and provided the necessary information to them. The students were required to memorize the contents and information. In the second group, the students were trained based on the four-component method with predetermined tasks, i.e. tasks that were provided by the instructor, and in the third group, the students received the ma four-component method with emergent tasks, i.e. tasks that are the responsibility of the student to prepare. In the end, for performance-based evaluation, the form was provided to the participants (Appendix 1 or 2) to complete at the end of the course. The following table is an example of the phases that must be taken in designing a training course to create diverse learning tasks (Table 2).

Data analysis

Descriptive statistics (mean, standard deviation) for each group were used to analyze the research data. Moreover, in order to investigate the efficiency of the 4C/ID compared to the conventional method and to compare the efficiency of the 4C/ID in terms of the variety of predetermined tasks and the variety of emergent tasks the pre-test-post-test plan with the control group. The data was analyzed with the univariate covariance analysis method (ANCOVA) using SPSS version 26 software. The Shapiro–Wilk test was employed to assess the normality of the population, given the small sample size in each group ($n < 50$). The homogeneity of variances was evaluated using Levene's test for equality of variance errors, along with an assessment of the assumption of homogeneity in regression.

Result

In this section, first, the descriptive statistics of the variables including means and standard deviation are examined, and then the research hypotheses are examined using ANCOVA.

Table 3 shows that in the post-test of personal initiative, the mean scores of the subjects in the four-component experimental groups, which included both emergent and predetermined tasks ($M = 6.40$), and the four-component experimental group with a variety of predetermined tasks ($M = 5.43$), are higher than

Table 1. Implementation stages of interventional research.

Phases	Method	Application
Design	Selecting the topic	Before carrying out the research, a meeting was held with the vice president of education of the fire department in Mashad. After exchanging views on the educational needs of the organization, "motivational teaching design" was selected as the subject of the training course, and then two different types of design were selected: The four-component method (including pre-arranged tasks) and the four-component method (including emergent tasks)
	Designing the Educational environment based on the emergent 4C/ID model	Employing two inductive-explanatory and inductive-exploratory strategies in this course 1. Learning tasks: (a) providing explanations about the way of conducting the course to the learners by the instructor, (b) encouraging the participation and attention of the learners by asking a question and expressing opinions by the learners, (c) presenting a simple task to the learners to complete, (d) Presenting tasks to the class as a group. 2. Supporting information: providing this information to the learners using an inductive-explanatory strategy (using examples and expressing their own experiences) to better understand the learner. 3. Procedural information: (a) Discovery of methodical information and relationships between their learning by learners in an exploratory way. 4. Presentation of part-tasks: due to the limited time, part-tasks were not presented in both emergent and pre-arranged groups.
	Designing the Educational environment based on the pre-arranged 4C/ID model	Providing a brief explanation of how to conduct the class to the learners to familiarize them with this type of education. 1. Learning tasks: presenting a simple task to the learners and performing that task by them. 2. Supporting information: (a) providing this information to learners along with an inductive-explanatory strategy and reinforcing it with a case study and examples; (b) Presenting the first tasks to the learners and taking care of it in groups. 3. Procedural information: (a) providing this information to the learners before starting the task, both verbally and written in the form of PowerPoint slides in the class, (b) providing two sources of methodical information (slides and teacher's guidance) to the learners while were doing the tasks, (c) communication and consultation of learners with each other regarding the methodology and how to do tasks; (c) reducing the presentation of methodological and supporting information and encouraging them to solve the latest tasks based on what they have learned using support by learners, (d) providing cognitive feedback about each category of tasks to learners.
	The training course on motivational design of teaching in the traditional way (traditional group)	(1) Presenting the material through a lecture with a slide show to the learners and starting the teaching by posing a question to attract the participation of the learners, (2) Discussing and exchanging the opinions of the learners and expressing their experiences on the topic in question, (3) Explaining the steps of the ARCS model by the teacher and Taksim The topic of self-teaching is divided into four stages: (a) using examples during self-teaching to better understand the topic and taking notes of important points by the learners, (b) presenting the desired content to the learner by the teacher and completing the assignments related to the parts of the lesson plan by the learners and repetition This process for all four stages (attention, communication, confidence, satisfaction) of the ARCS model, (c) memorization of information by learners, (d) recalling the material to active memory at the end of each section to solve their homework
Implementation	Administering pre-test	Administering the personal initiative in experimental groups at the start of the course
	Administering post-test	Administering the personal initiative in experimental groups at the end of the course
Analysis of the intervention efficiency	Descriptive statistics	Mean and standard deviation for each group were used to analyze the research data
	Inferential statistics	The data was analyzed with the univariate covariance analysis method (ANCOVA)

Table 2. Tasks of the ARCS model with pre-arranged and emergent tasks.

