Abstract
This paper describes an innovative approach to introducing workplace readiness for Pharmacy Science students by using a game-based simulation.

The Virtual Pharmacy courseware comprises four games which mimic the activities in a dispensing pharmacy. At each station, students are trained in a task such as receiving prescriptions, interpreting and typing prescriptions, packing medications accurately, as well as counselling patients on their medicines. Players are required to complete as many correct prescriptions as possible in a specified time, with both accuracy and speed being critical components of the score.

This courseware was first implemented in October 2013 in two modules in the first and second years of the Diploma in Pharmacy Science course (Introduction to Pharmacy and Pharmacology) to help students to better understand the application of their lessons to the job activities in a pharmacy. Through these games, students were able to revise topics in these modules such as the legal requirements for a prescription, interpretation of terminology, types of drug classes, actions and side effects as well as counselling points.

A post-implementation survey was carried out on first and second year students. A focus group was also conducted on third year students undergoing internship. Feedback on the courseware was very positive. Students agreed that the activities helped them to better understand key topics, were appropriate and relevant and helped them to understand the workflow of the pharmacy. They also found the game enjoyable and easy to play. Students were able to see how the coursework prepared them for their internship and work environment. The main issue that students faced was with technical issues faced in downloading the game.

Staff and industry partners surveyed also felt that the courseware was useful in preparing students for a career in pharmacy practice, especially in allowing simulated error situations which would be difficult to simulate in the workplace.

Keywords: Virtual pharmacy, Game based simulation, Pharmacy practice, workplace readiness, Pharmacology

Introduction
The Virtual Pharmacy courseware is an innovative courseware to prepare Diploma in Pharmacy Science students for work in a dispensing pharmacy. Students spend the first two years of their course at Ngee Ann Polytechnic before undergoing a year-long internship, in their final year, at the National University Hospital (NUH) pharmacy department.

This courseware was developed in response to staff and students’ feedback that students found it challenging to relate the knowledge learnt in the first and second year of the course to real life pharmacy practice. The courseware also aimed to bridge identified gaps in the requisite skills and knowledge of our graduates. In addition, the team also wanted to reduce the “transitional shock” that students may face when embarking on their internship in their final year of studies.

With the above considerations, the Virtual Pharmacy courseware was developed. It mimics a typical hospital pharmacy to provide students with an authentic learning experience where they practice applying their knowledge and skills in a virtual pharmacy environment.

Design and Development of the courseware
Prior to the development of the courseware, the development team did an industry scan to find off-the-shelf courseware that is designed to train Pharmacy Science students to work in the outpatient pharmacy setting. However, such courseware was not available both locally and worldwide and the development team decided that they would create their own courseware for the Pharmacy Science students.

The courseware development team comprised pharmacists with many years of experience in local pharmacy practice working with instructional designers and software developers. This enabled the team to design the courseware that is tailored to suit the local pharmacy context. For instance, the drugs prescribed in the courseware are those that are commonly used in Singapore. The prescription terminology mimics that used by local doctors. The medication errors included are those that are commonly seen in the hospital and polyclinic pharmacies.

The courseware tries to replicate the actual pharmacy environment as closely as possible so as to give students an authentic learning experience. For
example, the dispensing software in the courseware is designed to mimic the actual dispensing software (iPharm) used in many hospitals in Singapore.

Another consideration in the design of the courseware was to make it interesting and attractive to students, so that they are willing to participate in the courseware activities and to use it for learning. For this reason, the courseware design included features found in everyday operations in a typical pharmacy that would enhance the fun and excitement factor of the games. For example, the courseware displayed images of patients getting angry if they waited too long for their medications and a time challenge was included to make the game more exciting. Research has shown that by making learning “feel less like a chore and more of an enjoyable opportunity”, it helps in retention of learning and promotes the intrinsic satisfaction of the learners (Mims, 2003).

Description of the courseware

(1) An authentic learning environment

There are four stand-alone scenarios in the Virtual Pharmacy courseware. These mimic the four primary stations in a typical dispensing pharmacy, which are the Receiving, Typing, Packing and Dispensing counters. The home screen of the game can be seen in Figure 1. The objectives of each station can be found in Figure 2.

In each of the four games, students are required to complete as many correct prescriptions as possible in a specified time. Accuracy and speed of completion are both critical components of the score that students receive at the end of the game. Feedback is provided during the game and a competitive element is introduced via a “top scorer leaderboard”.

(2) Development of Professional skills

The courseware was purposefully designed to reinforce certain essential values, skills and professional competencies required when working in a pharmacy and thus increase our students’ readiness of the work environment.

Working with accuracy: As the work in the pharmacy requires speed and accuracy, students need to be able to have the opportunity to develop these skills. The “Right Drug, Right Dose, Right Patient, Right Time” concept is very important to prevent medication errors. In this game, students are trained to continually strive for accuracy at every stage. Students are not allowed to proceed with the game without checking that the patient identity, labels or prescriptions are correct and they are also penalized for inaccuracy.

