Integrating Ausubel's meaningful learning and Kolb's realistic simulation in medication preparation: a reflection article

Integrando a aprendizagem significativa de Ausubel e a simulação realística de Kolb na preparação de medicamentos: um artigo de reflexão

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ABSTRACT
This study reflects on the key concept of the teaching-learning process in the preparation of medicines from the dialogical perspective of Kolb and Ausubel, to subsidise the discussion and present a contextualised approach, in order to carry out a reflective analysis by searching the scientific literature for productions based on the concepts cited in the Virtual Health Library. This is a descriptive study with a qualitative and theoretical-reflective approach. Exploring the
application of meaningful learning in realistic simulation scenarios is extremely important, as it combines the benefits of both approaches to create a highly effective and relevant educational experience. The teaching-learning process in the preparation of medicines should be studied and systematised through pedagogical actions that benefit healthcare students and that this type of active methodology makes students develop self-confidence, capacity and motivation to learn during realistic simulation.

**Keywords:** realistic simulation, teaching materials, teaching, medication therapy management, nursing.

**RESUMO**
Este estudo reflete sobre o conceito-chave do processo ensino-aprendizagem na preparação de medicamentos sob a perspectiva dialógica de Kolb e Ausubel, para subsidiar a discussão e apresentar uma abordagem contextualizada, a fim de realizar uma análise reflexiva, buscando na literatura científica produções baseadas nos conceitos citados na Biblioteca Virtual em Saúde. Trata-se de um estudo descritivo com abordagem qualitativa e teórico-reflexiva. A exploração da aplicação da aprendizagem significativa em cenários de simulação realística é extremamente importante, pois combina os benefícios de ambas as abordagens para criar uma experiência educacional altamente eficaz e relevante. O processo de ensino-aprendizagem na preparação de medicamentos deve ser estudado e sistematizado por meio de ações pedagógicas que beneficiem os alunos da área da saúde e que esse tipo de metodologia ativa faça com que os alunos desenvolvam autoconfiança, capacidade e motivação para aprender durante a simulação realística.

**Palavras-chave:** simulação realística, materiais didáticos, ensino, gerenciamento de terapia medicamentosa, enfermagem.

**1 INTRODUCTION**

Seeking to improve the teaching-learning process should be a constant challenge for any teacher in the preparation and administration of parenteral medications, since the adverse effects generated by the lack of knowledge of nursing professionals is a problem in the hospital setting (ESCRIVÁ GRACIA et al., 2019). This problem can cause harm to the patient during hospitalisation. Educating nursing students is key to preparing future professionals and preventing adverse drug events.

There are many ways to promote learning, and previously tested and validated pedagogical methodologies and tools show the efficiency of this process (FRIGOTTO; ARAÚJO, 2018). Meaningful learning shows this efficiency for the intellectual gain of the participant, known in the educational environment as a student. Realistic simulation brings, among other aspects, the training incorporated into the knowledge acquired in the various ways
of manipulating and dramatising work situations technically imposed by the profession in which training is sought.

Meaningful learning (AGRA et al., 2019) is when ideas expressed symbolically interact in a substantive and non-arbitrary way with what the student already knows. In relation to Learning Theories, there are different modalities that contemplate different teaching strategies (CHANG et al., 2021), the main ones can be highlighted as Cognitive Theory, which focuses on the fundamental mental abilities for the formation of knowledge. Affective theory, which proposes that knowledge is assimilated through internal experiences; Psychomotor theory considers learning based on body language and muscular responses acquired through practice and training (SILVA-PIRES et al., 2020).

Kolb's theory addresses the student's need to carry out repetitive activities in realistic environments in order to train for the workplace (PRADO et al., 2020). Meanwhile, David Ausubel's theory (2012) deals with the prior knowledge that each student brings to the learning environment. When these two theories are combined, they can improve the teaching-learning process for health care students when it comes to preparing parenteral medication.

The aim was to reflect on the key concept of the teaching-learning process in medication preparation from the dialogical perspective of Kolb and Ausubel.

2 METHODOLOGY

This was a descriptive study with a qualitative approach of the theoretical-reflective type (BALBINO et al, 2020), anchored in Kolb's concept of realistic simulation and Ausubel's significant learning in the improvement of the nursing teaching-learning process in relation to the preparation and administration of medicines in nursing.