Phases of ARCS	Problem	The experimental group was treated with pre-arranged tasks	The experimental group was treated with emergent tasks
Attention	Problem 1: The educational program titled "The Role of Values in Life" is going to be held for secondary school students. At the beginning of the class, what can the instructor do to attract the attention of the learners?	Task 1: An educational program titled "Moving in Smoke" will be held for citizens in the amphitheater. What can be done to capture attention at the beginning of the program?	Task 1: Note down a problem you have faced or think instructors usually face in attracting the attention of learners in the educational program. What do you suggest to solve this problem based on the ARCS model?
		Task 2: Select a curriculum that you have mastered and write in the form of the next lesson plan in the attention section What do you do to attract the attention of the learners?	Task 2: Select an educational program that you have mastery over its content and write in the lesson plan (attention section), what you are going to do to capture the attention of the learners.
Association	Problem 2: The training program titled "Conflict Management" is going to be held for managers of an automobile company. What should be done to connect the content with the needs and experiences of the learners?	Task 3: A home safety training program is to be held for housewives. What can be done to associate the content with the experiences and needs of the learners?	Task 3: Write down a problem you have faced or think teachers usually face regarding the relationship between the content of the program and the needs and experiences of learners in the educational program. What do you suggest to solve this problem based on the ARCS model?
		Task 4: For the selected educational program, write what you do to associate the content of the educational program with the experiences and needs of the learners in the lesson plan form in the communication section.	Task 4: For the selected educational program in the upcoming lesson plan form (Association section), write what you do to connect the content of the educational program with the experiences and needs of the learners.
Sense of Security (Self-confidence)	Problem 3: SPSS training program for humanities students is going to be held. Usually, these students have a negative self-concept in learning computer software. How can you increase their self-confidence in learning?	Task 5: A firefighting training program for new employees of an automobile company is supposed to be held at that company's location. Many participants have a fear of working with an extinguisher and not succeeding. What can be done to solve this problem?	Task 6: Note down a problem about the low self-confidence of learners in the educational program that you have faced or think teachers usually face. What do you suggest to solve this problem based on the ARCS model?
		Task 6: For the selected educational program in the upcoming lesson plan form (the sense of security section), write what you do to create the expectation of success in the learners and make them feel succeeded.	Task 6: For the selected educational program in the upcoming lesson plan form(the sense of security section), write what you do to create the expectation of success in the learners and make them feel succeeded.
Satisfaction	Problem 4: The educational evaluation course is held for undergraduate students of educational sciences. What can be done to make them feel satisfied?	Task 7: A training program titled "First Aid and Rescue" is supposed to be held at the station for new employees of the fire department. What do you do to create a sense of satisfaction in learners?	Task 7: Write a problem regarding the low satisfaction of learners in the educational program that you have faced or think that teachers usually face. What do you know the reason for it? What do you suggest to solve this problem based on the ARCS model?
		Task 8: For the selected educational program in the upcoming lesson plan form, write what you do to create a sense of internal and external satisfaction in the learners.	Task 8: For the selected educational program in the upcoming lesson plan form, write what you do to create a sense of internal and external satisfaction in the learners.

those in the control group ($M = 4.29$). Comparatively speaking, the mean in the four-component experimental group with diverse emergent tasks was higher than the mean in the four-component training group with diverse predetermined tasks. The Shapiro–Wilk test results confirmed that the population followed a normal distribution ($P < 0.05$).

Table 3. Means and standard deviations of the variables in the control and experimental groups (4C/ID).

