LEARNING STRATEGIES USED BY UNDERGRADUATE NURSING STUDENTS IN THE CONTEXT OF A DIGITIAL EDUCATIONAL STRATEGY BASED ON SCRIPT CONCORDANCE: A DESCRIPTIVE STUDY

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Conflict of Interest

The authors have no conflict of interest to declare.

Ethical Approval

The research team has obtained the ethical approval from the Université de Montréal (# 17-156-CERES-D)

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ABSTRACT

Background: the digital educational strategy based on script concordance is an educational method that has been attracting increasing attention in healthcare education programs to fostering the development of clinical reasoning. It includes a digitized Script Concordance Test with incorporated expert feedback. However, the learning strategies required of students in the context of its use remain unknown.

Objective: This study aimed to identify the learning strategies that undergraduate nursing students need to use in the context of the digital educational strategy based on script concordance.

Method: A qualitative descriptive design was used to identify student learning strategies. Data was collected using an online questionnaire and semi-directed focus group interviews. Bégin's taxonomy provided the framework for linking the data collected to learning strategies required of students.

Results: Forty-four students participated in the study. Results show that when using a digital educational strategy based on script concordance, students are called to rely on their nascent scripts in order to select the data in short ill-defined clinical vignettes, evaluate new information repeatedly, anticipate microjudgments, and thus, gradually increase their knowledge and refine their scripts. Viewing the experts' feedback and consulting the referencing tools helped students self-monitor their knowledge, a key metacognitive strategy to learning clinical reasoning. Completed individually or with peers, the digital educational strategy could be used to learn a particular concept or as an integrative activity before an evaluation.

Conclusion: This original study has allowed us to link nursing clinical reasoning teaching conditions to the learning strategies used to develop this competency. Study results inform instructors about digital educational strategy based on script concordance to make it complementary with other educational strategies to better support complex learning of nursing clinical reasoning.

Keywords: nursing clinical reasoning; learning strategies; cognition; e-Learning; nursing education; descriptive study

BACKGROUND

One of the challenges currently facing nursing instructors is to design and plan the articulation of educational strategies with a view to promoting optimal competencies development, including nursing clinical reasoning (NCR). NCR comprises the nurse's recursive cognitive and metacognitive processes when faced with a clinical situation (Goudreau et al., 2014; Simmons, 2010). These cognitive processes make it possible to be on the lookout for key clues in a given situation, to attribute meaning to the data provided, and to develop a treatment plan that is adapted to the situation (Goudreau et al., 2014; Simmons, 2010).

The digital educational strategy based on script concordance (DESBSC) is an educational method that has been attracting increasing attention in healthcare education programs to supporting the development of clinical reasoning (CR). It emerged from studies on the use of script concordance testing (SCT) in medical education (Charlin et al., 2018; Fernandez et al., 2016; Foucault et al., 2015; Lecours et al., 2018). It consists in the use of a number of SCT vignettes presenting contexts seen in professional practice containing complex or incomplete data. Each vignette briefly proposes a clinical situation and questions relating to clinical hypotheses which present new information. The microjudgment required for each question involves considering the impact of the new information on the suggested hypothesis. A nursing SCT vignette is shown in Figure 1.

In the DESBSC, the microjudgments exercised by students are compared to the response previously provided to the vignette questions by a panel of experts, hence the concept of concordance (Fernandez et al., 2016; Foucault et al., 2015). Each expert explains his or her responses without consulting documents or peers. In the context of the DESBSC, students exercise microjudgments in order to answer the questions. They are provided with the automated expert feedback, i.e. 1 – the response choices of the experts, 2 – the experts' comments explaining their response. They are also offered a third type of

feedback which is an educational synthesis aimed at pointing to the key message of a vignette or a set of vignettes and providing resources to consult.

The DESBSC is based on script theory (Charlin et al., 2000). According to Schmidt et al. (1990) and Charlin et al. (2000), CR is supported by the development of scripts, rich networks of knowledge, created and organized in long-term memory. These scripts enable the activation and effective use of knowledge for the purpose of rapidly identifying the key elements of a situation, resulting in its understanding, in implementing the right clinical intervention, and in anticipating or predicting the potential consequences of the situation (Charlin et al., 2000). In short, the scripts underlie the multiple microjudgments exercised in interaction with one another in the context of clinical practice in order to consistently and iteratively solidify the CR process (Charlin et al., 2018; Nendaz et al., 2005).

Research on DESBSC use has introduced its educational contribution in medical education for the development of CR through a cognitive companionship approach (Fernandez et al., 2016; Foucault et al., 2015; Lecours et al., 2018). This constructivist and sociocognitive approach is characterized by sharing and a conscious and deliberate scaffolding between experts and students of cognitive and metacognitive strategies required and deployed for solving clinical situations (Collins et al., 1991; Collins et al., 1989). As cognitive apprentices, students build knowledge in an active and autonomous manner in the context of answering the various DESBSC questions. In exercising microjudgment, students rely on prior knowledge which is compared to the experts' response choices and comments (Fernandez et al., 2016; Foucault et al., 2015). Seeing the experts' feedback, the experts being cognitive companions, allows the students to evaluate and self-monitor their knowledge, add detail or create new links, which thereby becomes increasingly significant (Lajoie et al., 2018) and ultimately foster script creation.

