

FOR THE PURPOSE OF PROMOTION
FROM SENIOR LECTURER TO ASSOCIATE PROFESSOR
(EDUCATION)

DOSSIER

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Preface

The vision of the Virtual Integrated Patient (VIP) becoming a realistic AI-chatbot with human-like responses, seemed fleeting yet attainable at the same time. As a teaching tool, the VIP has morphed from layers of foundational work whilst developing PharmaGAMES, PharmaVIDEOS and PharmaCASES. Coincidentally, COVID-19 pandemic spurred interest in the use of VIP from remote settings. The safe-distancing limitations increased the number of users such that VIP quickly elevated from a meaningful pursuit to a credible teaching tool within our medical school.

Meanwhile, PharmaCASES, PharmaVIDEOS, PharmaGAMES were also widely deployed in online learning. As it stands now, there is increasing commercial interest, especially in the much touted “Metaverse” social media industry. I am invited to speak on future development of medical ed-tech at Temasek Holdings, Monash University KL and SUTD.

VIP’s *raison d’être* is co-creation through knowledge building with our learners and stakeholders. Currently, there are also ongoing collaborations for VIP, allowing other users such as Dentistry and Nursing, to adopt the backend infrastructure for their own specialisation. Evidently, the VIP is gaining more traction through conference merit awards, features in several university publications, and winning the Faculty Digital Educator Team Award (2022). The VIP is funded \$750,000 by the Ministry of Education and the NUS medical school.

To this end, as Education Director for Nursing and Digital Transformation, I have managed to influence my peers to use evidence-based frameworks to revamp pharmacology’s relevance across different healthcare professions. I have also managed to address the shortcomings and limitations in teaching pharmacology online, soothing some insecurities which tutors and students have with technology.

I believe our homegrown e-learning tools can be leading products of our School. By basing them first on Pharmacology, its measured growth with realistic milestones can translate into useful curriculum design and new scientific realms.

Teaching philosophy

Transforming knowledge to application

Pharmacology is one of the more challenging prospects in all healthcare curriculum: vast in scope and content heavy, most students complain of the needless theoretical memorization and their irrelevance to real-life clinical applications¹. Over the eight years of teaching pharmacology across various disciplines spanning from medical, nursing, pharmacy to life sciences, I observe the struggle and disengagement of my students in learning pharmacology.

I believe that learning Pharmacology should be more integrated and organised in our healthcare curriculum. As a basic science, it should also be relatable to our students that it can be applicable to their clinical settings. Pharmacology is an interdisciplinary topic that requires learners to know from the norm to perturbations of systems to therapeutics. While the students are knowledgeable in the content, they find it hard to apply what they know to solve problems in the clinical settings². I apply the framework depicted in **Figure 1**³ to integrate several approaches like case studies, problem solving and the use of artificial intelligence (AI) to assist our learners in comprehending pharmacology and its therapeutics.



Figure 1. A framework to assist comprehension of applied pharmacology and therapeutics.

Learners' involvement in co-creating and collaborative knowledge building

Over the years, I have involved my learners co-creating and the development of education tools using the framework of stakeholder involvement in co-creation (**Figure 2**)⁴. I believe that involving students in teaching and learning helps in co-construction of knowledge and motivation to learn. Not only does it motivates learners by enhancing their feelings of engagement, ownership, and empowerment, I believe their involvement also provided me feedback to improve on the tools I have developed for their classes.

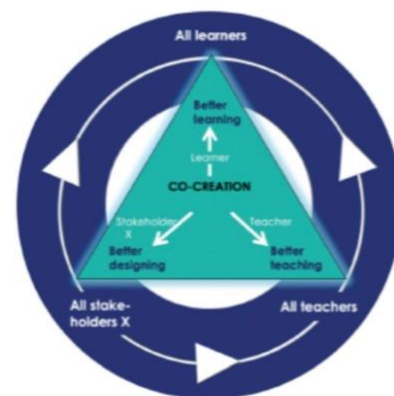


Figure 2. Framework of Stakeholder Involvement in Co-Creation

¹ Engels, F. (2018). Pharmacology education: Reflections and challenges. *Eur J Pharmacol*, 833, 392-395.

