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ORIGINAL ARTICLE

Program Evaluation of the Clinical Education Based on Four-Component Instructional Design (4C/ID) Model

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A B S T R A C T

Background: Clinical education is a key step in medical education. The study aimed to evaluate clinical education in undergraduate medical education programs based on the Four-Component Instructional Design (4C/ID) model.

Methods: The cross-sectional study was conducted at Shahid Sadoughi University of Medical Sciences in 2023-2024. Fifteen departments where medical students studied the clerkship and internship courses were evaluated. An evaluation checklist was used including four domains, 23 questions, and 100 items. The evaluation was implemented in three steps including "Preparation of evaluation", "Execution of evaluation" and "Preparation of evaluation report and application of results". Data were analyzed using descriptive tests (mean, standard deviation, SD, and frequency).

Results: The findings showed that the status of the departments in the "educational goals and learning tasks" domain in the clerkship and internship courses were 48.33 and 49.26, which achieved the highest level of compliance. The lowest compliance reported in the domain of "practice opportunities" was 14.30 and 15.77 in the clerkship and internship courses. The compliance in the domain of "procedural information in educational events" in the clerkship courses was 33.15 and in the internship courses was 36.17 and in the domain of "supportive information" in the clerkship courses was 24.36 and internship was 23.46, indicating a medium to a low level of compliance.

Conclusion: Clinical learning is recognized as a complex learning, which requires supportive information and practice opportunities for learning. The results showed that lower compliance was reported in the domains of "practice opportunities" and "supportive information" in the educational department clerkship and internships. Therefore, it is recommended to plan for the development of support resources on various platforms. It also requires an appropriate educational design to deliver practice opportunities in simulation and workplace environments in undergraduate medical education.

Keywords: Program Evaluation, Internship, 4C/ID, Four-Component Instructional Design, Clinical Education

Introduction

Clinical education is considered the key step in undergraduate medical education and the basis for developing basic skills as a physician (1, 2). Considering the complexities of educational models in medical education systems, ensuring the quality of clinical education is crucial to training competent general practitioners (1, 3). Achieving continuous quality improvement in the medical

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education program requires program evaluation (4, 5). Alvarez et al. have introduced program evaluation as a key step in the training program, which facilitates the recognition of the weaknesses and strengths of the program (6, 7). The results of evaluating medical education programs may apply to changes in the programs (8). Results of program evaluation can be used to ensure the quality of teaching and learning methods, improve the quality of education, and solve educational problems (7, 8). In addition, program evaluation is a valuable learning strategy to increase knowledge about the program components and their outcomes (9) .

The use of comprehensive models that address various components and processes of learning is recommended in program evaluation. A model of complex learning processes is the 4C/ID model, which explains the key educational components of complex skills. The 4C/ID model is an evidence-based model proposed by Merrienboer Van. This model is used in the design of complex medical education processes and to develop complex skills (10, 11). The model consists of four main components, including "learning tasks", "supportive information", "practice opportunities", and "procedural information in educational events" (12, 13). The components are interrelated, and each component is uniquely effective in developing complex skills in the 4C/ID model, the "learning tasks" are defined as specific activities in which learners practice all parts of a complex task in an integrated manner (14). These tasks should be authentic to facilitate the integration of knowledge, skills, and attitudes and the transfer of learning (15). The "supportive information" helps learners deal with non-repetitive aspects of a learning task, such as tasks that require reasoning, analysis, and problem-solving (14). The "practice opportunities" addressed the common aspect of activities that require a very high level of self-efficacy after training. This component is necessary for learning tasks that require repetition opportunities to reach a high level of self-efficacy (16). "Procedural information in educational events" is provided when learners are performing tasks. Procedural information primarily supports routine aspects of tasks. To encourage learners to become independent healthcare providers, procedural information should be presented in a “scaffolding” manner (13). The 4C/ID model considered the holistic learning approach and cognitive load theory (17). Merrill (2002) introduced the 4C/ID model as the most comprehensive problem-oriented educational design model due to consideration of the basic principles of education (18). Thus, the use of 4C/ID components in the evaluation process can help to describe the key components in the complex learning process, such as the clinical learning program. Furthermore, considering the focus of this model on the basic components of complex learning, the use of evaluation results based on the component model may facilitate the improvement of the quality of education. Therefore, the present study aimed to evaluate the clinical education in undergraduate medical programs using the 4C/ID model at teaching hospitals of Shahid Sadoughi University of Medical Sciences.

