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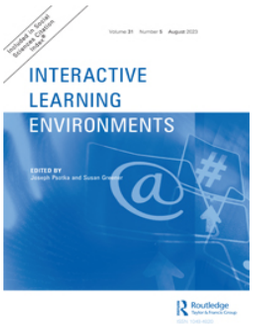

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Developing media literacy as complex learning in secondary schools: the effect of 4C/ID learning environments

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ABSTRACT

Background: Today, the importance of teaching media literacy in education has been highlighted, and the need for effective instructional design in this field has received more attention. This research attempts to investigate the effect of the Four-Component Instructional Design (4C/ID) model on developing media literacy. Method: This study employs a quasi-experimental pre-test-post-test design. The research subjects were recruited from tenth-grade students at secondary schools in Mashhad, Iran. A total of 30 students were selected as the sample using the convenience sampling method. Fifteen students were placed in the experimental group, and the rest were placed in the control group. Result: Statistical analysis (ANCOVA, MANCOVA & MANOVA) showed that designing instruction based on the complex-learning model (4C/ID) improved learning outcomes, critical thinking, and conscious interaction with the media. Conclusion: Acquiring media literacy competence is a complex learning process. Based on the results of this study, the four-component instructional design model (4C/ID) can promote the development of media literacy skills in students.

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4C/ID; media literacy; critical thinking; complex learning

1. Introduction

The spread of advanced technologies in today's digital age has facilitated quick access to new information and made sending media messages to masses of people much easier. However, access to technological devices or the ability to use them does not guarantee valid and reliable information (Koc & Barut, 2016). People who are literate in the use of digital media and can monitor and control their performance are less likely to misperceive the informational messages of the media (Römer et al., 2022; Su et al., 2022). To prepare people for a changing world, educational programs need to adopt strategies that focus on developing critical thinking, problem-solving, research, and life-long learning (Jugl, 2022; Luan et al., 2020).

Media literacy refers to the ability to access, analyze, and evaluate various types of information in print and non-print forms (Hobbs & Jensen, 2009; Wallis & Buckingham, 2019; Zhang et al., 2014). Developing media literacy, which is related to cognition, attitude, and skills, is considered complex learning. Complex learning aims to combine knowledge, skills, and attitudes; to create coordination among qualitatively different constituent skills; and to transfer what has been

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learned to life and work settings (van Merriënboer & Kirschner, 2017). For teaching media literacy, educational institutions attempt to develop the competencies of young students to make them able to analyze media content actively (Sekarasih et al., 2018) Because media literacy is a competency that by cultivating, learners can have a critical view of media content and act independently (Dezuanni, 2018; O'Rourke et al., 2022). Therefore, it is necessary to try to provide plans that promote media literacy education (Kahne & Bowyer, 2019).

Researches show that in some educational systems, media literacy is considered an independent subject, which is presented in the form of a specific textbook with its theoretical content. This type of exposure to media literacy is based on the protectionist approach that learners only learn descriptive information and no skills are taught (Carlsson, 2019; O'Rourke et al., 2022; Rasi et al., 2019).

A task-centered learning approach is an approach that supports certain practices for instructional design and teaching to promote learning and transfer of learning (Frerejean et al., 2021). Instead of focusing on learning through lectures, the task-centered approach focuses on learning tasks that require students to apply knowledge to a specific domain by completing a selected set of real-world tasks (Francom & Gardner, 2013).

Using authentic learning tasks can promote learning transfer and develop complex cognitive skills. Such tasks provide learners with an opportunity to complete whole tasks that include a wide range of constituent skills required for task performance and support and guidance (van Merriënboer & Kirschner, 2001). Several models of task-centered learning use real-world problems such as Cognitive Apprenticeship (Collins et al., 1991), First principles of instruction (Merrill, 2002), and four-component instructional design (4C/ID) (van Merriënboer et al., 2002; van Merriënboer & Kirschner, 2017).