Use of specialized software: One of the skills identified by pharmacy managers as being highly valuable in our graduates was the ability to use the pharmacy dispensing software to generate and modify pharmacy situation where students may be assigned to the receiving counter during their internship.

In the real pharmacy workplace, students have to learn to deal with the pressure of dispensing the medication accurately within a limited time frame. The waiting time for patients as well as the medication error rate are some of the key process indicators to measure the performance of the pharmacy service. Students need to acquire the key competence of being fast yet accurate in their work. To help train students in these qualities, a time challenge in the form of a “ticking clock” was integrated into the game to remind students of the limited time they have for each task. In addition, the impatient and unhappy patients provide additional “pressure” for the students which is a reality that they will have to deal with in the actual pharmacy. These features of the game add to an authentic environment for learning and prepare students with the reality of the occupational stress that students might face in their future work environment.
The dispensing software in the typing game was painstakingly designed to mimic the current iPharm dispensing software used in most restructured hospitals and polyclinic pharmacies in Singapore as much as possible. A screenshot of the typing game can be seen in Figure 5.

Figure 5: Screenshot of the Typing game

Communication skills: Another essential skill in pharmacy staff is being able to communicate effectively with patients. Through the interaction with the game avatars, students learn to develop good communication skills and the appropriate language used in counselling patients. There are certain key phrases that are essential when dispensing to patients and also specific phrases to be used when describing the mechanism of action and side effects of drugs. These key phrases are necessary to increase the clarity of instructions to patients.

In the dispensing game, students were required to “counsel” patients on their medications in simple terms that the patients can understand. For example, the phrase “this drug is used to lower your blood pressure” should be used as it is more easily understood by patients rather than the more technical phrase “this drug is for treating hypertension”. The courseware thus reinforced the use of correct terminology throughout the game.

In order to reinforce the necessity of checking for the right identity of the patient and for possible allergies, the courseware incorporated an “automatic” dialogue which students had to go through before proceeding to dispense each prescription. These included phrases such as “Good Morning! May I check your identity card or appointment card please?”, and “May I check if you have any allergies?”

The continual exposure to these key phrases, although repetitive, would help students to internalize this process and make it part of their routine when communicating with patients in future. Salomon and Perkins (1989) describe this as a reflexive process or the low road transfer of learning. That is, when the student is later placed in an environment that is similar to a prior context of learning, it is believed that this can trigger a well-developed semi-automatic response.

Implementation of the courseware

The courseware was first implemented in two modules of the Diploma in Pharmacy Science course, namely Introduction to Pharmacy and Pharmacology in October 2013.

The Introduction to Pharmacy module, which is taught in the first year, serves as the first touch-point to introduce students to the various aspects of pharmacy and the course. It covers the role of pharmacists and pharmacy technicians in a pharmacy, the various laws relevant to the pharmaceutical industry, and the interpretation and handling of prescriptions.

In this module, students play the “Receiving” and “Typing” games of the courseware as an e-learning tutorial. These games were designed to reinforce two main concepts which were taught in this module – the list of legal and other requirements for prescriptions and the basics of prescription interpretation. It also serves to introduce the work flow in the pharmacy and the role of the pharmacy technician to the students.

The second year Pharmacology module is a content-intensive module which covers many classes of drugs, their mechanism of action as well as side effects and basic counselling points. Through the module evaluation surveys conducted prior to the implementation of the courseware, students provided feedback that the module required a lot of memorization and was dry and boring. Students felt that there were too many drug names and side effects which required plain memorization.

The Virtual Pharmacy courseware was introduced in Pharmacology as an in-class tutorial to help students to connect the information learnt to real life. The Packing game helps students to revise the drug classes while the Dispensing game helps students to revise the purpose and side effects of the medicines. The opportunity to practice and revise the drug names during the games is important to students as many of them have indicated that they find it difficult to remember drugs and their effects. Through these games, students were better able to understand the clinical context of the drugs and see how they are used in combination with other drugs for certain patients.

Feedback on the Effectiveness of the Courseware

Feedback on the courseware was sought from the students, teaching staff and industry partners who shared their views of the courseware in aiding students to learn more about the workings of a hospital pharmacy and the development of professional skills.

A triangulation method was used to seek feedback. First and second year students and teaching staff were surveyed on their immediate learning experience after completing the activity, as well as how the courseware achieved the learning objectives in the modules. Post-internship students in their final year and industry partners were asked about the usefulness and relevance of the courseware in preparing students for internship and work in the pharmacy.

(1) Feedback on learning experience

Feedback from students on their learning experience: Thirty-eight first and second year students were surveyed on their learning experience after completing the activity. The comments of the students were analysed qualitatively and correlated well with the quantitative scores. All students agreed or strongly
agreed that the activities helped them understand the topics better, stretched their thinking, were appropriate and relevant to their learning, and that the visuals were helpful for their learning. Figure 4 shows the responses of the students to the surveyed items.