Materials and Methods

This cross-sectional study was conducted at Shahid Sadoughi University of Medical Sciences in 2023-2024. Fifteen clinical education programs that the medical students studied in their internship and clerkships courses were evaluated.

Study tools: A tool has 23 questions and 100 items in 4 domains including learning tasks, supportive information, practice opportunities, and procedural information in educational events (19). The validity and reliability were confirmed in a previous study by the authors. The validity of the tool was proved based on experts' opinions. The content validity indices including content validity ratio (CVR) and content validity index (CVI) were calculated. The face validity and content validity of the tool were confirmed based on quantitative and qualitative indicators. The reliability of the tool was confirmed based on Cronbach's alpha of 0.93 (Cronbach's alpha of four domains of the 4C/ID model was proved including learning tasks (0.937),

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supportive information (0.901) and practice opportunities (0.944), procedural information in educational events (0.962). In this tool, each item scored by a 5-point Likert scale including not at all (0-10%), low (10-20%), medium (50-21%), high (51-70%), very high (71-100%)(19).

The evaluation process: The evaluation was planned in three steps including evaluation preparation, evaluation implementation, evaluation report preparation, and application of the results.

Step 1 - Evaluation preparation: The prerequisites and planning for the implementation of the evaluation were conducted. The evaluators were two faculty members with experience in program evaluation who had 9 (±3) years of work experience in teaching and evaluating the medical education program. The evaluators included 1 male (50%) and 1 female (50%) with a mean age of 36 years (±3).

In the preparation step of the evaluation, various stakeholders and evaluators were trained about the evaluation process, questions, items, and how to score. Several meetings were held with the evaluators to explain the evaluation implementation process and discuss the details of the evaluation implementation. Moreover, the staff, clinical teachers, and directors were informed about the evaluation process, tools, and required documents. The evaluation schedule was planned.

The second step - evaluation implementation: The step was implemented in three steps including "self-evaluation of educational departments", "site visit and evaluation of documents" and "preparing of reports". To implement the self-evaluation, the directors were asked to complete the self-evaluation tool. The self-evaluation findings were reviewed by evaluators in the evaluation committee of the Education Development Center (EDC) before the site visit. In the next step, the site visits were conducted by evaluators. During the site visit, the evaluators interviewed students, faculty members and visited educational events, and evaluated the documents. In the third step, the evaluators were asked to complete the evaluation form according to the schedule.

The third step is preparing the report: In this step, the evaluation results of each department were presented by the evaluators and discussed regarding the evaluation results and providing developmental solutions. The evaluation report was developed. In the next step, feedback sessions were held with participating directors, faculty members of the department, and directors and managers in the school.

Data analysis: The data were analyzed using descriptive tests (mean, standard deviation, SD, and frequency). The results were calculated based on percentage and the ranges of non-compliance (0-25%), low relative compliance (26-50%), high relative compliance (51-75%), and complete compliance were reported (76-100%).

Results

The results showed that the compliance in the domain of "learning tasks" in the clerkship and internship were %48.33 and %49.26, respectively. The compliance of "procedural information in educational events" domains was %33.15 in the internship and %36.17 in the clerkship. Also, compliance in "practice opportunities" in the clerkships was reported %14.30 and internships %15.7. The compliance of the "supportive information" domain was reported %24.36 in the clerkship and %23.46 in the internship (Charts 1 and 2).

The evaluation results of 15 clinical education programs in the clerkships and internships are reported in Table 1.