² Foster, V., Collins, E., Dong, H., Nteff, G., & Pinkney, L. (2017). Teaching Clinical Pharmacology to Undergraduate Nursing Students: Barriers and Strategies. *Open Journal of Nursing*, 07(08), 918-929.

³ Banning, M. (2003). Pharmacology education: a theoretical framework of applied pharmacology and therapeutics. *Nurse Education Today*, 23(6), 459-466.

⁴ Konings, K. D., Mordang, S., Smeenk, F., Stassen, L., & Ramani, S. (2021). Learner involvement in the co-creation of teaching and learning: AMEE Guide No. 138. *Med Teach*, 43(8), 924-936.

Curriculum redesign for better professional outcomes

Over this last decade, Singapore introduced prescribing rights for healthcare professionals other than doctors⁵. I believe that the proper incorporation of pharmacology into nursing curriculum can be more tailored to give nurses a greater level of autonomy and empowerment of patient care, with prescriptive authority and safety to meet the emerging healthcare needs of Singapore's population (**Figure 3**). Since 2016, I have been in-charge of teaching and developing the pharmacology curriculum in both the undergraduate and postgraduate nursing programmes. Engaging actively with the stakeholders in Nursing and Pharmacology and drawing experience from successful implementation of non-medical prescribing rights in other countries, I am able to evaluate and adjust the pharmacology content in NUS for the longitudinal training and progression of nurses' requirements at various levels. The curriculum redesign weaves in both of my teaching philosophies and my interest lies in not just what the students know but how practical application of pharmacology and learners' co-creation for the delivery of the curriculum content.



Figure 3. The competency framework for all prescribers, to include non-medical prescribers. This is how we envision our new curriculum revamp for nursing, our definition of what is good prescribing and our goal to improve the quality and safety in healthcare. **A**, There are key tasks that a collaborative prescribing practitioner needs to be able to do: **1.** assessing the patient with an analytical view point to **2.** considering the appropriate treatment plan from his/her knowledge to **3.** reaching a shared decision between patient and practitioner to **4.** prescribing the appropriate medications and **5.** providing patient education and **6.** monitoring and reviewing the medications. The implementation of these tasks and their maintenance are important in informing and improving practice, development, standard of care and safety (for both the prescriber and patient). **B**, Prescribers' governance is also important. Prescribers are to use their own professional codes of conduct, standards and guidance alongside this framework. Their key tasks comprises of **1.** prescribing safely, **2.** prescribing professionally and ethically, **3.** to keep on improving on good prescribing practice and working as a team and **4.** knowing their roles in prescribing as part of a team. These guidelines help to shape our nursing curriculum to keep them relevant to our society and needs.

⁵ Ministry of Health (2021) Guidelines for the implementation of collaborative prescribing services. [Link](#)

Teaching Narratives

Transforming knowledge to application

A long standing issue in teaching pharmacology

Pharmacology is an intimidating subject in medical and nursing education curricula. Students report anxiety and difficulty assimilating the extensive pharmacological knowledge required of them. Many pharmacology curricula feature a lecture-heavy format, which skews learning towards *remembering* and *understanding* in revised Bloom's cognitive taxonomy, often resulting in cognitive overload⁶. However, memorization does not translate information into knowledge or facilitate its application in clinical contexts and students often do not completely comprehend the integration and operational basis of pharmacological therapeutics.

Tools development to aid in teaching pharmacology

As I started my journey as an educator, I looked for suitable framework that could translate effective teaching and learning to teach the principles of applied pharmacology and therapeutics in both undergraduate and postgraduate nurse education programmes under my care. The conceptual frame proposed by Banning is underpinned by the components of the acquisition of knowledge, storage and utilization of knowledge and the style of reasoning style⁷. I started integrating tools I have developed, either by myself or with my education team, into this framework to teach pharmacology more effectively (**Figure 4**). At the same time, I have learnt to be mindful of the timing of the activities to reduce the cognitive overload faced by the students.



