RESEARCH BRIEF

Descriptive Analysis of Pharmacy Students' Impressions on Virtual Interactive Case Software

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Objective. To assess students' impressions on whether Virtual Interactive Cases (VICs) contribute to their learning experience.

Methods. Ten fourth-year pharmacy students each independently completed the same four VICs followed by a semi-structured interview conducted by VIC project team members. The interviews were audio-recorded, transcribed, and coded for themes using qualitative research methods.

Results. All participating students completed all the cases. Overall, students' feedback on VIC was positive. Five main themes emerged from the transcripts: VIC facilitated their skills in information gathering; they learned from the built-in, real-time, formative feedback; they had a fun and positive learning experience; VICs were realistic; and VIC system was user-friendly. Students also recommended that VIC be incorporated into classroom learning. Some students required additional explanation on the concept of time and costs associated with each action they selected, and the associated performance score.

Conclusion. Pharmacy students' positive experiences with VICs support its use to bridge classroom learning with clinical practice.

Keywords: virtual cases, active learning strategies, deliberate practice, experiential education, advanced pharmacy practice experience

INTRODUCTION

The acquisition of clinical skills through experiential education is emphasized by both the Canadian Council for Accreditation of Pharmacy Programs¹ and the Accreditation Council for Pharmacy Education.² Didactic teaching provides students with knowledge in pharmacology and therapeutics, as well as a framework to identify, resolve, and prevent drug therapy problems (DTPs). The pharmacy students' experiential training is meant to bridge the transition from didactic learning to the practice of a fully licensed pharmacist. However, the transition from classroom learning to clinical practice may be challenging to some pharmacy students.

Knowledge acquisition is only the first step in developing competence and clinical skills in pharmacy practice. Didactic teaching is a well-recognized method of imparting knowledge to students. After knowledge acquisition, pharmacy students develop their clinical reasoning skills through knowledge application. Clinical reasoning, defined by Miller³ as the skill of gathering information, synthesis of these findings and translation into a therapeutic plan, can be achieved through pattern recognition acquired through experience. Clinical reasoning is thought to involve two processes – analytic and non-analytic.⁴

Whereas the analytic process adopts a systematic approach using available information to make decisions, non-analytic process is based on pattern recognition acquired through experience. The non-analytic process becomes more prominent with the acquisition of clinical expertise.

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Clinical expertise is acquired through knowledge, experience, and the development of competence. Ericsson described a process of “deliberate practice,” which is the practice with the intent to obtain feedback for improving proficiency.⁵ Ericsson argues that deliberate practice is a key factor in individuals who have achieved expertise in their field. Although literature is lacking in pharmacy education, incorporating a variety of simulation-based educational activities with deliberate practice is of growing interest in medical education.⁶⁻⁸

The Virtual Interactive Case (VIC) system⁹ is a web-based software developed at the University Health Network in Toronto, Canada that allows students to practice their skills in patient encounter, information gathering and assessment. They receive built-in, real-time feedback at the end of the case based on their ability to correctly identify the patients’ DTPs and create an appropriate care plan with monitoring parameters. VIC also provides a debriefing and a score reflecting the efficiency of their information gathering during their assessment of the patient. During patient assessment, the students must select from a wide variety of questions to ask the patient and breadth of information from the patient chart, such as patient history, medical imaging, laboratory values, medications, and other items that contribute to patient assessment. This exercises their judgment in discerning which information is relevant for determining the DTPs in this patient. When the student feels they have sufficient information to identify the patient’s DTPs, they proceed to select the DTPs, followed by selecting the appropriate care plan items, monitoring parameters, and follow-up schedule. Once the selections have been submitted, feedback is provided with explanation (debriefing). The VIC score is determined by assigning points to pertinent findings in the case. The time and cost of each assessment and action taken is totaled to encourage a focused assessment of the patient and discourage assessing irrelevant items.

The objective of this study was to assess students’ impressions of Virtual Interactive Cases (VIC) and whether VIC contributes to their learning experience.

METHODS

A semi-structured interview was used to explore students’ perspective of the VIC software. The study was conducted from September 2015 to February 2016. The consolidated criteria for reporting qualitative research (COREQ) was used to report study findings.¹⁰ Approval was granted by the Research Ethics Board of the University Health Network.