In their review of task-centered learning models, Francom and Gardner (2014) show that most of these models share five principles, which are similar to the First principles of instruction proposed by Merrill. Considering the importance of developing media literacy in teenagers, in the present research, we seek to investigate the effects of the 4C/ID model on the basic component of media literacy. A study in which developing media literacy based on the 4C/ID model is validated in a conventional classroom, those are teacher-based, might generate new insights into the validity of the 4C/ID model for different educational systems. There is no empirical evidence of the effectiveness of the 4C/ID model in developing media literacy competency in the public education setting**.**

2. Literature review

2.1. Media literacy

The twenty-first century has shown unprecedented progress in the field of new media. The media has become so widespread and found a way into various aspects of our society (Su et al., 2022). The mass media have taken over the transfer and guidance of a wide range of symbols, norms, values, opinions, messages, and thoughts within society to the extent that some experts believe that the media will transform the entire socio-cultural life of people (Guan et al., 2022). New media are not just technical tools with a slight effect on culture; rather, they are tools contributing to a new culture from which they cannot be separated (Cho et al., 2014). At the same time, with the rise of media literacy, researchers and educators have tried to provide definitions of media literacy and reach a consensus on various issues such as information literacy, digital literacy, critical literacy, and news literacy (Choi et al., 2019). Media literacy includes a range of different skills, such as the ability to acquire, analyze, evaluate, and produce messages in various forms (Wallis & Buckingham, 2019).

Media literacy has been conceptualized as teaching students about media and how to access and understand its content (i.e. media consumer), create media content, and share it with others (i.e. media production) (Koc & Barut, 2016). The goal of media literacy education is to promote more skepticism towards media messages related to appearance (i.e. Body image) by increasing critical

thinking skills (Berel & Irving, 1998). Potter (2021) believes that media literacy includes not only skills but also knowledge structures and personal position. In this view, analysis, evaluation and production are competencies that can be used to interpret media messages (Cho et al., 2022; Potter, 2021). Social media analysis competency includes the ability to monitor and observe the behavior, motivations, and outcomes of social media use (Cho et al., 2022). Competency deals with the evaluation and realism of the content that a person chooses and consumes. This includes subjective judgments about the contents to see whether they reflect the real experiences of their creators or not (Cho et al., 2014, 2019). Also, production means the ability to create counter-messages against dominant media messages, which can be shared with others with the participation of people of these precise counter-messages (Cho et al., 2022; Mihailidis, 2018). In fact, according to the nature and goals of media literacy, this learning is considered a complex learning that includes complex skills and specific cognitive processes (de Abreu et al., 2019).

The conceptual basis of media literacy has several components in the three dimensions of knowledge, skill and attitude, which understanding is essential for researchers' empirical studies. In most conceptualizations about media literacy, its knowledge and skill dimensions are more visible, while behaviors, emotions and beliefs are another dimension of media literacy (James & Chan, 2016; Potter, 2021). Also, each of these dimensions includes a wide scope, which complicates the learning of media literacy (James & Chan, 2016). Accordingly, this type of complex learning requires the use of special educational design models such as the 4CID model.

2.2. Task-centered learning

Task-centered learning environments attempt to have a trade-off between scaffolding for the learner and self-directed learning. This is a factor that distinguishes this environment from the problem-based one (Doran, 2022).

The underlying philosophy of task-centered learning is intrinsic motivation, effectiveness, and efficiency with slowly reduced scaffolding and prioritizing the transfer of learning to the real world (Chang & Chen, 2022 & Francom & Gardner, 2013). The task-oriented approach provides learners with a complete series of tasks within the scope of the learner's development (Frerejean et al., 2021). Modern instructional design models assume that realistic and rich learning tasks are the driving force of learning (Merrill, 2002). Well-designed learning tasks encourage learners to integrate and coordinate the required skills, knowledge, and attitudes. This eventually leads to rich knowledge which can be transferred to everyday life and future work situations (Merriënboer et al., 2004). Authentic tasks require many interactions between different aspects of task performance and their respective goals. Integrated goals should not only have the ability to effectively perform each aspect of a complex task separately but also pay attention to the ability to coordinate these different aspects in the performance of authentic tasks (van Merriënboer & Kester, 2014). Given that real tasks play an important role in learning transfer, task-centered approaches have been developed to make learning transfer more effective (van Merriënboer & Kirschner, 2017).

2.3. Four-component instructional design model (4C/ID) and media literacy enhancement

In the 1990s, Van Merriënboer and colleagues used a holistic approach to develop the 4C/ID model for teaching complex subjects. In this model, to learn complex subjects, four interdependent elements are mandatory (Francom, 2018).