4C/ID								Conventional			
Emergent tasks				Predetermined task							
Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test	
SD	M	SD	M	SD	M	SD	M	SD	M	SD	M
0.73	6.40	0.83	3.81	0.86	5.43	1.23	3.18	1.02	4.29	0.89	3.67

Hypothesis 1: Teachers exposed to 4C/ID with predetermined task variability will demonstrate significantly higher personal initiative than those trained via conventional methods The results of Levine's test indicated that the assumption of homogeneity of variances was fulfilled ($P < 0.05$, $F(1,34) = 1.34$). The results of examining the assumption of homogeneity of regression slopes also indicated that this assumption was fulfilled ($P < 0.05$, $F(1,32) = 2.60$). ANCOVA was used to compare the effect of 4C/ID with diverse predetermined tasks on teachers' personal initiative with the conventional method. This analysis was carried out to compare the means of the groups in the post-tests of personal initiative results in the 4C/ID with predetermined tasks ($M = 5.43$), 4C/ID with emergent tasks ($M = 6.40$), and conventional ($M = 4.29$) groups. The difference between the post-test adjusted means of the two experimental and control groups is statistically smaller than 0.01 ($F = 40/12$, $P < 0.001$). Therefore, the subjects in the four-component experimental group with a variety of predetermined tasks had a higher mean than the subjects taught using the conventional method (5/59 vs. 4/14) and the efficiency of the intervention on personal initiative was 0.55%. This means that 55% of the variance in post-test scores can be accounted for by the intervention condition.

Hypothesis 2: Teachers using 4C/ID with emergent, self-initiated tasks will show greater personal initiative than those using conventional methods The Levine test results confirmed that the assumption of homogeneity of variances was met ($P < 0.05$, $F(1,34) = 0.54$). Similarly, the analysis of the homogeneity of regression slopes showed that this assumption was also satisfied ($P < 0.05$, $F(1,32) = 0.49$). To test the hypothesis, univariate covariance analysis was used to investigate the effect of 4C/ID with diverse emergent tasks compared to conventional teaching on teachers' personal initiative. Examining the results of covariance analysis ($F = 88/92$, $P < 0.001$) at the 99% confidence level showed the significance of the univariate test index and intergroup differences in personal initiative. This means that the subjects of the 4C/ID with a variety of emergent tasks had a higher mean compared to their counterparts in the conventional group (6/35 vs. 4/35). The effect of the intervention on personal initiative was 0.73%. That means, 73% oof the variance in post-test scores can be accounted for by the intervention condition.

Hypothesis 3: Emergent-task 4C/ID will outperform predetermined-task 4C/ID in fostering personal initiative of teachers. Levine's test results confirmed that the assumption of homogeneity of variances was met ($P < 0.05$, $F(1,34) = 0.12$). Similarly, the evaluation of the homogeneity of regression slopes indicated that this assumption was also satisfied ($P < 0.05$, $F(1,32) = 0.70$). Based on the results of the assumptions of normality and homogeneity of variances and the significance of the test index ($005/0 > P$), it can be emphasized that there is a significant difference between the two experimental groups where one group was treated with diverse emergent tasks and the other with diverse predetermined tasks at a confidence level of 95%, and personal initiative has been associated with intervention in learners.

A parametric test (Univariate Covariance Analysis) was used to understand if the four-component teaching method with diverse emergent tasks or the four-component teaching method with a variety of predetermined tasks has caused a difference in the personal initiative of teachers. The result of covariance analysis ($P < 0.005$, $F = 9.15$) showed the significance of the test at the 95% confidence level. The comparison of the adjusted means also showed that the subjects of the four-component training group with diverse emergent tasks had a higher mean than the counterparts of the four-component experimental group with predetermined tasks (6.23 against 5.61). The effect of the intervention on personal initiative was 0.22%. This means that 22% of the variance in post-test scores can be accounted for by the intervention condition.

Discussion

In modern education systems facing increasing demands for adaptive teaching competencies, personal initiative has become an essential skill for educators to navigate dynamic classroom challenges. Teachers with this capability demonstrate proactive, self-regulated professional development, maintaining pedagogical focus while implementing innovative strategies to overcome instructional obstacles. This study investigates the effectiveness of the 4C/ID instructional model – particularly the variability principle in learning task design – for developing teachers' personal initiative, comparing its outcomes with conventional professional development approaches. The study results demonstrated that teachers in the experimental group – who received four-component instruction (4C/ID) with varied pre-designed tasks – showed significantly greater improvement in personal initiative compared to those receiving conventional training. These

findings support previous research by Campos et al. (2017), which established that active learning approaches foster personal initiative more effectively than traditional methods. Additionally, the results align with Moradi et al. (2018), who found the 4C/ID model superior to conventional instruction for developing learner creativity and divergent thinking skills. This finding can be explained by fundamental differences in cognitive engagement between the two methods. In conventional instruction, learners passively receive information without activating personal initiative, resulting in limited engagement of deeper cognitive processes. In contrast, the 4C/ID model's predetermined problem-based tasks require active environmental interaction and cognitive resource mobilization. As learners must continually exercise initiative to complete tasks, this repeated engagement facilitates both skill development and personal growth through progressive challenge.