A letter inviting student participation was sent by a pharmacy administrative staff member to fourth year students in a four-year Doctor of Pharmacy program who were assigned to at least one Advanced Pharmacy

Practice Experience (APPE) rotation at the study site. Those who volunteered to participate were assigned a random 5-digit study number to ensure anonymity. Participants were provided with a \$25 coffee gift card in compensation for their time. After providing written informed consent, 10 students independently worked through four VIC hospital pharmacy cases, one from each of the following therapeutic topics: asthma, hypoglycemia, orthopedic surgery, and intra-abdominal infection. No time limit was applied for each case and students were able to work at their own pace. Upon completion of the cases, students participated in a 15- to 20-minute semi-structured, interview conducted in person by two study investigators. All case workups and interviews took place in a private area on hospital premises.

The interview was audio-recorded and transcribed. Co-investigators who are pharmacy department staff or faculty members were blinded to the participants’ identities and were not present during the VIC workup and interview.

Prior to initiation of the study, a test session with a volunteer APPE student was conducted to try the interview questions for clarity and understanding. The final interview guide used in the study is listed in Table 1. The data from the pilot interview was not included in the data analysis. Using qualitative descriptive methods, the audio-recorded interviews were transcribed, coded manually, and analyzed for themes. To enhance the reliability and validity of the data, two team members independently reviewed and coded the transcripts. After all the interviews were concluded and transcribed, four transcripts were randomly selected to develop a coding framework. Disagreements in codes were discussed and consensus between the two reviewers was reached. The remaining six transcripts were then coded using the framework. Codes were again reviewed for consistency after completion of the 10 transcripts. Themes that emerged from the transcripts were identified, discussed, and agreed upon by the reviewers based on the coding framework (Appendix 1).

RESULTS

Ten APPE students completing their rotation at UHN participated in the study. During data analysis, it was determined that data saturation was reached at the fourth participant as no new themes arose from subsequent interviews. Five main themes emerged from the transcripts: VIC facilitated students’ skills in information gathering; students learned from the built-in, real-time, formative feedback; students had a fun and positive learning experience; VICs were realistic; and VIC system was user-friendly. Students’ feedback on how the software could be improved and how VIC could be used

Table 1. Structured Interview Guide to Collect Student Feedback on VIC

Domain	Interview Questions
General Feedback on VICs	Can you tell me more about your overall experience going through VICs? What did you like/dislike about VICs? How did you find the instructions? Navigating through the program?
Content/Process	How helpful or unhelpful were the cases? Can you tell me more about the feedback you received at the end of each case?
Impact on Learning	What skills can students gain from working through VICs? How do these skills differ from what you might have gained through paper cases? What knowledge (if any) did you gain from going through the VICs? If given the opportunity to work on more VICs (eg, throughout pharmacy school, during APPE Transition Week, prior to the start of a rotation), how do you think the feedback can impact your learning?
Relevance to clinical practice	How do you think VICs can impact your approach to real-life patient care? Can you compare/contrast VICs and traditional paper cases? What learning gaps do you think still exist between course work and real-life patient care? How could using VICs fill that gap? Where do you think VICs fit?
Recommendations	What aspects of the VICs could be improved? What was most helpful to you? What are your suggestions for how VICs can be improved? Would you recommend VIC to your fellow students? Why or why not?

in the curriculum to maximize learning were also captured. Sample quotations based on transcripts are provided in Appendix 2.

Themes

Information gathering. The students unanimously reported that VIC software is most useful for practicing information gathering skills.

Feedback. Students identified that the feedback from VIC was superior to that provided from paper cases as it was immediate, focused, and could be applied to future cases to improve their performance. The feedback allowed students to review the correct and incorrect DTPs and apply this feedback when they select their care plan items and monitoring plan. Students also appreciated that the feedback provided was comprehensive. VIC provides feedback on each DTP, care plan, and monitoring item on why the answers are correct or incorrect.

Fun and positive experience. All the students enjoyed working through the cases. Some students compared VIC to a game in that they tried to improve their score in subsequent cases. Other students described their enjoyment from working through the VICs based on how closely the pharmacy VICs mimic the clinical scenarios they come across during their APPE rotations. In addition, most students reported that they would recommend VIC to their peers to help prepare for clinical hospital rotations.