Building and implementing DESBSC is very demanding. It requires a great deal of expertise to develop the learning scenarios and to assist the actors involved (Authors, 2020, submitted). Documenting the learning strategies used by students in the context of the DESBSC can inform instructors about its effective use in programs, in addition to enabling the integration of complementary educational strategies that are less demanding in terms of creation and implementation. In a nutshell, evaluating how students cope with DESBSC

cognitively can help in choosing the educational activities to put in place in programs and in getting students to use the right learning strategy at the right time.

Learning strategies are categories of cognitive or metacognitive action used in a learning situation toward the accomplishment of a task and they serve to operate knowledge with a view to specific objectives (Bégin, 2008, p.53, authors translation). Just like knowledge and abilities, they are resources that students use to develop skills (Dunlosky et al., 2013; Weinstein et al., 1983). To this extent, researchers have developed taxonomies for categories of learning strategies and identified their components in order to better orient instructors' educational choices (Bégin, 2008; McKeachie et al., 1987; Weinstein et al., 1983). Designing educational strategies with teaching conditions that require students to use learning strategies fosters situated cognition (Brown et al., 1989). Situated cognition consists in stimulating cognitive and metacognitive processes in a real-life context or in a context that is close to professional situations. Learning is thus directly related to the context in which it is acquired, which is also part of a distinct social and professional culture (Brown et al., 1989; Lave et al., 1991). As a result, educational success and the potential transfer of the learning strategies used by students to other, similar contexts are also optimized (Dunlosky et al., 2013).

To the best of our knowledge, no research has been conducted on documenting NCR learning by undergraduate nursing students through a DESBSC. The design, testing, and assessment phases have been documented elsewhere (Authors, 2020, submitted). A descriptive study was included in the research process during the assessment of the DESBSC to identify the learning strategies that the students were called to apply. This descriptive study and the learning strategies that the students used are presented in this article. It sheds new light on how to appreciate the educational strategies implemented in programs for the purpose of promoting NCR development.

METHOD

A qualitative descriptive research design (Creswell, 2013; Graneheim et al., 2017) was used in order to explore the learning strategies that students applied in the context of

the DESBSC. A qualitative descriptive design is particularly relevant to research questions exploring a complex phenomenon and obtaining relevant data from subjects (Bradshaw et al., 2017; Kim et al., 2016; Sandelowski, 2000, 2010), such as students in the learning process of NCR. The goal is to gain knowledge about the experience from within (Neergaard et al., 2009; Sandelowski, 2000). It is also an appropriate choice when the information sought is to be used to develop and refine interventions (Kim et al., 2016; Neergaard et al., 2009), such as when DESBSC use is in its infancy in nursing education. The research question was the following: What are the learning strategies that undergraduate nursing students use in developing NCR through a DESBSC?

Study background

The study was carried out at a Canadian university faculty of nursing. The university offers an undergraduate nursing program giving over 200 students per year access to a permit to practice the profession. This program implements a competency-based approach. The duration of the program is three years, spread over approximately six terms, and it requires 103 credits where each credit equals 45 hours of educational activity.

The DESBSC aimed at identifying students' learning strategies included 81 questions relating to 22 vignettes in the context of medical (module 1) and surgical (module 2) general care nursing. It included a digitized SCT with incorporated expert feedback. Script concordance testing is comprised of ill-defined clinical vignettes. Each vignette is designed to represent how new information is processed during the NCR in a context of uncertainty (Authors, 2017). For each clinical vignette, there is 3 columns: 1- a plausible nursing option; 2- a new information; and 3- a choice of answer to determine the significance of the new information in relation to the option. In short, students were asked to answer 3 to 5 questions (If you thought…, And then you find… Your option becomes…) related to each vignette. Their answers were then compared to those acquired from a reference panel of twelve nursing experts (Authors, 2020, submitted). This automated feedback also includes the experts' comments explaining their response. Students were also offered a third type of feedback which was an educational synthesis aimed at pointing to the key message of a set of vignettes and providing resources to consult. An example of a

vignette, including the three types of automated feedback, is presented in the supplementary documentation (see Supplementary documentation).

The DESBSC was implemented over a period of seven weeks, during which students were doing both modules asynchronously outside of class hours, split into several parts depending on their availability. The platform could be used on a PC, a tablet, or a smartphone. Registration on the platform was individualized for each student and required a confidential password. The average duration of the training for module 1 (12 vignettes, 43 questions) was 59.9 minutes, +/- 23. 8. The average duration of the training for module 2 (10 vignettes, 38 questions) was 46.2 minutes, +/- 22, 2 (Authors, 2020, submitted).