In order to present a contextualised approach, a reflexive analysis was carried out by searching the scientific literature for productions based on the concepts mentioned in the Virtual Health Library (VHL), using the keywords: Kolb's theory, realistic simulation, meaningful learning, nursing, and selecting articles available in full and with significant content to support the proposed discussion.

It should be noted that there was no intention to carry out an integrative or systematic review of the literature, focusing only on theoretical reinforcement for the reflections made. The reflection in this article was taken from the master's thesis: "Realistic Simulation for the
3 RESULTS AND DISCUSSIONS

The text is organised into the following sections: Kolb's Theory; Kolb's Theory and Realistic Simulation; Realistic Simulation; Meaningful Learning Theory; Meaningful Learning Theory: Relevance to Education and Professional Training; Principles of Meaningful Learning; Meaningful Learning in Realistic Medication Simulation Scenarios.

3.1 KOLB'S THEORY

Kolb theory refers to the experiential learner theory developed by David A. Kolb, an American psychologist and educator. This theory focuses on how people learn through practical experience and how this learning influences their personal and professional development (PRADO et al., 2020).

According to Kolb's theory, the experiential learning process is made up of four stages that take place in a continuous cycle (GARCIA; MONTENEGRO, 2019): Concrete experience, refers to direct experience or active participation in a situation or event; Reflective observation, the person reflects on the experience they have just lived through; Abstract conceptualisation, the individual aims to understand the experience and extract general understandings and theoretical concepts from it; Active experimentation, the learner applies the concepts and theories they have extracted from the concrete experience in new situations, which leads to new concrete experiences and starts the cycle all over again (DE AZEVEDO; ZAMPA, 2021).

Kolb's theory suggests that each person has different motivations and learning styles, and that these influence the way in which they approach and learn from experiences. Kolb identified four learning styles associated with these stages of the cycle: The accommodating style, which prefers concrete experience and active experimentation, tends to act before reflecting or planning; the convergent style, which prefers abstract conceptualisation and active experimentation, seeks practical solutions to problems; the assimilating style prefers reflective observation and abstract conceptualisation (DINIZ, 2020) focuses on theoretical understanding and solving problems logically; the style that prefers concrete experience and reflective observation, is creative and
focuses on generating ideas and diverse perspectives is known as divergent (COSTA; DE LIMA et al., 2023).

Kolb's theory emphasises the importance of practical experience in learning and how the reflection and application of theoretical concepts drawn from his experiences can improve and enrich a person's learning process.

3.2 KOLB'S THEORY AND REALISTIC SIMULATION

Kolb's theory, which centres on experiential learning, can be linked to realistic simulation, as both have learned key elements in the learning process (PRADO et al., 2020). Realistic simulation is a teaching technique that seeks to recreate real-life situations and scenarios in a controlled and safe environment, so that students can acquire practical skills and relevant knowledge (DE BRITO PARANAGUÁ et al., 2021).

The relationship between Kolb's theory and realistic simulation can be understood as follows: concrete experience; reflective observation; abstract conceptualisation; active experimentation (DAVITADZE et al., 2022). This practical application helps strengthen learning and improves the ability to face real situations in the future. Realistic simulation (WIJNEN-MEIJER et al., 2022) provides a concrete and practical learning experience that is in line with the first stage of Kolb's theory. Thus, the process of reflection and conceptualisation is embedded in the witness stages of Kolb's learning cycle. Finally, students have the opportunity to actively experiment and apply what they have learnt, completing the experiential learning cycle proposed by Kolb's theory (BRESolin et al., 2022). The combination of both methodologies can be a powerful educational tool, especially in fields where practice and decision-making in experience are key (ROCHA et al., 2023).