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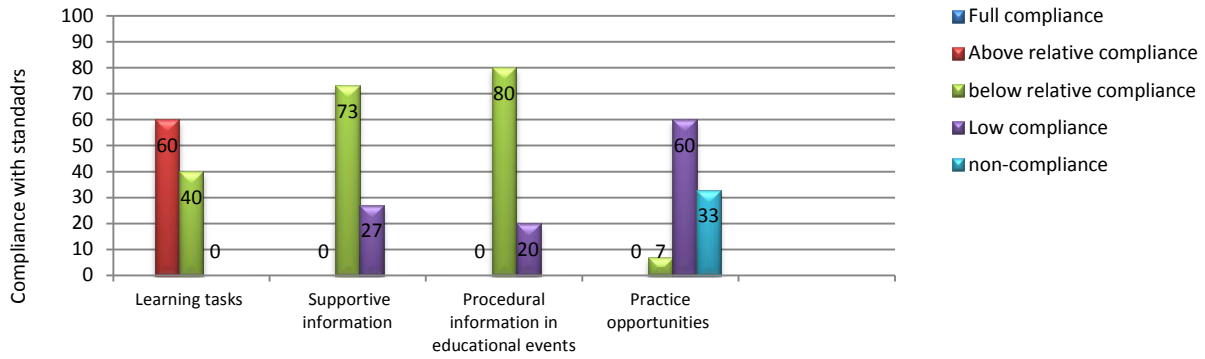

Chart 1- Evaluation results of clerksips by domains

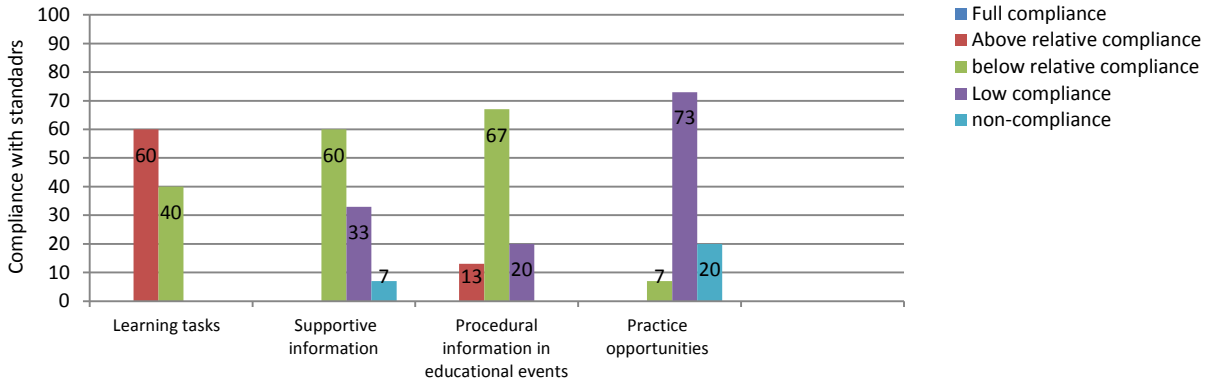

Chart 2- Evaluation results of internship by domains

Table 1. The results of the evaluation of the clinical education of undergraduate medical education in the form of clerkship and internship