Participants

Participants were selected by convenience sampling (Polit et al., 2014) of undergraduate nursing students. First- and third-year students were invited to participate in the study. Extreme groups were chosen in order to better distinguish the learning strategies used at two different levels of training.

Data collection

Two data collection tools were used in order to identify the learning strategies applied in the context of the DESBSC. First, an online questionnaire was used to have students evaluate the DESBSC. This questionnaire was available at the end of each module. It also contained questions about the acceptability and usability of the DESBSC, as well as the following the open-ended question relating specifically to learning strategies: “What is the most important thing you learned through the educational strategy?”

Focus group discussions were then carried out in small groups of students (Hesse-Biber et al., 2011; Krueger et al., 2009) per year of study in order to confirm and deepen our understanding (Miles et al., 2003) of their responses to the online questionnaire, including in relation to the learning strategies they used with the DESBSC. Our concern with validating inferences drawn from the questionnaire enhanced the credibility of the data reported (Bradshaw et al., 2017; Miles et al., 2003). Interviews were conducted by the primary researcher or a research assistant, none of whom was nor had been previously involved with the students. The students were also informed that their participation in this

study, including their written responses to the open-ended question in the online questionnaire and testimonies obtained during interviews were not linked to any evaluation of their performance in the educational program. Group discussions were recorded using a digital audio device to ensure the data reported was accurate (Miles et al., 2003). A discussion guide was used, including questions such as: How would you describe your general experience of using the educational strategy? Did you encounter a learning need/challenge for the development of NCR when using the educational strategy? What are your comments in this regard?

Data analysis

Data analysis is abductive in nature to the extent that Bégin's work on learning strategies (Bégin, 2008) was used as the initial coding matrix for the data collected. Abduction in making explicit the object of knowledge consists in confronting prior knowledge with the practical experience of the research in order to redefine its intelligibility in a manner that is coherent and useful (Eriksson et al., 1997; Graneheim et al., 2017) for the pragmatic utilization of the educational strategy.

Bégin's taxonomy was used as a framework for creating a list of codes before analysis. Bégin drew on an exhaustive review of the cognitive psychology literature (Bégin, 2008). For each learning strategy, the taxonomy describes the observable and non-observable actions, techniques, and procedures used by the student. Learning strategies are briefly presented in Table 1 following the three categories documented by Bégin (2008), i.e. 1- cognitive processing strategies; 2- cognitive execution strategies; and 3- metacognitive strategies. Information processing strategies refer to cognitive action related to knowledge use such as selecting, repeating, decomposing, comparing, elaborating, and organizing. Execution strategies include the cognitive actions enabling the student to show mastery of knowledge in specific contexts or in relationship to specific requirements such as evaluating, verifying, producing, and translating (simplifying) data. Metacognitive strategies involve conscious management of the cognitive strategies used by the student such as anticipating or making assumptions, as well as self-monitoring (Bégin, 2008; Medina et al., 2017).

Individual written responses to the open-ended question in the online questionnaire and testimonies obtained during interviews were transcribed verbatim and coded using MAXQDA2018, to ensure the transparency and the credibility of the data reported and to facilitate comparison between investigators (Bradshaw et al., 2017; Graneheim et al., 2017). In order to identify the learning strategies used with DESBSC, transcripts were read twice by the researcher and portions thereof coded based on predetermined codes. Finally, the codes were related to each other for the purpose of synthesis and application. Based on verbatim transcripts and written comments, this approach helped to exemplify cognitive strategies involved in the context of using the educational strategy. A triangulation of data analysis (Miles et al., 2003) was carried out through validation with the research supervisor who is second author of this article. Finally, the number of codes associated with student learning strategies for each level of training were counted using MAXQDA2018.

Ethical considerations

The study was approved by the research ethics board of a Canadian university (# 17-156-CERES-D). All students gave their free, informed, and ongoing consent by signing a consent form.

RESULTS

Following the presentation of the socio-demographic data we present the results as per the research question: What are the learning strategies that undergraduate nursing students use in developing NCR through a DESBSC?

Sociodemographic data

Twenty first-year students and twenty-five third-year students participated in the study. Thirty-seven (82.2%) of them responded to the online questionnaire and thirty (66.6%) participated in one of the five focus group discussion interviews (2 to 10 students per interview). Group discussions lasted between 30 and 60 minutes each. Based on the data collected (Table 2), most of the students were women (n=33, 86.8%) aged between 21 and 25 (n=32, 84.2%).

The learning strategies used in the context of the educational strategy

The data collected was analyzed based on 12 codes following Bégin's taxonomy Bégin (2008). Segments of speech were highlighted to illustrate the learning strategies reported. Figure 2 presents an example of coding extracted from MAXQDA2018. The segment appears to the right of the text containing the students' speech. Each code is associated with a color.