The participants in the 4C/ID group, which utilized diverse emergent tasks, demonstrated significantly greater improvement in personal initiative compared to those receiving conventional instruction. These findings align with Workman et al. (2011), who reported superior performance in creativity and medical reasoning among learners exposed to four-component teaching, further validating the effectiveness of problem-based approaches for fostering innovative thinking. The success of the 4C/ID model may stem from its inherent emphasis on self-initiated learning. Unlike conventional methods that rely on direct content delivery, this approach requires students to take ownership of task completion throughout the learning process. Such continuous engagement creates consistent opportunities for personal initiative development – a growth potential largely absent in traditional, teacher-centered instruction.

The comparative analysis revealed that the 4C/ID approach utilizing diverse emergent tasks significantly enhanced teachers' personal initiative more than the version employing pre-arranged tasks, as evidenced by higher mean scores in the experimental group. This superior effectiveness aligns with Strauss and Parker's (2015) findings that problem-focused interventions promote active learning behaviors – a core dimension of personal initiative. The emergent task variant's success can be explained through the tripartite framework of personal initiative: (1) self-initiation, (2) active engagement, and (3) obstacle overcoming. First, by requiring learners to identify and bring problems to class, the emergent approach inherently strengthens self-initiation. Second, the task-centered nature of 4C/ID ensures sustained active engagement. Third, as participants assume ownership of both task selection and solution, they necessarily develop strategies to overcome challenges. Conversely, in the pre-arranged task condition, reduced self-initiation opportunities occur because instructors provide the tasks. This teacher-centered element diminishes learners' sense of responsibility, potentially leading to external attribution of challenges ("the teacher gave this difficult task") rather than the internalized accountability fostered by emergent tasks.

Conclusion

Personal initiative, like creativity, inherently requires complex and divergent thinking. The 4C/ID model's task-oriented design systematically cultivates these cognitive processes through its two core analytical phases: (1) cognitive strategy analysis and (2) mental pattern analysis. This framework naturally incorporates all dimensions of personal initiative: self-initiation, proactive behavior, and obstacle overcoming. The model operationalizes these dimensions through specific mechanisms: (1) Proactive engagement: achieved via multifaceted task involvement (task selection, feedback reception, and access to supportive/procedural information), culminating in part-task practice for content mastery. (2) Obstacle overcoming: facilitated through goal-focused subtasks that develop automated performance capabilities, enabling more effective challenge navigation.

The critical distinction between emergent and predetermined task variants lies in self-initiation. While the predetermined format presents teacher-generated problems, the emergent version requires learners to: (1) identify level-appropriate problems under teacher guidance and (2) develop and implement solutions. This problem-generation phase fundamentally strengthens personal initiative by transferring learning control to students. Consequently, emergent 4C/ID demonstrates superior efficacy in initiative development compared to both predetermined 4C/ID and conventional methods, as it comprehensively addresses all three initiative components through its structured yet flexible framework.

Research limitations, future directions and practical implications

While this study provides valuable insights, several limitations should be acknowledged. First, the relatively small sample size may affect the generalizability of the findings. Second, the multifaceted nature of personal initiative poses measurement challenges, particularly when assessed through lesson plan evaluations. Third, the reliance on self-reported questionnaire data introduces potential response biases, as participants may have provided socially desirable answers rather than accurate reflections of their capabilities. These limitations suggest several productive avenues for future research including: replication studies with larger, more diverse samples across different educational contexts, development of more robust, multi-method assessment tools for personal initiative, and longitudinal designs to examine the sustained impact of 4C/ID training. Moreover, based on our findings, we recommend two following practical applications: comprehensive professional development programs introducing educators to 4C/ID principles and implementation strategies and specialized in-service training focusing specifically on the emergent task variant of the 4C/ID model.

Authors' contributions

M.K. and A.F. designed the study. Z.H.S. and M.K. performed the experiments. Z.H.S. and Z.Kh. Analysed the data. Z.Kh. wrote the paper with input from all authors. All authors discussed the results and contributed to the final manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Ethics approval and consent to participate

This study was carried out in Iran in accordance with the applicable rules concerning the review of research ethics committees and informed consent (The Research Ethics Committee of the Ferdowsi University of Mashhad).

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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