According to van Merriënboer, the characteristics of the elements of holistic design models are (1) paying attention to the complete meaningful learning tasks; (2) scaffolding learners to coordinate different aspects of the whole tasks; and (3) using activities that facilitate learning and its transfer (Dolmans et al., 2013). The basis of the training design of this model consists of four interrelated components: (a) whole learning tasks, (b) supportive information, (c) procedural information, and (d) part-task practices (Francom, 2018).

Media literacy is complex learning that requires specific knowledge, skills, and attitudes (Brand-Gruwel et al., 2005). In addition to covering all instructional principles, the 4C/ID model has been used in specialized technical educational environments and specialized technical educational environments, and it is associated with communication (Frèrejean, 2017).

In the study (2003) by Hoogveld, Paas and Jochems, the effectiveness of this model was investigated as an educational design approach based on complex assignments, and the results showed that the amount of learning is higher when using the 4CID model. As the study Maddens et al. (2020) also shows that developing complex skills such as media literacy using the 4CID model by providing whole learning tasks and also integrating knowledge, skills and attitudes will transfer learning from the educational environment to real life (van Merriënboer & Tjiam, 2013).

Objectives and hypotheses of the study

This research attempts to investigate the effect of the 4C/ID model on developing media literacy skills in real classrooms. Also, the results of this research can theoretically contribute to the 4C/ID model in a public education setting. Based on the purpose of the study, as well as the goals of the thinking and media literacy Text book, given the media literacy as a complex concept, three variables Critical Thinking Disposition, conscious Interaction with the Media and learning outcomes were selected, and three hypotheses were formulated:

1. The 4C/ID model is valid model for developing media Literacy as Complex Learning.
2. Designing course instruction based on the 4C/ID model have a significant effect on the learning outcomes of students in thinking and media literacy classes.
3. The 4C/ID model has a significant effect on students' critical thinking disposition.
4. The 4C/ID model has a significant effect on students' conscious interaction with media. (Actually, increase the conscious interaction of students with the media)

3. Method

3.1. Participants

The participants in this study were 30 students in the tenth grade of schools in one of the districts of Mashhad, Iran. All the students were females between 15 and 17 years old. Thirty participants were placed in the experimental group and the control group.

3.2. Research design

This study used a quasi-experimental design to measure the variables of learning outcomes, critical thinking disposition, and conscious interaction with the media from the pre-test-post-test design with the comparison group. The quasi-experimental research design was used in this study because it was impossible to randomly assign students to experimental and control groups.

3.3. Instruments

3.3.1. Achievement test

An academic achievement test was used to measure students' learning outcomes. The test consisted of ten analytical questions. This research-made test was developed based on the objectives and content of the thinking and media literacy Textbook. For this purpose, an objective – content table was created with the help of the class teacher. This test measures the knowledge, facts, materials, principles, concepts, and skills of students (Appendix 2 and 3). The content validity of

the test was approved by 3 professors of educational sciences and 2 teachers of thinking and media literacy courses.

3.3.2. Critical thinking deposition questionnaire

The questionnaire developed by Ricketts and Rudd (2005) was used to measure critical thinking skills (Appendix 1). This questionnaire consists of 33 five-choice questions (from completely agree to disagree) on a Likert scale. It has 3 subscales of creativity, cognitive maturity, and mental engagement (Ricketts & Rudd, 2005). This questionnaire has been extensively used in previous studies and has been shown to have good content and construct validity (Duncan et al., 2016; Lenhardt et al., 2011). The reliability of this questionnaire was investigated by Pakmehr and his colleagues (2012) using the Split Half method in the Iranian context. Cronbach's alpha coefficients for all subscales and the total scale in both genders and all subjects were psychometrically good (0.86), and all the correlations between the subscales and the total scale score were also significant. The reliability of the critical thinking disposition questionnaire in this research was calculated using Cronbach's alpha coefficient. This value was 0.73.

3.3.3. Media literacy assessment questionnaire

The selection of the questionnaire was based on the goals of the 10th-grade thinking and media literacy book. The goals include smart and accurate use of media; analysis of overt and hidden messages in media; evaluation of the purpose of message senders; and recognition of values and representation of messages and goals. The above-mentioned goals are in line with the components of the Questionnaire of the Media Literacy Assessment (Falsafi & Niromand, 2013) (Appendix 3).