Finally, codes were grouped into categories following Bégin's taxonomy. Results show that when using DESBSC, the participating students applied learning strategies that fall in the three categories proposed by Bégin. Findings suggest that regardless of the students' level of training, they applied essentially the same learning strategies with differences in frequency (Table 3).

Cognitive processing strategies

Three cognitive data processing strategies, i.e. selecting, repeating, and elaborating, were applied by students at both levels of study in a similar manner when using DESBSC. In addition, results show that the "selection" strategy was more frequently used by first-year students. Data selection could be seen through the cues that students determined as being significant for their understanding of the situation. The "repetition" strategy was more frequently used by third-year students. The DESBSC required the use of this learning strategy by the range of vignettes repeating questions of the same nature. The "elaboration" strategy was only used by third-year students. This cognitive processing strategy enabled the establishment of relationships between situation data and the enrichment of nascent knowledge and scripts thanks to experts' comments and to referencing tools integrated in the DESBSC. Table 4 presents the cognitive processing strategies applied by students along with a short description of the learning strategies as well as verbatim extracts for the purpose of illustration.

Finally, some students reported wanting to make comments as well in order to not only validate the concordance of their response choices but also the concordance of elements explaining their choices, as mentioned by this student:

I wish I had room to integrate justification of my own responses. They would have appeared next to the experts' and I would have been able to compare." Student 6, 3d year

Cognitive execution strategies

In this category, only the "data evaluation" strategy was required from first-year and third-year students in the context of the DESBSC. In addition, applying this strategy was asked to a greater extent of first-year students compared to their third-year peers. The ability to prioritize nursing hypotheses through accurate data evaluation was required for questions relating to the DESBSC vignettes. Students' testimonies suggest that the DESBSC helped them to generalize and to discriminate data in order to judge the vignette hypotheses. One student also commented that the information related to the hypotheses accompanied by expert feedback helped her to learn about data evaluation (Table 5).

The DESBSC illustrated the absence of unequivocal responses on the part of experts in regard to the microjudgments relating to clinical situations. In addition, a degree of doubt about decisions or questions remained despite the microjudgments performed. The student comments below suggest that this particularity of the DESBSC brought up the need to look for additional information to evaluate the data relating to clinical situations.

"Vignettes as ambiguous as those presented bring up a lot of questions and possibilities for nursing interventions. It is therefore important to gather more factual information or information about better NCR." Student 36, 1st year

"I found it useful to have various points of view and to note that I wasn't alone to ask myself questions after reading the description, in particular about missing information or information that would have helped to make a decision in the situation." Student 34, 3d year

Metacognitive strategies

The "anticipation" and "self-monitoring" metacognitive learning strategies were frequently identified in first-year and third-year students' use of the DESBSC tool. In addition, they were to a much greater extent required of third-year students, in particular "self-monitoring" (Table 6).

Although needed, the anticipation strategy triggered by the microjudgments in relation to the educational strategy vignette questions was deemed to be difficult by students, in particular due to the lack of data in the situation and the lack of knowledge or experience in a clinical setting. A certain degree of discomfort with making decisions in a context of uncertainty remained, making some students' response choices arbitrary. Students reported that in some instances they were able to identify cues in the vignettes and that this helped them to connect knowledge they had previously acquired in their academic training, either through problem-based learning or in the context of internships in a clinical setting. The activation of prior knowledge and nascent scripts in students was suggested in the DESBSC and the way to achieve this was to use several situations included in the vignettes.

Results show that the DESBSC automated feedback helped students to self-monitor some of what they learned. This was supported by the relative interpretation of the experts' response choices in the explanatory comments that followed the responses. Finally, students found it useful to position themselves in relation to a group of people, i.e. in validating their level of concordance with the experts.

DISCUSSION

The study involved 45 students who participated in the DESBSC. This study aimed to identify the learning strategies that undergraduate nursing students tend to use in the context of the DESBSC. Results show that students used both cognitive and metacognitive learning strategies. This finding demonstrates the opportunities provided by digital environments in supporting in-depth, high-level learning such as NCR through the pertinent stimulation of students' cognitive resources (Mayer, 2005).

In line with medical education studies on the subject, our study results show that the DESBSC is part of a cognitive companionship approach (Collins et al., 1991; Collins et al., 1989). Findings reveal that the DESBSC enables students to build knowledge using a range of cognitive and metacognitive learning strategies to solve clinical situations drawn from professional practice. In the cognitive processing strategies category, students are called to rely on their nascent knowledge and scripts in order to "select" the data described

in clinical situations, “repeat” questions of similar nature, and thus gradually “elaborate” their knowledge and scripts.