Domains	Learning tasks		Supportive information		Procedural information in educational events		Practice opportunities	
Group code	Clerkship Compliance percentage	Internship Compliance percentage	Clerkship Compliance percentage	Internship Compliance percentage	Clerkship Compliance percentage	Internship Compliance percentage	Clerkship Compliance percentage	Internship Compliance percentage
Group 1	63.89	58.33	15.38	21.15	46.58	49.32	10.58	18.27
Group 2	52.78	55.56	32.69	28.85	48.63	48.63	17.31	14.42
Group 3	61.11	61.11	38.46	34.62	46.58	47.95	17.31	17.31
Group 4	30.56	33.33	28.85	25.00	16.44	20.55	31.73	37.50
Group 5	50.00	50.00	28.85	13.46	31.51	39.73	11.54	8.65
Group 6	55.56	55.56	26.92	30.77	45.89	47.95	24.04	19.23
Group 7	50.00	50.00	19.23	19.23	26.71	28.77	17.31	17.31
Group 8	36.11	41.67	7.69	7.69	4.79	5.48	9.62	9.62
Group 9	41.67	36.11	30.77	40.38	49.32	54.11	12.50	14.42
Group 10	30.56	33.33	21.15	19.23	35.62	33.56	7.69	6.73
Group 11	55.56	66.67	38.46	40.38	52.74	53.42	13.46	19.23
Group 12	50.00	50.00	30.77	13.46	32.19	39.04	12.50	14.42
Group 13	47.22	47.22	21.15	25.00	22.60	28.77	9.62	10.58
Group 14	69.44	69.44	21.15	21.15	30.82	35.62	11.54	12.50
Group 15	30.56	30.56	3.85	11.54	6.85	9.59	7.69	16.35
Total	48.33	49.26	24.36	23.46	33.15	36.17	14.30	15.77

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Discussion

In the present study, the evaluation of the clinical education program was carried out using the 4C/ID model. The results showed that the status in the domain of "educational goals and learning tasks" was in relative compliance level, and the domain of "practice opportunities" was in low compliance level .

The domain of "educational goals and learning tasks" was evaluated by the set of activities to inform learning goals and tasks. Informing the goals and tasks of learning to different stakeholders is a key criterion in curriculum management, Moreover, the activity facilitates personal planning and students' self-regulation skills, at the individual level and the provision of education infrastructure and the evaluation of their fulfillment at the systemic level (20, 21). Thus, various tools and different channels to communicate tasks and objectives to different stakeholders are critical. In this domain, different channels such as study guide, lesson/course plan, website, and booklet were evaluated. The results showed that lesson plans and study guides were used more than other tools to inform students of educational goals and learning tasks, and the booklets and websites of educational groups were used less. In our university, the study guide was developed (22), but informing and using the study guide in clinical education needs to be planned by the director of the education program. Therefore, planning and use of a mechanism to inform goals and tasks using study guides and formal and informal channels and social networks are recommended.

According to the 4C/ID model, it is necessary to provide resources and information to learners about non-repetitive aspects of education that facilitate learning (23). Supporting resources assist learners based on learning tasks (18). In this domain, the use of various support tools was assessed in clinical education such as clinical guidelines, illness scripts, patient management flowcharts for training patient management skills, and physical and electronic simulators for teaching procedures. Furthermore, feedback-based learning opportunities for teaching patient management skills, communication skills, and procedures were emphasized in this domain. In addition, group discussion methods, patient discussion in educational rounds and clinics, scenario-based assignments, a computer-based learning environment, and the opportunity to discuss in social networks regarding the patient cases were assessed in the domain. The results showed that clinical guidelines, educational videos, and patient management flowcharts were the most used for patient management training in clinical education, and illness scripts and electronic and physical simulations were used less. Patient management flowcharts and illness scripts are the main support resources aimed at teaching clinical reasoning and acquiring decision-making skills for learners (24, 25). An illness script is a structured framework for teaching clinical reasoning skills when discussing clinical cases. Levin et al. recommended that illness scripts and disease management flowcharts be considered in clinical education (26). The simulation-based medical education facilitates students' learning by experiencing situations similar to reality (27). Therefore, the simulation provides proper opportunities for students to learn through practice and repetition and receive feedback without the risk of harming patients. The simulation environments prevent medical errors and provide clinical scenarios that require medical education (28). The common methods in the supportive opportunities for teaching patient management are discussions related to the patient in various educational events such as rounds and morning reports. However, support mechanisms such as discussion methods in small groups, computer-based learning, and virtual networks in the department have been neglected. The discussion method in small groups helps to involve learners in active learning and improve their communication skills, critical thinking, and reasoning skills. The use of problem-solving methods in interactive settings in clinical education is recommended (29, 30). Furthermore, social networks as informal support opportunities play a

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key role in the learning process of students. Thus, networks with a focus on learning clinical cases in different clinical courses are suggested for use in clinical education as a supportive resource. According to the growing trend of educational technologies, the development of technology-based clinical skills with a focus on the development of decision-making skills and clinical reasoning in clinical education requires planning in clinical education.