3.3 REALISTIC SIMULATION

Clinical simulation is a pedagogical strategy guided by experiential learning that seeks to ensure the development of competences needed to assist patients safely (SEHNEM et al., 2021). In the field of health knowledge, realistic simulation has proven to be a valuable tool for learning and training health professionals (YAMANE et al., 2019). By simulating clinical scenarios and medical situations, students and professionals can acquire practical skills, improve decision-
making and develop the confidence needed to face real situations effectively (COSTA et al., 2023). Some types of realistic healthcare simulation are as follows:

Among the various simulation strategies, the following stand out: clinical simulation for skills training, clinical simulation using simulators (mannequins), clinical simulation (PINHEIRO DANTA et al., 2021), with a standardised patient (actor), hybrid simulation (simulator + standardised patient), Deliberate Practice in Rapid Cycles - PDCR, virtual simulation (virtual reality), in situ simulation and telesimulation.

Deliberate practice in rapid cycles is one of the most recent forms of simulation and training approach that focuses on performing intensive and concentrated repetitions of a particular skill or task, (OLIVEIRA et al., 2020), followed by rapid analysis of the results, feedback and adjustments to improve performance. The idea behind rapid cycles is to allow practitioners to get instant feedback on their actions and apply immediate adjustments to improve their performance (DE AZEVEDO JUNIOR et al.,2019). Instead of performing prolonged practice with long intervals between attempts and feedback, practitioners engage in cycles of repetition of trying (OLIVEIRA et al., 2020), analysing and adjusting in a short space of time. This allows them to experience faster and more effective improvements in their skills.

This type of training is especially effective for skills that encourage detailed refinement and constant repetition (ALMEIDA et al., 2022), such as sports, music, martial arts and other activities that involve fine motor coordination and precision.

Three important principles of deliberate practice in rapid cycles include (OLIVEIRA et al., 2020): Maximising the time for practitioners to carry out practical activities known as hands-on, to develop muscle memory called overlearning through the multiple opportunities for repetition; Offering constant, evidence-based feedback to participants. The mediator should interrupt and apply immediate corrections to the participant and then ask the participant to return to the start of the activity in 10 seconds and perform the task again as shown in Figure 1; Creating a cosy and safe environment to ensure the psychological health of the participants, where the methodology of cycles is made clear to the participants at the start of the simulation and that with increasing complexity and errors, interruptions will be necessary for possible corrections.
3.4 MEANINGFUL LEARNING THEORY

The theory of meaningful learning was proposed by American psychologist and educator David Paul Ausubel in the 1960s. Ausubel was born in 1918 in New York and spent his life studying educational psychology (PUHL et al., 2020) and research into the learning process. His philosophical foundations are rooted in the currents of constructivism and pragmatism.

Constructivism argues that knowledge is actively constructed by the learner, who organises, interprets and gives meaning to information based on their experiences and previous knowledge (FILATRO, 2023), pragmatism emphasises the importance of experience and the practical application of knowledge to make it relevant and meaningful.

The Psychological Bases of learning theory also means being grounded in principles of cognitive psychology, Ausubel was influenced by the ideas of Jean Piaget, who explored the cognitive development of children (TIBAO, 2021) and the importance of constructing knowledge through assimilation and accommodation. In addition, Ausubel also draws on Gestalt Theory, which emphasises the perception and organisation of knowledge as a coherent whole (CRISPIM, 2018).

David Ausubel's contributions were pioneering in proposing that learning is more effective when new knowledge is anchored in the learner's prior knowledge (DE OLIVEIRA; ZARATINI, 2019). He developed the idea of "meaningful learning" as an opposite approach to "machine learning" or "scripted learning". Ausubel differentiated meaningful learning (SILVA, 2021), where there is assimilation and anchoring of new knowledge in prior knowledge, from...
scripted learning, which is based on memorising learned information without connecting it to what the student already knows.

3.5 MEANINGFUL LEARNING THEORY: RELEVANCE TO EDUCATION AND PROFESSIONAL TRAINING

The theory of meaningful learning, proposed by psychologist and educator David Paul Ausubel, is one of the pillars of educational psychology. This theory emphasises the importance of the relationship between new knowledge and the cognitive structure that already exists in the learner's mind (DOS SANTOS GUIMARÃES; MACIEL, 2021). According to Ausubel, learning is more effective and meaningful when new information is constructed and related in a coherent and logical way to the prescribed knowledge (JÚNIOR et al., 2023) that the student already possesses, this anchoring related to the student's prior knowledge is what Ausubel calls subsumers, thus forming a network of meanings for the individual.