The study shows that it is pertinent, even crucial, to stimulate students’ questioning in order to avoid hasty closure of potential hypotheses when faced with a clinical situation, a challenge that has been observed in healthcare students’ reasoning development (Audétat et al., 2017). Illustrating three to four plausible hypotheses for each vignette question gives rise to a range of possibilities for approaching the clinical situations. The “evaluation” cognitive execution strategy, i.e. adopting a critical approach to determining the relative importance of the situation data, was required of students when they dealt with the DESBSC questions. The “anticipation” metacognitive strategy was also used when making microjudgments illustrated by students’ response choices. The interpretive range of expert comments that followed response choices expanded the students’ purview to considering that there was more than one option possible to solving the clinical situation. Fernandez et al. (2016) and Foucault et al. (2015) made the same observation in their studies on medical education. Despite their unease due to the absence of a consensual response from experts, students appreciated the opportunity to grasp the various interpretations related to the different response choices.

The DESBSC stimulates the use of sociocognitive imbalances in students, thereby fostering metacognition. The “self-monitoring” strategy was much more frequently identified in third-year students. Results show that viewing the experts’ feedback and consulting the referencing tools helped students to self-monitor their knowledge. Students had the possibility to add new links and detail to the data in order to develop the significance of knowledge (Tardif, 2016) and hence foster script formation and densification. These results can be examined from the angle of cognitive conflict, a concept initially developed by Piaget (Piaget, 1967). The difficulty or the impossibility for the student to make a microjudgment or to visualize his or her “discordant” in relation to the experts’ opinions response engages cognitive challenges which trigger the need for new learning (Tardif, 2016). The awareness triggered in the students requires a learning effort on their part. In a nutshell, the student makes changes to modify his or her cognitive schemas in order to address their shortcomings as regards the solving of the situation.

Although cognitive imbalances are an integral part of natural development, they can be used to speed up the process of knowledge development (Lajoie et al., 2018; Tardif, 2016).

Results show the potential that vignette questions offer for generating a cognitive dialogue between experts and students, for using students' sociocognitive imbalances, and for fostering metacognition. They are in line with the findings reported by Power et al. (2016) and with Tedesco-Schneck (2019). Power et al. (2016) used the reflection drafted using SCT questions in medical pediatrics to bring to light the interpretive nuances in reasoning and to help to identify interpretive biases. In her account, Tedesco-Schneck (2019) explains that undergraduate nursing students did SCT where they were allowed to comment their reflections. In both cases, group discussions followed the SCT. Discussions among peers and the various perspectives helped students to better grasp the complexity of the CR process. Results also highlighted the variety of student interpretations of the SCT vignette questions.

This study offers a new contribution to the field by showing that the DESBSC integrates scaffolding more broadly into cognitive companionship (Collins et al., 1991; Collins et al., 1989) as an educational principle to support skills development. Scaffolding is defined by a set of educational methods put in place by an instructor to guide students in solving complex situations that are beyond the reach of their current abilities (Chi et al., 2001). This consideration echoes what Vygotsky describes as the proximal development zone. The proximal development zone is the space where students, accompanied by a more competent individual, succeed in solving a clinical situation (Vygotsky, 1978).

Based on our findings, by stimulating students' cognitive and metacognitive learning strategies and by illustrating experts' "living knowledge," the DESBSC provides learning support to help students progress in their NCR development. Through the vignette questions, it enables the use of nascent scripts in students and promotes their refinement. Experts' explanatory commentary and key references are provided to the students who can thus take their learning further. In a nutshell, faced with the uncertainty of their microjudgments, students receive help and a measure of "remote" supervision to improve their knowledge and scripts. Results also show that expert knowledge visibility is increased

through DESBSC. They act as reflexive role models when explaining their microjudgment in vignette questions. It has proven to be useful and even instructive to note the experts' hesitations, questioning, and enlightening data; they have been a precious educational tool for the students.

Results show the students' appreciation of the possibility to position themselves in relation to a professional group's opinion in solving real-life professional situations. As demonstrated, the DESBSC fosters repeated questioning in the inherent to clinical practice context of uncertainty and ambiguity. The vignettes present ill-defined or unstructured situations with incomplete information. Using real-life professional situations promotes situated cognition (Brown et al., 1989), i.e. the use of real-life professional context or similar thereto cognitive and metacognitive processes. Learning is therefore directly related to the context in which it is acquired, embedded in a distinct social and professional culture (Brown et al., 1989; Lave et al., 1991).

In brief, our results show that extensive theoretical relationships of cognitive companionship as well as situated cognition can be operationalized through DESBSC. As illustrated in Figure 3, DESBSC components foster the students' use of cognitive and metacognitive learning strategies drawing on real-life professional situations, expert opinion, and key reference tools to support the development of the scripts necessary to NCR. Completed individually or with peers, the digital educational strategy could be used to learn a particular concept or as an integrative activity before an evaluation.

Recommendations suggest the use of complementary educational strategies that are less demanding in terms of resource preparation and which are likely to support the complex learning of NCR.