This questionnaire consists of 20 questions and 5 components. Questions 1–4 assess the understanding of the content of media messages; questions 5–8 assess the awareness of the hidden goals of media messages; questions 9–12 assess the conscious selection of media messages; questions 12–16 assess a critical look at media messages; and finally, questions 17–20 measure the analysis of media messages (Appendix 3). The content validity of this questionnaire was evaluated by 10 professors and experts in the field, and its reliability was calculated using Cronbach's alpha. The reliability value on this scale was 0.83. The same value was reported by Falsafi in 2013.

3.4. Data collection procedure

In this research, some topics were selected from the tenth-grade thinking and media literacy courses and were designed and implemented based on the 4C/ID model in the experimental class. The 4C/ID group received the intervention program for three months while the conventional groups received the conventional program that teaches media literacy is taught based on the definition of specific lessons and in a teacher-centered way that was being practiced at school (Table 1).

The following table is a sample of the steps that need to be taken while designing a training course for one of the complex assignments (Table 2).

3.5. Data analysis

To analyze the research data, descriptive statistics (frequency, mean, and standard deviation) were used for each group. Univariate analysis of covariance (ANCOVA) was run to compare the performance of the groups on the post-test learning outcomes. Since critical thinking has sub-components, multivariate analysis of covariance (MANCOVA) was used to analyze their associated data. Also, for the variable of conscious interaction with the media, which had sub-components and in its measurement, a post-test design with a control group was used, and multivariate analysis of variance (MANOVA) was used to analyze its data. It should be noted that all statistical operations were performed using version 26 SPSS software.

Table 1. Intervention research implementation stages.

Stage	Procedure	Implementation
Design	Selecting an educational topic	Choosing lessons "hamburger message" images are not clear, beware of overload, use media wisely, and media ethics
	Designing the learning environment based on a 4C/ID model	Determining the main goals: a) Analysis of media messages (recognition of text, subtext, hypertext) b) smart and conscious use of media and media consumption regime
	Instructional course design	Whole Tasks Dividing whole tasks into task classes Providing supportive information Providing procedural information Presentation of part-task practices (Table 2)
Implementation	Dividing the participants into two experimental and control groups	Experimental group: teaching students in a learning environment based on the 4C/ID model**.** Control group: teaching students in a conventional learning environment at school
	Training the instructor for the instructional course based on the 4C/ID model	Providing instructional brochures Holding follow-up training sessions Introduction of scientific resources such as articles, videos
	Administrating pre-tests	Administrating an achievement test and a critical thinking disposition questionnaire in two experimental and control groups before the course starts
	Implementation of the instructional course based on the 4C/ID model by the instructor (Intervention)	Informing students about this instructional model and its steps Providing whole tasks at the beginning of each class. Providing supportive information before completing each task Providing procedural information in the form of a brochure before completing each task Providing part task exercises as supplementary assignments
	Implementation of the instructional course in a conventional way	Teaching based on the teacher's guide Presenting the material in a lecture style Solving exercises by question and answer method
	Administrating pre-tests	Administering tests and related questionnaires
Analysis of effectiveness	Variable: Learning outcome	Using the pre-test and post-test design
	Variable: Critical thinking disposition	Using the pre-test and post-test design (Ricketts & Rudd questionnaire)
	Variable: Conscious interaction with the media	Using the post-test design (Falsafi questionnaire for measuring media literacy)

4. Results

We predicted that the participants who receive media literacy teaching based on the 4C/ID model will have better learning outcomes, the tendency to think critically in them increases, and their conscious interaction with the media is improved

Table 3 provides descriptive data such as mean, standard deviation, and research components according to the type of test (pre-test, post-test).

4.1. Testing hypothesis 1

Univariate analysis of covariance was used to investigate the effect of designing thinking and media literacy course instructions based on the 4C/ID model on students' learning outcomes. This analysis was used to compare the groups' means on the posttests of learning outcomes in the 4C/ID ($M = 15.3$) and conventional groups ($M = 14.4$) while controlling for the effects of the pretests. Analysis of the data at the 99% confidence level showed a significant difference between the experimental and conventional groups. The result ($F(1, 27) = 10.746$, $p < 0.01$) showed the null hypothesis which showed no significant differences between groups was rejected. It can be concluded that there was a significant difference between the groups.

Table 3. Mean and standard deviation of variables in conventional and 4C/ID groups.