Figure 4. Using the conceptual framework from **Figure 1**, I have integrated instructional learning activities to teach pharmacology. **PharmaGAMES** is a game to help novice students to acquire knowledge of how generic drug names are classified into the pharmacological classes. **PharmaVIDEOS** is a series of medical documentaries to bridge the basic to clinical aspects. **PharmaCASES** is a class-based activity whereby students have case scenarios and with more advanced learners using script concordance. **Virtual Integrated Patient (VIP)** is a self-directed, web-based AI-embedded chatbot whereby our students practice by interacting with virtual patients. These tools will be described in more detail in the following sections.

⁶ Foster, V., Collins, E., Dong, H., Nteff, G., & Pinkney, L. (2017). Teaching Clinical Pharmacology to Undergraduate Nursing Students: Barriers and Strategies. *Open Journal of Nursing*, 07(08), 918-929.

⁷ Banning, M. (2003). Pharmacology education: a theoretical framework of applied pharmacology and therapeutics. *Nurse Education Today*, 23(6), 459-466.

PharmaGAMES

PharmaGAMES was designed to give students the foundation to aid in memory retention and active recall. It addresses students' struggles with the vast number of antibiotic names. After I tried this method, I found this works best with novice learners undergraduate students (Years 1-2) to recognize drug nomenclature and help in their learning (**Figure 5A**). Our department adopted PharmaGAMES and other renditions of rapid-fire serious games, such as QuizUP and BrainScape to interest and motivate our students. However, there was a caveat: these games only achieve knowledge acquisition of Banning's framework and the first two levels of Bloom's taxonomy *recognition and recall* but they may not necessarily translate to better scores in the exams as our questions are application-based with clinical scenarios (Levels 3 & 4, **Figure 5B**).

Survey of PharmaGAMES	% of students that strongly agree or agree
The lesson activities were easy to follow.	78.6
The games were useful and helped me to understand the lectures's learning objectives.	73.3

Total no. of respondents: 94 out of 114 (82.5%)
NUR 2117, Nursing Year 2

Intervention	Mean Score	Score of Levels 1 & 2 Recognise and Recall	Score or Level 3 & 4 Evaluate & Apply
Before introduction of PharmaGAMES	72.5	82	63
After introduction of PharmaGAMES	76.8	88	65.6
P-value	n.s. (p=0.067)	Significant *p=0.044	n.s. (p=0.08)

Figure 5. A, A survey done in a Nursing Year 2 class that have used PharmaGAMES as part of their learning activities. 73.3% of novice students agreed that it is useful for their learning (94 out of 114 respondents; survey from 2017 cohort). **B**, I compared the cohorts that were taught by me with traditional didactic lectures versus cohorts that were taught by me with lectures supplemented with PharmaGAMES. The cohorts are from different academic years. In their assessment, cohorts that used PharmaGAMES scored better in questions targeted at recognition and recall (Before PharmaGAMES: 82%; After PharmaGAMES: 88%; cohorts from 2016-2017) but not significantly higher in application-based questions (Before: 63%; After: 65.6%; cohorts from 2016-2017).

PharmaVIDEOS

Pre-Covid, I conducted a survey and we noticed many of our Generation Z students tend to be visual learners⁸ but there are some deficits in our current webcast videos (**Figure 6A**). From their qualitative feedback, I explored two areas to enhance existing webcast lectures⁹ and I conceptualized **PharmaVIDEOS** which are documentary-style series of videos that explore different infectious diseases and treatment (**Figure 6B**). My students improve on their quiz scores when I tested them on their knowledge pre-watching and post-watching a video. Our learners feedbacked that PharmaVIDEOS helped them in their learning and their level of engagement (**Figure 6C & D**).