This study reveals that it is advisable to combine the DESBSC with other educational strategies in order to address the complexity of NCR development. Some cognitive processing or execution strategies were briefly mentioned or not used at all by students, such as knowledge "elaboration" and "organization," which are essential characteristics of expert scripts (Charlin et al., 2000). There is no doubt that incorporating a targeted choice of educational strategies into study programs would stimulate the use of

a range of learning strategies in students. Problem-based learning, mapping, simulation debriefing sessions, self-explanation exercises in a clinical setting, and reflexive practice (Tyo et al., 2019) are examples of educational strategies that stimulate the use of cognitive and metacognitive strategies such as knowledge elaboration, organization, and comparison, as well as their self-monitoring through reflection. A balanced use of various educational strategies is recommended alongside the DESBSC in order to make the most of the self-monitoring enabled by the educational strategy. To the extent that third-year students used metacognitive learning strategies more often than their first-year peers, it might be pertinent to incorporate the DESBSC half-way through a program or later in academic training in the form of an integrated activity.

Triggering the use of other learning strategies through the DESBSC can also enhance and diversify its use. In this study, vignette questions forced students to make microjudgments with little information. The expert choices and interpretations in the educational strategy were therefore highly diversified but also very instructive. They highlighted the necessary contribution and relevance of referencing tools suggested in the educational strategy (Charlin et al., 2018). The ambiguities and diversity of inferences raised require discussion among peers and between students and instructor, as well as consulting scientific literature in order to develop one's knowledge In this regard, the DESBSC can be used individually online; however, its positive impact on NCR development can be much greater if response choices served as a basis for debate or as a starting point for subsequent educational activities. This would enable group discussions, data comparison, and supporting learning via expert assistance and referencing tools. If repeated over the course of the students' academic training, conducting discussions using DESBSC vignettes can increase the opportunities for knowledge transfer to similar situations (Dunlosky et al., 2013).

Finally, it has been suggested to add space in the digital environment in order to record, where necessary, the students' interpretation of the educational strategy questions. This could be done before the questions are presented (What are your thoughts on this?) and after each question in order to explain response choices (Figure 4). In addition to enabling comparison with the experts' comments, this may contribute to knowledge

elaboration in students when they identify significant information in situations and when they make connections between situations. Moreover, students would be able to share their thoughts with their peers using the DESBSC. This type of use of the strategy can foster in-depth learning in a digital environment by triggering in a pertinent manner the students' cognitive resources (Mayer, 2005), as well as interactive processes around case discussion and reflection (Buzzetto-More et al., 2006) with a view to NCR development.

Limitations of the study

In this study, NCR learning through vignettes is based on simulated nursing practice situations. It is difficult to determine whether this educational strategy can simulate the cognitive effort that occurs during real-life contact in nursing practice. The participating students were not used to this educational strategy. This may have influenced the thoughts they shared in the online questionnaire and in the interviews. The data collection tool could include more specific questions in order to focus on actions, techniques, and procedures carried out by the student in order to probe with greater precision for the learning strategies used. This could promote a stronger validity of the tools used during data collection, in particular the open-ended question on the online survey which could generate sparse answers, and which did not always answer the research question precisely. In addition, the data collected is based on self-reported information, not on an observation of the intellectual process displayed during participation in the educational strategy.

Finally, the study is also highly contextualized: it explored an educational strategy applied in a nursing training program at a single learning institution. Participation in the study was not part of the regular academic curricula, which may have limited students' availability and interest in participating. It is therefore possible that the students who took part in the study were already interested in engaging in the educational strategy in order to enhance their skills development, including NCR. Further tests involving a greater number of participants and as part of a course is therefore warranted with a view to generalizing results and studying the impact of the educational strategy on NCR development.

CONCLUSION

The DESBSC is based on the use of authentic situations for problem resolution in a context of uncertainty and of formative and comparative scaffolding of microjudgments obtained from a reference panel for the resolution of these situations. Exploring the learning strategies used by students when participating in a DESBCS is an innovative approach in the field of nursing education. Similar studies, in medical education addressed participants' appreciation of DESBSC, but none of them documented the learning strategies that are used. Whereas the processes related to CR are relatively unconscious and automatic (Charlin et al., 2000), cognitive learning strategies refer to conscious means of activating these processes and facilitating skills learning (Bégin, 2008).

This original study allowed us to link NCR teaching conditions to the learning strategies used to develop this competency. Study results inform instructors about this DESBSC to make it complementary with other educational strategies to better support complex learning of NCR.

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Table 1. Taxonomy of learning strategies according to Bégin (2008)

Cognitive processing strategies	Cognitive execution strategies	Metacognitive strategies
– Selecting	– Evaluating	– Anticipating
– Repeating	– Verifying	– Self-monitoring
– Decomposing	– Producing	
– Comparing	– Translating	
– Elaborating		
– Organizing		

Table 2. Sociodemographic data of participating students (n=38[†])		
Sex	Male	5 (13.2)
	Female	33 (86.8)
Age	Under 20 years of age	6 (5.3)
	21 to 25	32 (84.2)
	26 to 30	0
	31 to 40	3 (7.9)
	41 years and over	1 (2.6)
Prior studies in the health and social services field	Yes	32 (84.2)
	No	6 (15.8)
Work experience in the health and social services field	Yes	16 (42.1)
	No	22 (57.9)

NOTE. Data are presented in frequency distribution, the percentages are in parentheses.
[†]Seven participants did not respond to the online sociodemographic questionnaire (15.6%).