Variables and components		4C/ID				Conventional			
		Pretest		Posttest		Pretest		Posttest	
		M	SD	*M*	SD	*M*	SD	*M*	SD
Learning outcome		14	1.94	15.3	1.85	13.96	1.78	14.4	1.7
Critical thinking	Creativity	39.6	4.67	43.4	3.31	41.93	2.6	42.93	2.86
	Cognitive maturity	29.46	4.35	29.93	3.49	27.53	5.2	28.06	5.06
	Mental engagement	43.73	6.63	49.93	6.04	46.13	3.44	48.06	3.45
Conscious interaction with media	Understanding the content of media messages			16.8	2.11			13.8	2.51
	Awareness of the hidden goals of media messages			16.8	1.2			12.66	2.99
	Conscious selection of media messages			15.93	2.54			13.8	2.98
	A critical look at media messages			14.53	2.44			11.06	2.28
	Analysis of media messages			13.8	3.4			10.93	3.05

Also, the value (Adjusted R Squared = 0.84) shows that 84% of the changes in the dependent variable, i.e. the increase in learning scores, are due to the intervention.

4.2. Testing hypothesis 2

To test the hypothesis, the assumptions of the normality distribution of critical thinking disposition scores in the 4C/ID and conventional groups were examined. The homogeneity of the variances and covariance matrices between these groups were tested. Since the assumptions were not violated and the homogeneity of variances and covariances was not significantly different between the groups, parametric statistics, and multivariate covariance analysis statistical tests were used. The result of Wilks's lambda ($F = 13.537$, $P < 0.01$), at the 99% confidence level showed the significance of the multivariate test index. There was a significant difference in at least one of the components of critical thinking disposition between the 4C/ID and conventional groups. As a result, at the 99% confidence level, designing course instruction based on the complex learning model had a significant effect on critical thinking disposition.

The post-hoc test was performed to understand which components caused a difference in the two groups. The results of the post-hoc test showed that of all the components of critical thinking disposition, there was a significant difference in the creativity component ($t = 2.551$, $p < 0.05$) at the 95% confidence level. The higher mean of the 4C/ID group ($M = 43.4$) on creativity compared to the conventional group ($M = 42.93$), showed that course instruction designed based on the complex learning model increased students' creativity. There was a significant difference in the mental engagement component ($t = 5.35$, $p < 0.01$) at the 99% confidence level between the two 4C/ID and conventional groups. The higher mean scores of mental engagement in the 4C/ID group ($M = 49.93$) compared to the conventional group ($M = 48.06$), confirmed the positive effect of students' mental engagement at the 99% confidence level. However, no significant differences were found between the 4C/ID and conventional groups on the component of cognitive maturity ($t = 0.699$, $p > 0.05$).

4.3. Testing hypothesis 3

Based on the results of normality assumptions and homogeneity of variance and covariance, parametric statistics and multivariate covariance analysis statistical tests were used.

The significance of the multivariate test index based on the result of Wilkes's lambda ($F = 6.383$, $P < 0.01$) confirmed that the linear combinations of the components of conscious interaction with the media were significantly different between the 4C/ID and conventional groups. Therefore, it can be said that, at the 99% confidence level, the enhancement of conscious media interaction in students

Table 2. Intervention research implementation stages.

The purpose of the assignment	Learning tasks		supportive information	Procedural information	part-task practice
Determining the main goals a) Analysis of media messages (recognition of text, subtext, hypertext)	Analysis of three message layers in video messages	Examining the presented images and expressing their message Examining newspaper and magazine images Poster design with the topic of optimal use of media	Providing an example or template Providing cognitive strategies Create a mental model	Poster design: providing practical information about things such as color selection, typeface, visual hierarchy, selection, geometric shapes, intelligent composition, observing proportion, image, and other things	Presenting three images with hidden political, economic, and social messages and group analysis of their messages
	Analysis of three message layers in text messages	Checking the message of the presented poems Examining the message of textbook poems	Case Study Discover the mental pattern Cognitive feedback		Presenting positive and influential poems and sentences in your mind
	Analyzing the triple layers of messages in movies and recognizing representations	Examining the themes in the presented cartoon Recognizing the representation of national media advertising messages Provide research on the positive and negative aspects of using representation in the media	Providing cognitive strategies Creating a mental model Cognitive feedback	Research steps: providing information such as research and researcher, importance and necessity of research, and research steps	Presenting positive and influential movies and series in your mind A discussion about movies and series that hurt Chame

was associated with the intervention. With the purpose of understanding which components of conscious interaction with the media caused differences in the 4C/ID and conventional groups separately, Tukey's post hoc test was performed.