Realistic. Students compared their experience using VIC with their experience working through paper cases in the pharmacy curriculum. They reported that VIC was more reflective of their experience in hospital placements compared to paper cases mainly because they have to search for key sources of information such as best possible medication history (BPMH), laboratory findings, and medication orders. Because of this finding, some students suggested that VIC should be incorporated into the curriculum and introduced to students before starting clinical placements.

User-friendly. Most students admitted that they did not read the instructions on the first page before proceeding to work through the cases. As a result, they initially did not understand how the scoring system worked and how to efficiently navigate through the cases. Despite this, students found VIC to be intuitive and easy to use and they were able to use VIC effectively by the end of their first case. However, some students noted that they did not understand the costing or scoring system used in VIC. After working through all the cases, students stated that it became more apparent that all of their actions in the cases were associated with a cost (dollar value), and that the more actions taken (eg, clicking through irrelevant information or asking the virtual patient irrelevant questions) increased the cost of patient care.

Opportunities for Improvement

Students identified opportunities for improvement associated with the VIC software. Although designed to provide students with a scoring system that reflects their performance, the cost-score system acted as a deterrent for some students to explore different sources of information during information gathering.

Some students avoided or hesitated to explore additional sources of information even if they thought relevant content would be revealed within that section because they wanted to keep their cost (dollar value) as low as possible. As such, some students tried to identify the DTPs with the least information possible.

In the VICs, the students need to choose appropriate care plan and monitoring items after DTP identification. These items are intermixed, which forces the students to read through all options to select those that are most appropriate. Some students commented that they would prefer to have the DTPs, care plan, and monitoring items be grouped together by issue (eg, blood sugar control, pain management, etc.).

Although VIC provides immediate feedback to the student after they identify the patient's DTPs and management plan, as well as feedback at the end of the case on their information gathering process, some students identified that it would also be helpful to have a verbal discussion about the case. Some students proposed that the cases could be assigned as homework and in-class time could be spent discussing the case and their questions.

DISCUSSION

Our findings show that students have a positive impression of VICs. The VIC software was developed to help bridge the gap between classroom learning and clinical practice. Our results identified a gap in learning as students reported that there is limited opportunity to practice information-gathering skills in their pharmacy program. Traditional pharmacy curricula have used structured patient encounters with standardized patients to simulate real practice, as well as paper cases to practice creating pharmaceutical care plans. This teaching format provides students the opportunity to apply their knowledge and skills by practicing information gathering, patient assessment, and care plan development skills. However, the volume of simulated patient encounters with standardized patients and case writing required can be challenging, resource-intensive, and often cost-prohibitive.¹¹ Paper cases used in the current curriculum provides pharmacy students with all relevant information about the case, whereas VIC is designed for students to determine for themselves which informa-

tion is relevant to create a complete patient profile and identify the patient's DTPs. Traditional paper cases also have a lag time in marking and providing feedback to students. Hence, the teachable moment is often lost. The immediate feedback from VIC overcomes this challenge and captures the opportunity for self-directed learning. The VIC software provides a favorable option to help students practice these essential skills and supplement traditional teaching techniques currently in use in the pharmacy curricula.

There is currently limited literature on the use of virtual patients in pharmacy education. Douglass and colleagues assessed the impact of a virtual patient pilot program on pharmacy students' clinical competence skills on subsequent examination assessments.¹² In this study, students were presented with pharmacy cases from a web-simulation software similar to VIC and were required to identify and resolve DTPs. In addition to assessing the association of improved clinical competence and performance in an examination, perceptions of pharmacy students regarding the virtual patient software was also collected. Similar to the findings of our study, the majority of the participants in the study by Douglass and colleagues reported that working with virtual patients improved their ability to identify pertinent information, competence in identifying and resolving DTPs, and had a positive contribution to their learning. Other studies on the application of virtual simulation systems in pharmacy students showed that working on virtual pharmacy cases can help pharmacy students improve clinical skills and practicum scores,¹³ although there is uncertainty from available data if virtual systems can help students prepare for APPE rotations.¹²