Table 3. Frequency of codes linked to cognitive and metacognitive learning strategies used by first-year and third-year students

	1st year	3d year
Cognitive processing strategies	6(24)	12(24)
Selecting	5	2
Repeating	1	7
Elaborating	0	3
Cognitive execution strategies	9(36)	7(14)
Evaluating	9	7
Metacognitive strategies	10(40)	31(62)
Anticipating	3	8
Self-monitoring	7	23

Note: The code frequency percentages linked to the use of strategies are in parentheses

Table 4. Cognitive processing strategies identified in the context of the DESBSC

	Description	Student verbatim comments
Selection	Searching and identifying data that is relevant to understanding or solving the clinical situation.	*"Sometimes, I identified keywords in the situations. I asked myself questions, knowing that this could orient my choices. I Googled the word to confirm. Then I was able to better understand the situation."* Student 24, 3d year
Repetition	Frequently repeating or reproducing the same problem resolution action in the various clinical situations.	*"In our training, we often deal with one subject or case at a time. This training allows us to mix things a bit more; to "shuffle the cards" if I may use the expression and to get more than one point of view regarding a number of practice situations."* Student 1, 3d year
Elaboration	Developing relationships between data and transforming the clinical situation data in order to attribute meaning to them.	*"I liked having articles I could consult after the experts' comments. I also found it pertinent to see evidence supporting the reasoning in the experts' comments."* Student 4, 3d year *"Each expert's comments helped me to better grasp the situation presented. This was useful in allowing me to draw my own connections between theory and practice. I find that having the experts' view on clinical scenarios helps to improve reasoning."* Student 37, 3d year

Table 5. Cognitive execution strategy identified in the context of the DESBSC

	Description	Student verbatim comments
Evaluation	Identifying the relative importance of situation data in order to make the right choice.	*"Taking into consideration the information that isn't available when making a decision and when evaluating the situation. In other words, it is important to ask oneself questions about each avenue possible and to be able to identify the missing information and how it can influence us."* Student 36, 1st year *I mostly learned intervention prioritization and the importance of making connections and a complete evaluation in order to provide appropriate care to the patient; as well as to not overlook important elements and to avoid making interventions that are not called for in the situation."* Student 35, 1st year

Tableau 6. Metacognitive strategies identified in the context of the DESBSC

	Description	Student verbatim comments
Anticipation	Planning and exploring actions that would be useful in the situation. Formulating hypotheses with a view to solving the situation.	*For certain situations I found that there was too much information missing to allow for a response. I asked myself What was his blood sugar level the last time it was taken? Had he eaten ? Has he already taken insulin ? If so, what dosage? I couldn't make a decision, there was too much information missing."* Student 2, 3d year *"There were times when I didn't know what to respond, i.e. what decision to take. I didn't have the knowledge required to answer."* Student 33, 1st year
Self-monitoring	Being aware of the knowledge required in the situation and adjusting in view of the results or the feedback	*"It helped me to figure out strange things, like a lightbulb moment that hadn't happened before. I thought to myself: true, this is how I would do things spontaneously and based on my current knowledge. But my knowledge could improve, and this could completely change my view."* Student 14, 1st year *"It helped us to position ourselves in relation to a group of nurses [...] It's like information sharing I would say. It shows us what we didn't do and what we could have taken into consideration."* Student 14, 3d year

Ms. Gervais, 78, has been admitted in your short-term geriatric unit for an assessment of fall risk in a patient with Parkinson's disease. This morning, Ms. Gervais's daughter mentioned to you that her mother is not behaving as usual. She seems both agitated and confused.

If you are thinking of…	***And then you find…***	***The impact of this new information on the hypothesis is:***
... an infectious process with uncertain etiology in Ms. Gervais.	... an absence of fever in the patient.	☐ : highly negative; ☐ : negative; ☐ : neither more nor less negative (neutral); ☐ : positive; ☐ : highly positive.