The post-hoc test showed that of all components, there was a significant difference between the 4C/ID and conventional group in terms of understanding the content ($F = 12.533$, $p < 0.01$) at the 95% confidence level. The higher mean of the 4C/ID group ($M = 16.8$) on understanding the content compared to the mean score of the conventional group ($M = 13.8$), showed that the intervention increased the understanding of the content of media messages.

There was a significant difference between the 4C/ID and conventional groups in terms of awareness of the hidden goals of media messages ($F = 24.618$, $p < 0.01$) at the 99% confidence level. Also, the higher mean score of awareness of the hidden goals of media messages, in the 4C/ID group ($M = 16.8$) compared to the conventional group ($M = 12.6$), revealed that, at the 99% confidence level, the intervention-led to the improvement of student's awareness of the hidden goals of media messages.

There was a significant difference between the 4C/ID and conventional groups in terms of their critical view of media messages ($F = 16.109$, $p < 0.01$) at the 99% confidence level. The higher mean scores of critical look at media messages in the 4C/ID group ($M = 14.53$) compared to the conventional group ($M = 11.06$), confirmed that at the 99% confidence level, the intervention improved students' critical view of media messages.

A significant difference was found between the 4C/ID and conventional groups on the media message analysis component ($F = 5.883$, $p < 0.01$) at the 95% confidence level. Comparing the

mean of message analysis in the 4C/ID group ($M = 13.8$) with the one in the conventional group ($M = 10.93$), showed that the intervention improved the analytical ability of students regarding media messages.

5. Discussion

Interaction with digital media is a part of the daily lives of young people and teenagers in this era (Cannon et al., 2022). The way of dealing with the media should be properly taught since the media brings along challenges and opportunities (Boniel-Nissim et al., 2022; Mingoia et al., 2019; Su et al., 2022). Acquiring the competency of media literacy as complex learning requires designing instruction that fits its complex nature (Lin et al., 2013; Livingstone & Helsper, 2010; O'Rourke et al., 2022).

the investigation of the research background shows that the conducted studies are mostly correlational (Frerejean et al., 2019**;** Güney, 2019**)**. This could have been associated with the lack of executive facilities and specialized knowledge in general education (Costa et al., 2022**)**. This is the first research aimed at investigating the causal effect of instructional design based on the 4C/ID model. It has not been done in the field of media literacy education. Accordingly, the purpose of this study contributes to the developing of media literacy competence and also the theoretical development of the 4C/ID model by examining the causal effect of designing course instruction based on the 4C/ID model on the improvement of learning outcomes, critical thinking, and conscious interaction with the media.

In this study, before using the 4CID model, its validity was examined by reviewing numerous studies. Researches that have applied this model have acknowledged its validity in using it in task-centered learning environments to develop competencies (Bogdanova, 2019; Dolmans et al., 2013; Kester et al., 2001; Maddens et al., 2020; van Merriënboer et al., 2020; van Merriënboer & Kester, 2014). Also, in many researches, this model has been introduced as the only successful model in holistic learning environments (Dolmans et al., 2013; Frerejean et al., 2021; Susilo et al., 2013a) and in a meta-analysis of effectiveness This model has been examined in detail (Costa et al., 2022). The results of this study show the positive effect of the intervention on the learning of the students who received the intervention compared to their counterparts in the conventional learning environment. In the study of Morales Bueno and Santos Rodas (2020), it is indicated that knowledge concepts are transferred to learners in a more favorable way through the 4CID model and their learning is also improved. The major part of this learning improvement takes place through practical exercises, which is the focus of the 4CID model, and the importance of this issue has been pointed out in various researches as one of the main advantages of this model (Bogdanova, 2019; Frerejean et al., 2019; Susilo et al., 2013; van Merriënboer et al., 2020). The positive effect of the 4C/ID model on learning outcomes has been well documented in different research fields such as higher education (Frerejean et al., 2019), instruction design in multimedia environments (van Merriënboer & Kester, 2014), technical and professional education (Sarfo & Elen, 2007), medical education (Maggio et al., 2015), communication education (Susilo et al., 2013) and information problem solving (Frerejean et al., 2016; Wopereis et al., 2015). In a different perspective, in some researches that examine the performance of the 4CID model in educational environments, they admit that this model does not achieve all goals alone in some educational contexts and there is a need for other models of educational design as well be used in combination (Maddens et al., 2020).