Our study adds to current evidence that virtual interactive patient software can have a role in the implementation of innovative methods of delivering pharmacy education. Today's generation of pharmacy students are constantly exposed to rapidly advancing technology. It is inevitable that students will come up with different ways on how these technological advances can simplify their daily tasks, such as improving efficiency on how they learn new concepts.¹⁴ Mobile apps are also widely available for students to easily access medical and pharmaceutical information.¹⁵ To enhance student experience and interest in course material, instructors should design courses to complement students' learning style and preference.¹⁴

Our study identified future opportunities for VIC. The development of VICs that represent different clinical scenarios may be beneficial to prepare students for various clinical rotations. At the time of the study, there were only four pharmacy VICs available. A bank of pharmacy

VICs is currently available for interested users on the VIC webpage. VIC may also be used in the classroom during patient case work up¹⁶ to introduce the practice of information gathering early in the curriculum and prepare for therapeutic discussions done in class to provide a richer learning experience.

Because all VICs presented in this study are based on hospital pharmacy practice and participants interviewed are from the Leslie Dan Faculty of Pharmacy at the University of Toronto, it is important to consider the generalizability of the findings in other pharmacy practice settings (eg, community pharmacy practice) and students from pharmacy programs at other academic institutions. Recognizing the small sample size of this study, the perception from study participants that VIC is helpful in preparation for APPE rotation may or may not be reflective of the perception of a wider cohort. It is also important to note that there are multiple variables that contribute to student performance in clinical rotations such as strength of prior clinical knowledge, preceptor and experiential site continuity, and student-preceptor learning styles.^{17,18}

CONCLUSION

The VIC software allowed pharmacy students to practice the patient care process, including information gathering, identification of DTPs, and care plan development with monitoring parameters. Students found the built-in feedback to be immediate and useful, and as such were able to apply the case's feedback to subsequent VICs. Students also identified that VIC software can help with their preparation for APPE clinical rotations. Future opportunities with VICs include further case development for additional therapeutic areas and the assessment of the impact on clinical reasoning through incorporation of VICs in the pharmacy curriculum.

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Appendix 1. Coding Framework Used to Develop Themes

Information gathering
Discerning pertinent information
Realistic cases
Cases that reflects hospital practice and/or patient challenges in hospital clinical rotations
User friendly
First case was used to learn navigation
Improve patient care process through practice
Exposure to a variety of cases
VIC addresses gap in pharmacy curriculum
Apply learning to future cases
Preparation for hospital rotations
Feedback
 Immediate
 Focused
 Comprehensive
 Can be applied to future cases to improve performance/score
“Cost” information and functionality
 Did not understand relevance of “cost”
 Distracted by “cost”
 “Cost” was deterrent to explore the tabs available in the case
Therapeutics
 Learned new concepts
 Identified one’s own knowledge gaps about the topic
Different from paper cases
 Feedback on information gathering
 Used required to do their own information gathering
 More realistic than paper cases
Opportunities for improvement
Game/beat score/maximize score
Recommendation to peers

Appendix 2. Sample Transcript Excerpts from VIC Study Participants

General Feedback on VICs

“I think it’s pretty straightforward... you don’t really need to prep beforehand in order to know how to use it [VIC].”
“...it [VIC] was easy to use. . . it [VIC] wasn’t complicated.” “Instructions were clear”

Content/Process

“... the feedback was really constructive.”
“I thought it [VIC feedback] was a bit more thorough than the kind of feedback I would receive in paper cases.”

Impact on Learning

“One of the biggest ones is really the gathering of information. . .knowing what’s important. I struggled a lot with that in the beginning.”
“...I rarely actually get feedback on the information gathering portion of working up a patient, which is the part I struggled most when I started my rotation.”
“...in paper cases they give you all the information... Usually it’s only the pertinent information. They [paper case] rarely, rarely give. . . additional information that’s not really necessary for the case.”

Relevance to Clinical Practice

“...pretty realistic to how I am working up patients right now [in hospital rotation]”
“It would be a good transition for those who haven’t had any experience in hospital to practice. . .”

Recommendations

“I would recommend it because it helps with improving. . .how to gather information, what kind of questions to ask, where to look for information.”
“I would recommend it because it’s a nice way of prepping students prior to the hospital rotation. . .easier for students to transition”