In the domain of "procedural information in educational events", the quantity and quality of different educational events were evaluated. The purpose of the domain in the 4C/ID model is to implement various educational events to integrate the skills, knowledge, and attitudes of learners (31). Various educational events, including rounds, morning reports, grand rounds, simulation education, and outpatient education were evaluated in terms of the quality and quantity of education. In the clinical rounds, different skills including history taking, physical examination, communication skills, clinical and para-clinical information interpretation, diagnostic reasoning, and patient management planning need to be taught. The results showed the focus of the rounds was on teaching the skills of history taking and physical examination. Skills such as diagnostic reasoning are taught through unstructured methods. Diagnostic reasoning is a complex patient-centered process aimed at determining the patient's problem and is considered one of the main competencies of a physician. Considering that the weakness of diagnostic reasoning skills is key to the occurrence of preventable medical errors, training the skill is very critical in medical education (32). The rounds were mostly held as patient visits and taught the principles of patient management. The results showed that evidence-based rounds are not used in clinical education. Evidence-based medical education is considered a main component of medical education that facilitates evidence-based practice in healthcare services (33). Therefore, it is recommended to plan for using evidence-based medical principles in various educational events including educational rounds, morning reports and outpatients, and bedside teaching.

Based on clinical education standards, skills such as patient management process, history taking, presentation skills, identification of medical errors, patient safety issues, and how to manage medical errors can be taught in morning reports. The results showed that the morning report focused on teaching the skills of history taking, patient management, and presentation skills of learners. The results showed that despite the importance of patient safety issues and the high rate of medical errors (34), these issues were less considered in the morning reports. Moreover, the morning report focused on clinical reasoning training, and the evidence-based morning report was neglected in clinical training. Journal Club is important for learning students' thinking skills and is considered an essential component in evidence-based medical education (35). Journal clubs aim to review the content aspect of articles, and the critical appraisal of their methodology is not discussed in most sessions in the departments. Journal clubs can be used as a method for teaching critical thinking, research methodology, and encouraging evidence-based medicine in clinical education (36).

The simulation provides a safe environment for learning (37). In clinical skills centers, students may learn various skills, including communication and history taking, counseling skills, physical examination and procedures, diagnostic skills, and basic and advanced procedures. The results showed that simulation education was used in most departments for teaching practical skills and procedures. The use of simulation education for encountering simulated patients for teaching communication skills, history taking and diagnosis, and patient management as non-technical skills have not been planned. Teaching non-technical skills is important along with technical skills in simulation environments. Thus, it is recommended to plan for education the non-technical skills in the situations (38). Teaching clinical knowledge, history-taking skills, patient management, prescription writing, medical ethics, and clinical

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reasoning is critical in outpatient situations. The results showed that the most education in outpatient centers was related to the skills of history taking, patient management, and clinical knowledge. However medical ethics and clinical reasoning are neglected. Applying structured approaches in education and appropriate models of outpatient education can provide opportunities to learn essential skills for medical students. The status of clinical skills training in most departments showed that systematic planning using educational models is critical to improving the effectiveness of education in the setting.