In terms of critical thinking, the findings of the study revealed that using the four-component model for designing the media literacy course increased participants' critical thinking disposition. Since one of the primary premises in complex learning settings is associated with problem-solving strategies, this part of the research findings adds credence to earlier studies' findings (Güney, 2019; Su et al., 2022; Tiwari et al., 2006; Yuan et al., 2008).

Also, this research is in line with the results of the research conducted by Yuan and his associates (2008) in terms of improving the content of the course, emphasizing the transfer of knowledge and

skills, and creating a supportive learning environment. In their research, they also examined the factors influencing the development of critical thinking. Among these factors, they mentioned the problem-solving method. In line with the results of these researches, learners in an instructional environment based on complex learning are involved in a learning scenario and are placed in a wide range of problem-solving situations, and the presence of learners in a team and together to solve a problem increases the power of problem-solving and increase cooperation and teamwork between them.

The results of the research showed an improvement in the conscious interaction of learners with the media after the implementation of the intervention variable (i.e. the environment designed based on the four-component model). This could be related to the active participation of learners in the environment where the four-component model was implemented, and the use of active teaching methods was emphasized. The results of this part of the research findings are in line with the previous research (Hobbs & Jensen, 2009; Scheibe, 2004; Wilson, 2012).

Therefore, for the enhancement of conscious interaction of learners with the media in the course of thinking and media literacy, one can refer to the teaching method, in which interaction with students has been emphasized. In the media literacy classroom, the teacher should not be a mere speaker and her interaction with the learners should be two-way. The teacher's role should be a facilitator guiding the students toward the desired goals. Also, the media literacy class should be a happy and attractive environment where all students with different abilities have a chance to participate in the learning process, share their opinions, critically examine different ideas, and feel that they participate in the learning process (Rasi et al., 2019). Also, this educational approach, by making the educational environment student-centered, leads to the realization of quality-oriented learning, which is one of the development goals of the education process (van Merriënboer et al., 2020). Therefore, teaching media literacy in classrooms requires an instructional design based on complex learning.

6. Conclusion

Developing media literacy competence is considered complex learning in the public education setting. In these instructional environments, media literacy is mainly taught by defining a specific lesson in a lecture and teacher-centered way. In this research, media literacy competence was developed through the design and implementation of the 4C/ID model**.** according to the results of this research, instructional design based on the 4C/ID model has a significant effect on improving learning outcomes, critical thinking, and conscious interaction with media, which are considered essential components in developing media literacy competence.

On the other hand, the results of this research add new insight into the effectiveness of the 4C/ID model and increase its generalizability. In other words, the results show that the 4C/ID model is powerful for general educational environments. In addition, indirectly, the results of this research provide the empirical validity of the theoretical basis of the 4C/ID model

7. Research limitations and future directions

Given the positive effects that the use of Model 4C/ID has, we need to pay attention to some factors that may create fanaticism and always consider all aspects. Since in both sections of our research, assignments were to be presented, in some cases learners do not care enough assignments, as well as the time of assignments at the defined time intervals. This had an effect on the sample size of our research. Although we expected to be able to involve more students in this research, administrative restrictions as well as the non-cooperation of schools in conducting this research limited access to a larger number of samples for researchers.

In addition, we should keep in mind that previous learners' preparations may affect the results, so teachers are advised to earn awareness of these factors. In future studies, we will examine the quality

of the experiences of learners and teachers in the use of the 4C/ID model to gain a deeper understanding of the effects of this model in different dimensions

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Appendices

Appendix 1. Critical thinking skills questionnaire

Greetings: Dear student: Choose one of the options for each question
Gender: Age: Field of study: Level of education: GPA:

Objects	Strongly disagree	Disagree	Do not know	Agree	Completely agree
I always believe that there is more to learn					
When someone disagrees with me, I usually ignore him					
I look for opportunities to solve problems					
I am interested in many subjects					
For me, it is important to have a deeper understanding of a subject					
I can communicate across a wide range of topics					
I ask many questions in the learning environment					
I enjoy finding answers to challenging questions					
I solve problems well.					
I am sure that I can reach a logical conclusion.					
It is important to be informed.					
It is impossible for me to change my values, even when I get new information that contradicts them.					
I like to think about everything.					
I enjoy solving problems.					
I know that I have prejudices and if other people cannot accept them, it is their problem.					
I can apply my knowledge to a wide range of different subjects.					
I enjoy learning even when I am not a student.					
Good leaders listen to different opinions.					
I can quickly judge people and decide whether I can get along with them or not.					
I can explain things clearly.					
When I try to clarify the solution, I ask good questions.					
I explain the topics accurately and clearly.					
The people of my hometown are better than the people of other societies.					
My views are not always correct.					
I look for the truth even when it upsets me.					
There are always different ways to answer a question.					
I keep working on something until I fix it.					
When I search the Internet, I do well in finding the information I need.					
I go out of my way to find the correct answers to a problem.					
All murderers deserve the death penalty.					

(*Continued*)

Continued.

Objects	Strongly disagree	Disagree	Do not know	Agree	Completely agree
When making a decision, I try to listen to all points of view.					
The problem of some people is that they cannot see simple solutions.					
Homeless people should only have a job.					

Appendix 2. The components related to measuring critical thinking disposition

Component	Description	Sample question	Number of questions
Creativity	The desire of students in intelligent and creative curiosity to discover new realities	There are always different ways to answer a question.	1, 5, 7, 11, 14, 17, 24, 25, 26, 28, and 29 (11 questions)
Cognitive maturity	To what extent are students aware of the complexities of real issues, and according to the knowledge they have about their own and others' knowledge, to what extent are they able to accept others' points of view (criticism)	When someone disagrees with me, I usually ignore them.	,32 ,31 ,30 ,23 ,19 ,15 ,12 ,2 and 33 (9 questions)
Mental conflict	Students' readiness to reason and predict situations that require reasoning and the student's confidence in his ability to reason.	I look for opportunities to solve problems.	,18 ,16 ,13 ,10 ,9 ,8 ,6 ,4 ,3 20, 21, 22, and 27 (13 questions)

Appendix 3. Media literacy assessment questionnaire

Greetings: Dear student: Choose one of the options for each question
Gender: Age: Field of study: Level of education: GPA:

Attitudes	Completely agree	Agree	Disagree	Completely disagree	No opinion
1 – When choosing a newspaper, I pay attention to the way it produces news and reports.					
2 – I have the ability to recognize the content of computer game messages.					
3 – When watching a movie, I notice the censors.					
4 – After watching a satellite program, I think about how to plan that network to prepare that program.					
5 – Some internet sites are trying to tell me how to think.					
6 – For some satellite networks, cultural and political goals are more important than informing me.					
7 – I see in myself the ability to detect fraudulent websites.					
8 – It is easy for me to recognize hidden goals in computer games.					
9 – Being aware of the policy of satellite networks is effective in my intelligent use of them.					
10 – I choose my favorite programs from different media.					
11 – I choose internet sites based on my opinions and beliefs.					
12 – I am not influenced by television advertisements.					
13 – Satellite networks seek to influence me to maintain and expand their financial interests.					
14 – The information available in cyberspace has made the Internet dominate me.					
15 – I have become addicted to television programs.					
16 – I am aware of the adverse effects of satellite networks on myself.					

(*Continued*)

Continued.

Attitudes	Completely agree	Agree	Disagree	Completely disagree	No opinion
17 – My awareness of the content of satellite networks makes me watch programs consciously.					
18 – Not knowing about the nature of the news causes me to get confused when dealing with all kinds of media.					
19 – I need some training to analyze television programs.					
20 – Society's pressure plays a role in my analysis of the news spread on the Internet.					

Appendix 4. Components related to media literacy Assessment (Conscious interaction with Media)

Component	Description	Sample question	Number of questions
Understanding the content of media messages	Knowing the content of the messages and understanding the message sender's intention	I have the ability to recognize the message content of computer games	1–4 (4 questions)
Awareness of the hidden goals of media messages	Identifying hidden goals and subtext layer of media messages	I see in myself the ability to detect fraudulent websites	5–8 (4 questions)
Conscious selection of media messages	Correct and conscious selection of messages from the multitude of media messages and correct consumption	I choose my favorite programs from different media	9–12 (4 questions)
A critical look at media messages	A critical look at messages before accepting them	Satellite networks seek to influence me to maintain and expand their financial interests.	13–16 (4 questions)
Analysis of media messages	Having different abilities related to the analysis of media messages	Not knowing the nature of the news causes me to be confused when facing all kinds of media.	17–20 (4 questions)