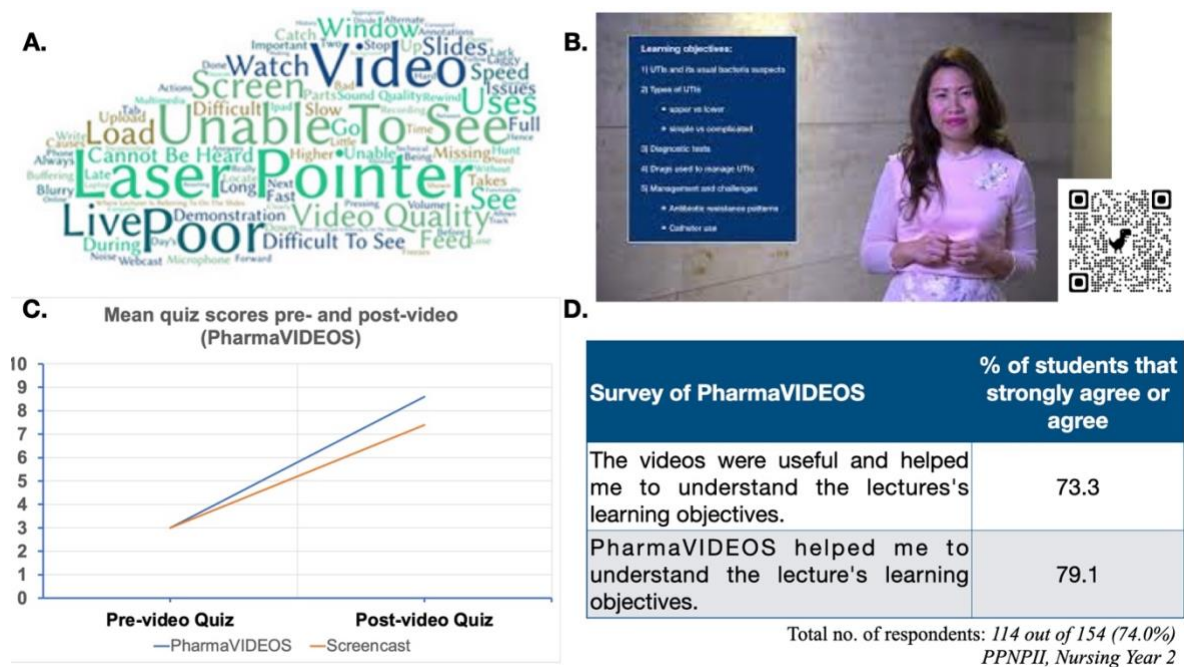


Figure 6. A, A word cloud of students’ problems they encounter in audiovisuals and webcasts materials. **B**, PharmaVIDEOS is a series of medical documentaries to bridge the basic to clinical aspects. You can scan the QR code or this [link](#) to get to the Youtube channel. **C**, I created 5 documentary-styled videos and 2 screencasts videos. I asked the students to do a quiz: before and after watching each video. I compared their scores before and after watching the videos. Both video formats improved the overall scores but they did slightly better with PharmaVIDEOS. **D**, A survey done in a Nursing Year 2 class that have used PharmaVIDEOS as part of their learning activities. 79.1% of students agreed that it is useful for their learning (114 out of 154 respondents; survey from 2020 Year 2 undergraduate nursing cohort).

⁸ Maniclang, M. A. F., Ang, Z. L. T., Hong, R. Y. H., Lee, E. J. D., & Sng, J. C. G. (2018). Students’ perceptions of webcast lectures and online video materials: Results of a survey at a higher education institution in Singapore. *Asian Journal of the Scholarship of Teaching and Learning*, 8(2). 150-180 [Link](#)

⁹ Maniclang, M.A.F., Hong R.Y.H., Marzin, M., Amellal, K., Rajendran K, Lee E.J.D., & Sng J.C.G. (2018). Evaluating the effectiveness of enhancing webcasts with digital tagging. *Asian Journal of the Scholarship of Teaching and Learning*, 8(1), 5-24 [Link](#)

PharmaCASES

To help our students see the relevance of pharmacology, I have been creating case scenarios with clinicians and advanced practice nurses. I inserted the necessary learning activities related to pharmacology and these case scenarios are called PharmaCASES. Case scenarios currently used are usually linear-passive and often portrays one-dimensional facet of a patient. They may not engage students in the same way as more complex, multi-choice real-life scenarios. I started PharmaCASES as linear path scenarios but began to shift to branching scenarios over the last few years. This in-class activity brings the students through rationale of using a certain medication and reasoning underlying the choices of drugs. This helps in clinical decisions and reasoning competence. PharmaCASES seemed to be more relatable to my advanced learners in the Masters of Nursing course compared to novice learners (**Figure 7A**). In summary, PharmaCASES creates a deeper level of understanding in our learners and bridges the gap between knowledge acquisition and knowledge utilization in actual clinical job performance (**Figure 4**), in turn, they do better in their continual assessments over the last few years (**Figure 7B**).