The purpose of the "practice opportunities" domain is to master learners using the support resources to achieve a high level of competency. In the domain, practice opportunities for the repetitive aspects of educational tasks are emphasized (39). The results showed that training mainly occurred through practice with real patients under the supervision of clinical teachers or senior residents. In clinical education, peer learning as the key source of learning (40) has received less attention. The practice opportunities mainly require planning and provision of necessary equipment and resources in clinical skills centers (41). The provision of equipment and resources, planning, and instructional design aimed at developing non-technical skills in different courses should be considered in clinical education. In teaching practical skills (procedures), learning opportunities, including practicing on the mannequin and models, receiving feedback, analyzing the video, and practicing on a real patient were evaluated. The results showed the practice on real patients under the supervision of the clinical teacher and senior residents is used mostly to teach clinical procedures. Considering the limitations available to patients, and the high risk of performing the procedure on real patients, it is recommended to use various methods. Educational videos as a long-lasting educational method (42), have not been considered in clinical education. Moreover, teaching of procedures using simulated models and mannequins which leads to improved learning and a decrease in the cognitive load of learners (43), was less used in clinical education. Therefore, planning for using diverse learning opportunities in medical education is recommended.

Formative and summative assessments of learners are key elements in the practice opportunities. "Assessment for learning" approach is aimed at improving inclusive learning as a continuous process through the interaction between assessment and learning. Assessment of learners provides evidence regarding the learning status of learners and their progress (44). The result showed the main examination in clinical education included oral examination, logbook, and multiple choice questions. The examination of clinical reasoning, performance assessment in simulation, and workplace-based assessment were not considered in the assessment system of clinical education. The finding indicated assessment of the clinical skills of medical students in the university was a main concern. Assessment with feedback had a significant impact on learning (45, 46). The results showed that the feedback to the examination in the majority of departments was not used to teach students in clinical education.

Conclusion

Clinical learning as a complex skill requires support resources and opportunities of practice for learning. The present results showed that the lowest compliance was reported in the domain of "practice opportunities" and "supportive information" in clinical education. Planning for the development of support resources in various platforms such as electronic and virtual platforms, simulation, and written tools is recommended. It is also suggested to improve equipment, facilities, and appropriate educational design along with opportunities for practice in simulation and real environments in clinical education. The development of teaching methods non-technical and technical skills and the use of educational technologies in clinical education is recommended. The development of communication channels with

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different stakeholders and the use of supportive tools such as study guides aimed at guiding self-direction learning in the process of clinical education among medical students are suggested.

Ethical Considerations

This project was approved by the ethics committee at the National Agency for Strategic Research in Medical Education, Tehran, Iran. (ID: IR.NASRME.REC.1403.012)

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Conflict of Interests

According to the authors, there is no conflict of interest.

Authors' Contributions

F.K designed the research; M.R, P.R, and Z.A conducted the research; Z.A analyzed data; and F.K and Z.A wrote the paper. F.K had primary responsibility for the final content. All authors read and approved the final manuscript.