Hypothesis	***New information***	***Microjudgment***

Figure 1. SCT vignette items

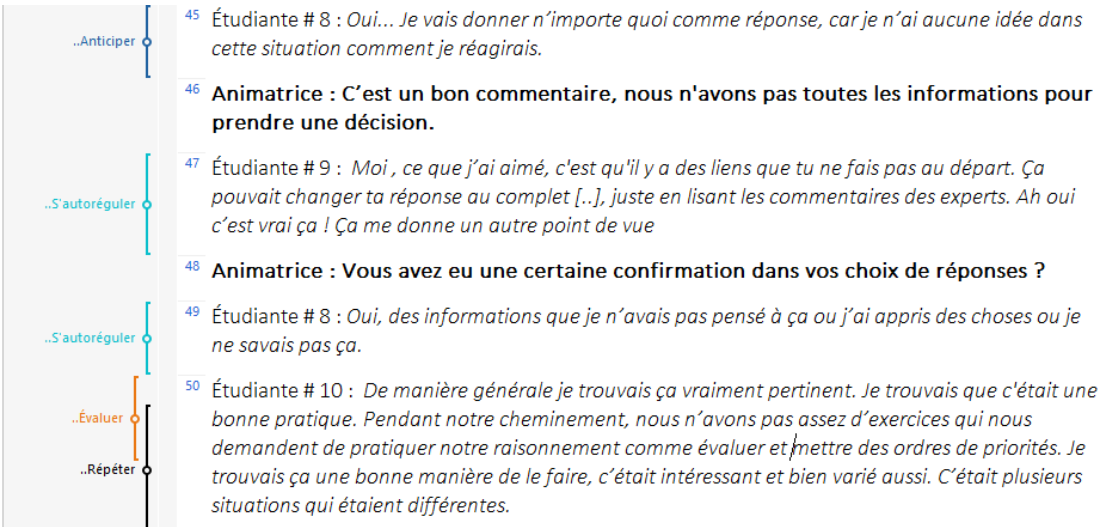

Figure 2. Extract of a third-year student group interview providing an example of descriptive coding

Ms. Gervais, 78, has been admitted in your short-term geriatric unit for an assessment of fall risk in a patient with Parkinson's disease. This morning, Ms. Gervais's daughter mentioned to you that her mother is not behaving as usual. She seems both agitated and confused.

Evaluating the information and ... **anticipating**

If you are thinking of…	***And then you find…***	***The impact of this new information on the hypothesis is:***
... an infectious process with uncertain etiology in Ms. Gervais.	... an absence of fever in the patient.	☐ : highly negative; ☐ : negative; ☐ : neither more nor less negative (neutral); ☐ : positive; ☐ : highly positive.

Digital view of response choices, experts' explanatory commentary, and referencing tools

Elaborating knowledge and self-monitoring

Figure 3. Cognitive and metacognitive learning strategies used in the context of the DESBSC

Ms. Gervais, 78, has been admitted in your short-term geriatric unit for an assessment of fall risk in a patient with Parkinson's disease. This morning, Ms. Gervais's daughter mentioned to you that her mother is not behaving as usual. She seems both agitated and confused.		
What is happening? What are your thoughts at this moment?		
If you are thinking of…	***And then you find…***	***The impact of this new information on the hypothesis is:***
... an infectious process with uncertain etiology in Ms. Gervais.	... an absence of fever in the patient.	☐ : highly negative; ☐ : negative; ☐ : neither more nor less negative (neutral); ☐ : positive; ☐ : highly positive.
Explain your response choice ...		

Figure 4. Other possible questions to integrate in the educational strategy vignettes

Supplement file: Automated feedback in a vignette

Mr. Buisson, 38 years old, had a cholecystectomy. He received Dilaudid® (hydromorphone) 2 mg PO 3 times since his return from the recovery room. You notice that the patient requires physical stimulation to keep him awake and that he has an embarrassed breathing, like a snore, with a respiratory rate of 10 breaths/min.

If you were thinking to…	***And then you find…***	***Your option becomes…***
		Feedback # 1
Notify the physician about Mr. Buisson's condition.	You notice the following results of a venous blood gas: pH: 7,25 PCO_2: 52 mmHg HCO_{3-}: 12 mEq/L	☐ Strongly contraindicated; ☐ Contraindicated; 1 expert has chosen this option ☐ Neither more nor less indicated; ☐ Indicated; 3 experts has chosen this option ☐ Strongly indicated. 6 experts has chosen this option

Feedback # 2

Expert no 1: Consider putting a pulse oximeter on Mr. Buisson with the alarm activated at all time and bringing him close to the nurses' station (to hear the alarm).

Expert no 2: It's looks like to a narcotic-related respiratory depression rather than sleep apnea: close monitoring is required for the patient's safety. Because Narcan® is not prescribed to all patients, the physician should be notified.

Expert no 3: This patient appears to be suffering from a narcotic-related hypoventilation. His blood gas reveals a mixed acidosis. Thus, there is a respiratory component, but also a metabolic component to investigate.

Feedback # 3

This situation highlights the close clinical monitoring of patients following the administration of opioids. Here are the recommendations made by the Ordre des infirmières et infirmiers du Québec [Quebec Order of Nurses]:

https://www.oiiq.org/sites/default/files/uploads/pdf/publications/perspective_infirmieres/2009_vol06_n01/14_avis_surveillance_clinique_patients_opiaces.pdf