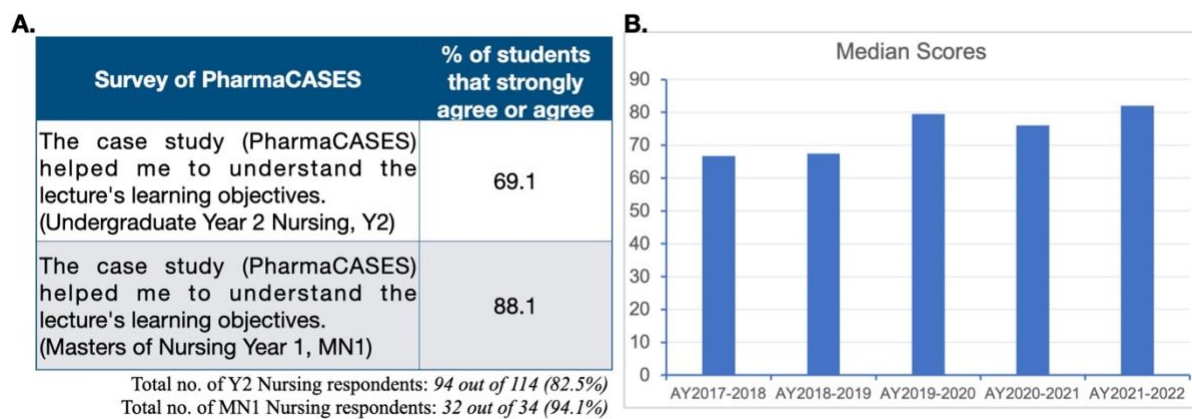
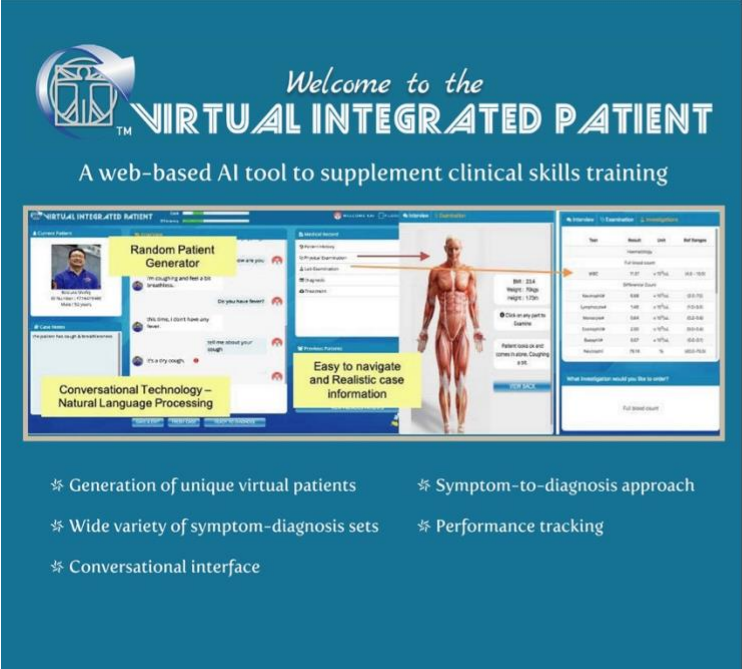


Figure 7. A, A survey done in two classes: Nursing Year 2 and Masters of Nursing students that have used PharmaCASES as part of their learning activities. More advanced learners agreed that PharmaCASES is useful compared to novice learners (88.1% vs 69.1%). **B,** PharmaCASES was implemented since 2017 and started out as linear passive case scenarios. Subsequently, there was more branching. I charted the continual assessment scores from the Masters of Nursing course over the years from the different cohorts and see an improvement in their scores.