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References

1. Heidari AA, Dudge Moghaddam M, Ebrahimi Garoui H. Challenges of General Medical Education (Extern AND Intern) in school of Medicine, Mashhad University of Medical Sciences. Horizons of Medical Education Development. 2021;12(3):35-49.
2. Mohammadi Mehr M, Maleki H, Nojoumi F. Determining Teaching-Learning Process in Curriculum of General Medical Course with Life-Long Learning Approach. Education Strategies in Medical Sciences. 2014;7(3):181-9.
3. Bedoll D, van Zanten M, McKinley D. Global trends in medical education accreditation. Human Resources for Health. 2021;19(1):70.
4. Snell L, Tallett S, Haist S, Hays R, Norcini J, Prince K, et al. A review of the evaluation of clinical teaching: new perspectives and challenges. Medical education. 2000;34(10):862-70.
5. Vaughan B. Clinical educator self-efficacy, self-evaluation and its relationship with student evaluations of clinical teaching. BMC medical education. 2020;20:1-11.
6. Newcomer KE, Hatry HP, Wholey JS. Handbook of practical program evaluation: Wiley Online Library; 2015.
7. Design of Performance Evaluation Model of Teachers from Mashhad University of Medical Sciences. Educational Leadership & administration. Educational Leadership & administration. 2019;13(2):249-66.
8. Mirbagheri Alireza GA HJ, Kadkhodaye Mehri, Bahador Abbas. Designing and establishing a comprehensive evaluation system for educational processes of postgraduate departments at the School of Medicine. ROYESH IN MEDICAL EDUCATION. 2021;56-65.
9. Newcomer KE, Hatry HP, Wholey JS. Planning and designing useful evaluations. Handbook of practical program evaluation. 2015:7-35.
10. Snell L, Son D, Onishi H. Instructional design: applying theory to teaching practice. Understanding medical education: Evidence, theory, and practice. 2018:89-100.
11. Kolcu MİB, Öztürkçü ÖSK, Kaki GD. Evaluation of a distance education course using the 4C-ID model for continuing endodontics education. Journal of dental education. 2020;84(1):62-71.
12. Vandewaetere M, Manhaeve D, Aertgeerts B, Clarebout G, Van Merriënboer JJ, Roex A. 4C/ID in medical education: How to design an educational program based on whole-task learning: AMEE Guide No. 93. Medical teacher. 2015;37(1):4-20.
13. Susilo AP, van Merriënboer J, van Dalen J, Claramita M, Scherpbier A. From lecture to learning tasks: use of the 4C/ID model in a communication skills course in a continuing professional education context. The Journal of Continuing Education in Nursing. 2013;44(6):278-84.
14. Maggio LA, Ten Cate O, Irby DM, O'Brien BC. Designing evidence-based medicine training to optimize the transfer of skills from the classroom to clinical practice: applying the four component

[DOI: 10.18502/jebhpme.v8i2.17184]