![Figure 4: Response from Student feedback (% of students responding “Agree” or “Strongly Agree”)](image)

Students also felt that the courseware provided them with an authentic learning experience which is a good way of introducing students to the working environment of the pharmacy, equipping them with the professional skills and competencies required and preparing them for the fast pace of the pharmacy. Students recognised the authenticity of the learning experience and valuable learning opportunity the courseware provides them.

Comments from first year students indicated that the courseware was a good learning experience and it provided them with an exposure to the working environment of a typical pharmacy, e.g., “the courseware gave us a scenario of what happens behind the pharmacy counter”. Second year students found the courseware useful in the revision of their drug knowledge and also highlighted the impact of the courseware in helping them gain a deeper understanding of the workings of a pharmacy that a text book could not provide. “The courseware gave me a very good understanding of the pace of the pharmacy in reality and I have never expected it to be so fast!” and “it helped me to really rethink about the purpose of the drug and it expanded my learning. Learning and understanding the notes can only bring you to a certain extent but with games like this, my learning and understanding has been shifted to another greater level.”

These comments from students show that the courseware was successful in providing students with the authentic learning environment and to help them better understand the workings of a real pharmacy. They were able to appreciate the challenges that they would face and the professional skills and competencies that they would need to develop in order to become a competent pharmacist technician in future.

Feedback from Staff on the effectiveness of the courseware: Feedback was also obtained from the Pharmacy Science teaching team on their perceptions of the courseware to support students’ learning needs, as well as how the courseware met the learning objectives.

Staff found the game useful in introducing the students to the realities of the working world. One staff who was involved in using the courseware in her module commented that it helped the students in reinforcing the drug knowledge of the students - “I think it’s excellent! I had my doubts in the beginning but seeing it develop; and seeing how students embrace it and learn from it, it has been an eye opener.”

This positive feedback from the teaching team is an important indicator that the courseware has achieved its aim to support students’ learning, and that the teaching team was able to see the impact it has on students and their engagement with the learning a subject matter which most students found dry and difficult to manage.

(2) Feedback of courseware experience on internship

Feedback from students on preparedness for internship: As one of the main objectives of the courseware was to increase student preparedness and reduce the “transitional shock” that they may face during internship, the purpose of this discussion was to find out if the courseware would have been helpful in preparing them for their internship.

Five final year students who were undergoing their internship at NUH were invited to a focus group discussion to share how the courseware has impacted their internship experience. Students found the game to be useful in preparing them for internship at the outpatient and polyclinic pharmacy, as they would be made more aware of the workflow and more familiar with the dispensing software used in the pharmacies.

One student commented that the game would have “helped me to know what to expect when we went for our internship.” Another student commented that it would have been helpful in enabling him to be more familiar with the dispensing software during his internship - “at least I would know how to use ipharm”.

Feedback from Industry partners: Industry feedback indicates that this courseware would be very useful in helping our students to have more “hands-on” experience in the pharmacy dispensing software and thus allow them to “hit the ground running” during their internship or work so that they would be able to participate more fully in the pharmacy operations.

This courseware was also presented to the school’s Advisory Committee where it received positive feedback from the committee members. In particular, Mr Wu Tuck Seng, President of the Singapore Pharmacy Council and head of NUH pharmacy complimented the courseware for its authentic learning environment as being a good way to train our students in handling common medication errors in the pharmacy. He felt that “…the software is a useful tool as it could simulate error situations to test the students on their responses. It would be difficult to simulate error situations in actual pharmacy training.”

Moving Forward

This courseware was developed in two phases. Phase one of the courseware, as described above, has been completed and phase two is currently under development. The second phase of the game involves a
multi-player game and will include more complex scenarios. It will be implemented in the curriculum of the third year modules.

Feedback from the students as well as staff has been taken into consideration in the development of the phase two courseware. For example, the variety of characters in the pharmacy, as well as the number of drugs and types of problems faced by the students will be expanded to increase the variety of medication related issues.

This will increase the complexity of the game and allow students to be exposed to more clinically challenging cases as well as complex ethical issues that they would face in the pharmacy.

Conclusions

The Virtual Pharmacy courseware is an innovative approach to introducing workplace readiness for our students by using a game based simulation. It is directly relevant to the training of the Pharmacy Science students for the workplace and increases their workplace readiness. The students are trained in an authentic environment and acquire the relevant skills and knowledge that are required for them to practice professionally in the pharmacy. It allows students to relate the skills and knowledge taught in their first and second year to the real world of the pharmacy environment, as well as prepares them for the work flow and fast pace of the pharmacy.

Students and staff have provided positive feedback on the game and indicated that it was fun, easy to play and prepared them for their final year internship at the hospital pharmacy.

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References