The essence of this theory lies in the advice that new knowledge is assimilated and retained more efficiently when the student is able to establish logical relationships and experience between the new content and what they already know (LEITE et al., 2023). Rather than memorising information comprehensively, meaningful learning seeks to promote a deep and autonomous understanding of concepts, allowing the learner to apply this knowledge in various situations and contexts.

This approach is very relevant to education and professional training for several reasons: motivation to learn: by connecting new knowledge with what students already know, learning becomes more meaningful and relevant to them. This increases their intrinsic motivation to learn, as they realise the usefulness of what they are learning in their personal life or future career (DA VEIGA; DE ASSIS, 2023); building solid knowledge: meaningful learning favours building a solid knowledge base. New concepts are integrated into previous knowledge, which makes learning more resistant to forgetting and facilitates the construction of future learning (DE ANDRADE et al., 2023); practical application: a thorough understanding of concepts allows students to apply knowledge to practical situations in everyday life and the workplace (DE SOUZA ARAÚJO, 2020). This learning process takes place due to the three principles of meaningful learning: anchoring in prior knowledge, relevance and pertinence, active learning (BORILLE et al., 2020).
3.6 PRINCIPLES OF MEANINGFUL LEARNING

Anchoring in prior knowledge is one of the central principles of this theory and has played a key role in how students construct and understand new concepts. It refers to the process by which new information is connected and integrated with what the student already knows, making learning meaningful (BORILLE et al., 2020). Each person has a unique cognitive structure, which is made up of their past experiences, acquired knowledge, beliefs and values (TÉBAR, 2023). This structure acts as a mental "hook" for incorporating new information. This process has two anchoring mechanisms: assimilation and accommodation.

Assimilation is the process by which new concepts are incorporated and integrated into the cognitive structures that already exist in the learner's mind. In this mechanism, new knowledge is related and connected in a logical and coherent way with previously acquired concepts. The new content is interpreted in the light of what the individual already knows, becoming an extension or deepening of this previous knowledge (JUNIOR et al., 2023). When assimilation occurs, new concepts are easily incorporated into the existing mental structure, as there is a base of prior knowledge that serves as a starting point for understanding the new material (TIAN et al., 2020). This results in more meaningful learning, where the student is able to relate information in a deeper and more comprehensive way. Accommodation, another important anchoring mechanism in the theory of meaningful learning, occurs when the new knowledge does not fit perfectly or is inconsistent with the learner's prior knowledge. In this case, an existing cognitive structure needs to be modified or adjusted to accommodate the new information (URRUTIA-HEINZ et al., 2022), in other words, when the new concepts cannot be easily assimilated.

Relevance and pertinence are also included in the principles of meaningful learning, when the student realises the voice of the content for their life and personal experiences. If the material presented is seen as useful, interesting and applicable, the student will be more motivated to assimilate and understand it (HAMMEL et al., 2021). Students consider relevant or pertinent learning situations that have applicability to their professional practice, practical applicability is presented in these situations as real-world contexts, educators help students understand how knowledge can be applied in concrete situations in this way the student will be more motivated to learn due to the understanding of the importance and usefulness of what will be learnt, students tend to feel more motivated to get involved in the learning process (MOREIRA, 2021).
This learning model awakens students' interest and curiosity, making the educational experience more meaningful and enjoyable, along with the connection of personal experiences. In this way, meaningful learning is facilitated when students relate the content to their personal experiences and prior knowledge. Educators can help create these connections, making learning more relevant and connected to students' everyday lives at work (DE SOUZA ARAÚJO, 2020). Presenting content within a meaningful context that resonates with students' experiences and interests allows them to see the importance of what is being learnt and how it relates to the world around them (SANTAROSA; DE CARLI TIBULO, 2022).

Active learning, in turn, is also one of the principles of meaningful learning and refers to an educational approach in which students take an active and participatory role in the learning process. Rather than merely being passive recipients of information, students are involved in activities that encourage them to think critically, solve problems, discuss ideas and apply knowledge to real situations (CARDOSO et al., 2023). Meaningful learning and active learning are complementary because they benefit each other. By applying active learning, educators have created opportunities for students to build connections between new concepts and their prior knowledge. Through active participation, students are more involved in the learning process, which facilitates the internalisation of new knowledge and a deeper understanding of the topics covered (MACEDO et al., 2018).