instructional design model. Academic Medicine. 2015;90(11):1457-61.
15. Janesarvatan F, Van Rosmalen P. Instructional design of virtual patients in dental education through a 4C/ID lens: a narrative review. Journal of Computers in Education. 2024;11(2):523-56.
16. Van Merriënboer JJ, Kester L. The four-component instructional design model: Multimedia principles in environments for complex learning. The Cambridge handbook of multimedia learning. 2005:71-93.
17. Postma TC, White JG. Developing clinical reasoning in the classroom–analysis of the 4 C/ID-model. European Journal of Dental Education. 2015;19(2):74-80.
18. Costa JM, Miranda GL, Melo M. Four-component instructional design (4C/ID) model: a meta-analysis on use and effect. Learning Environments Research. 2022;25(2):445-63.
19. Raadabadi M RP, Alavi Z, Keshmiri F. Program Evaluation in Clinical Education: A Validation Study. sabmitted. 2024.
20. Eslami Jahromi M, Sheikhtaheri A, Tahmasbi F, Ahmadi M, Rangraz Jeddi F. Evaluation of PhD Curriculum in Health Information Management: A Need for Revision. Journal of Modern Medical Information Sciences. 2023;8(4):362-73.
21. Mafinejad MK, Aghili R, Emami Z, Malek M, Baradaran H, Taghavinia M, et al. Study guides: effective tools to improve self-directed learning skills of medical students. Acta Medica Iranica. 2014:781-5.
22. Keshmiri F, Tabatabaee SS. The compilation of clinical practice guideline of medical students in Yazd shahid sadoughi university of medical sciences. Research in Medical Education.0-.
23. Drugova EA, Vaniev AI. Learning design using the four-component instructional design model (4C/ID) in higher education: Review of studies. RUDN Journal of Psychology and Pedagogics. 2023;20(4):747-71.
24. Si J. Strategies for developing pre-clinical medical students' clinical reasoning based on illness script formation: a systematic review. Korean journal of medical education. 2022;34(1):49.
25. Delavari S, Monajemi A, Baradaran HR, Myint PK, Yaghmaei M, Arabshahi SKS. How to develop clinical reasoning in medical students and interns based on illness script theory: An experimental study. Medical Journal of the Islamic Republic of Iran. 2020;34:9.
26. Levin M, Cennimo D, Chen S, Lamba S. Teaching clinical reasoning to medical students: a case-based illness script worksheet approach. MedEdPORTAL. 2016;12:10445.
27. Lopreiato JO, Sawyer T. Simulation-based medical education in pediatrics. Academic Pediatrics. 2015;15(2):134-42.
28. So HY, Chen PP, Wong GKC, Chan TTN. Simulation in medical education. Journal of the Royal College of Physicians of Edinburgh. 2019;49(1):52-7.
29. Michaelsen LK, Knight AB, Fink LD. Team-based learning: A transformative use of small groups in college teaching: Taylor & Francis; 2023.
30. Crisianita S, Mandasari B. THE USE OF SMALL-GROUP DISCUSSION TO IMRPOVE STUDENTS'SPEAKING SKILL. Journal of English Language Teaching and Learning. 2022;3(1):61-6.
31. Van Merriënboer JJ, Kirschner PA. 4C/ID in the context of instructional design and the learning sciences. International handbook of the learning sciences: Routledge; 2018. p. 169-79.
32. LaManna JB, Guido-Sanz F, Anderson M, Chase SK, Weiss JA, Blackwell CW. Teaching diagnostic reasoning to advanced practice nurses: positives and negatives. Clinical Simulation in Nursing. 2019;26:24-31.
33. Phillips AC, Lewis LK, McEvoy MP, Galipeau J, Glasziou P, Moher D, et al. Development and validation of the guideline for reporting evidence-based practice educational interventions and teaching (GREET). BMC medical education. 2016;16:1-10.
34. Zoladl M, Dehbanizadeh A, Nouhi E. Practice and procedural errors and their management methods by nurses. Payavard Salamat. 2018;12(2):128-37.
35. Haghighi R, Zibaei A, Oghazian MB. Moving to the Evidence-Based Journal Clubs: An Area for Targeted Education. 2021.
36. Khadem-Rezaiyan M, Dadgarmoghaddam M, Tabrizi M. Quality of Journal Club in different groups in Medical School (Mashhad University of Medical Sciences). medical journal of mashhad university of medical sciences. 2017;59(6):330-41.
37. Bugaj T, Nikendei C. Practical clinical training in skills labs: theory and practice. GMS journal for medical education. 2016;33(4).
38. McKimm J, Forrest K, Thistlethwaite J. Medical education at a glance: John Wiley & Sons; 2017.
39. Frerejean J, van Merriënboer JJ, Kirschner PA, Roex

[DOI: 10.18502/jebhpme.v8i2.17184]

A, Aertgeerts B, Marcellis M. Designing instruction for complex learning: 4C/ID in higher education. European Journal of Education. 2019;54(4):513-24.
40. Havnes A, Christiansen B, Bjørk IT, Hessevaagbakke E. Peer learning in higher education: Patterns of talk and interaction in skills centre simulation. Learning, Culture and Social Interaction. 2016;8:75-87.
41. Beigzadeh A, Bahmanbijri B, Sharifpoor E, Rahimi M. Standardized patients versus simulated patients in medical education: are they the same or different. Journal of Emergency Practice and Trauma. 2016;2(1):25-8.
42. Yousefvand H, Faezi M, Taleghani F, Bahrami T, Rejeh N. Comparison of the efficacy of electronic and moulage dental training models on adolescents. Journal of Nursing Education. 2018;6(6):33-40.
43. Gharibi F, Nateghi F, Moosavipour S, Seifi M. Comparing the Effectiveness of Augmented Reality, Virtual Reality and Traditional Education on Students' Cognitive Load in Biology. Technology and Scholarship in Education. 2022;2(1):45-56.
44. Brown GT, editor Is assessment for learning really assessment Frontiers in Education; 2019: Frontiers Media SA.
45. Wiliam D. What is assessment for learning? Studies in educational evaluation. 2011;37(1):3-14.
46. Maki PL. Assessing for learning: Building a sustainable commitment across the institution: Routledge; 2023.

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