Instead of a traditional lesson, the teacher can implement active learning by organising activities such as group discussions, debates, case studies, practical projects and simulations. These activities allow students to actively participate in the construction of knowledge, share ideas and experiences, and apply what they are learning to real-world situations (MORAM, 2021). This type of approach increases the likelihood that learning will be meaningful, as students are actively engaged in assimilating and accommodating new knowledge into their existing structures SANTOS, 2022.

3.7 MEANINGFUL LEARNING IN REALISTIC DRUG SIMULATION SCENARIOS

Exploring the application of meaningful learning in realistic simulation scenarios is extremely important as it combines the benefits of both approaches to create a highly effective and relevant educational experience. Ausubel emphasises the importance of linking new knowledge to the student's cognitive structure, in other words, their prior knowledge about the
drug and the correct preparation and administration technique. The new content is related logically and substantially to the knowledge that already exists in the student's mind and maximised through simulation, using practices such as hands-on and overlearning. In this process, new concepts are anchored in relevant and clear concepts, which makes learning more meaningful and lasting when integrated into the simulation, as can be seen in figure 2.

Figure 2: Interaction between Kolb's theory and Ausubel's theory during the application of realistic drug simulation.

Source: Prepared by the authors.

It can be seen that this combination of theories can bring benefits and importance to instrumentalising teachers in relation to this active methodology for improving learner competences, which are: meaningful learning for lasting retention; motivation and engagement; development of practical skills; preparation for real challenges; feedback and reflection.

Meaningful learning for lasting retention takes place through realistic simulation, which, by providing an environment close to practical experience, increases the voice and relevance of learning for students. Meaningful learning complements this process by allowing students to connect and relate the simulated experiences to their prior knowledge of drug preparation (BIZERRA, 2020). This deep connection increases the retention and transfer of knowledge about
the preparation and administration of medicines to real clinical situations (OLIVEIRA et al., 2023).

Motivation and engagement is a benefit of realistic simulation because it offers learners the opportunity to apply concepts in realistic clinical contexts, arousing their motivation to learn (COLNAGO; BRITO, 2022). When meaningful learning is created through simulation, students see the encouragement of the content for their lives and careers, becoming more engaged and motivated to become actively involved in the activity. Critical and highly complex situations such as administering potentially dangerous drugs to patients with multiple infusions or emergencies such as cardiac arrest.

The development of practical skills has been shown to benefit realistic simulation by allowing students to practise specific skills in controlled and safe environments. Students can reflect on their simulated experiences and connect the new knowledge with what they have previously learnt (DE OLIVEIRA et al., 2023). This leads to a more comprehensive development of practical skills and critical capabilities for professional life. Students have the opportunity to handle different infusion devices even before their first hospital placement.

The benefit of preparation for real challenges means that the combination of meaningful learning and realistic simulation prepares students to face real-world challenges more effectively. They have the opportunity to practise and apply their knowledge in authentic scenarios, which makes them better prepared for real situations they may encounter in their careers (ANTUNES, 2020).

Feedback and reflection benefit meaningful learning by encouraging reflection on the educational experience, allowing students to see how new knowledge relates to their lives and experiences. This can be extremely useful after a realistic simulation, where constructive feedback can be provided (DA LUZ BRAZÃO et al., 2022), allowing students to reflect on their actions and improve their performance.

4 CONCLUSION

The teaching-learning process in medication preparation needs to be studied and systematised through educational actions that will benefit healthcare students. Realistic simulation and its interaction with Ausubel's Meaningful Learning Theory proved to be an
effective educational method for improving teaching in relation to the preparation and administration of parenteral medication.

Satisfaction with learning has given students muscle memory, scientific knowledge and the ability to make decisions when preparing parenteral medication for critically ill patients. Students feel confident, capable and motivated to learn during realistic simulations, as they act as protagonists in the teaching-learning process.

There is a need to develop more realistic simulations for the nursing field and educational institutions should include this pedagogical model in their curricula in order to improve and perfect the teaching-learning process.
REFERENCES