Virtual Integrated Patient (VIP)

My interest in creating experiential branching cases evolved from PharmaCASES to Virtual Integrated Patient (VIP)¹⁰. Computer-based simulation offers an important strategic option in healthcare education. VIP is developed from 2016-2021 with my team, clinical tutors and students (see the next Narrative). There are a few key highlights of this educational tool (Figure 8; legend)¹¹. VIP provides a solution for overcoming limitations of clinical opportunities and a safe space to practice their clinical skills, without subjecting actual patients to stress or risk; As it is web-based, it can also cater to a large number of learners simultaneously and allowing self-exploratory learning, anywhere and anytime.



Increasing History-Taking Practice Through Blended Learning With A Virtual Patient

Boon See TEO¹*, Yueh Jia LEE^{1*}, Juanita S M KONG^{1*}, Pabba ANUBHARATH¹, Edmund J D LEE¹, Judy C G SNG¹

¹ Yong Loo Lin School of Medicine, National University of Singapore. * Equal contribution

AIMS
History-taking practice with standardised patients (SPs) is popular with medical students in our university, who often request more opportunities to practice. To meet their requests despite limited curriculum time, we supplemented the second-year history-taking module with a web-based virtual patient, Virtual Integrated Patient (VIP). We evaluated VIP's effect on students' history-taking performance and their satisfaction using VIP.

METHODLOGY
The existing history-taking module, anchored by the Family Medicine Department, consists of 3 tutorials over 3 weeks in which each student practises taking a history from an SP, and is scored by a tutor on a Mini-CEX checklist.

Students enrolled in the study (n=296) received access to VIP for the duration of the module, in addition to attending tutorials. Data was collected on students' scores and number of virtual patients clerked. At the end of the module, students were surveyed on their satisfaction with VIP.

RESULTS
Clerking more than 10 virtual patients was associated with a significant increase in scores (mean difference 1.70, 95% CI [1.59, 1.81], p=0.001). Lower frequency of VIP use was not associated with a change in scores.

69% of the students strongly agreed or agreed that VIP increased their confidence in taking a history. 87% felt that using VIP helped in remembering the content. 68% felt that VIP helped them to be more efficient in taking a history. 63% would recommend VIP to others.

CONCLUSIONS
Frequent use of VIP was correlated with better history-taking performance and VIP was well-received by students. VIP shows promise as a tool to supplement history-taking tutorials with SPs.

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This study was supported by Ministry of Education Tertiary Research Fund MCE2016-1 TRPoi awarded to Prof. Edmund Lee and Dr Judy Sng.

- * Generation of unique virtual patients
- * Symptom-to-diagnosis approach
- * Wide variety of symptom-diagnosis sets
- * Performance tracking
- * Conversational interface

Figure 8. How the VIP platform looks like and you can click this [link](#) to enter the webpage. There are three unique features of the VIP: one, it uses an artificial intelligence (AI)-enabled platform to generate random unique patient for students; two, it is based on natural language processing to create naturalistic conversations rather than options or pull down menu; three, it simulates real life clinical cases, taking the learner through from signs and symptoms to diagnosis (see Annex A-4). My team conducted a study with VIP user and clinical tutor, Dr Teo Boon See. In this study, the students were encouraged to log into the VIP, and they can clerk as many virtual patients during the 3 weeks of usage. We found that students, who clerked more than 10 virtual patients, had higher scores in their mini-CEX practice with standardised patients (SPs; actors role playing as patients). After the 3 weeks of VIP usage, a survey was conducted. Overall, students are more confident when they meet SPs or real patients in the clinics, and they also are more efficient in history taking and they would recommend VIP to other users. Dr Teo won 2nd place in the Primary Care Provider Congress for this poster presentation (Annex A-3).

We have studied the impact of VIP in our second year medical school students in “Communication with Patients” course led by a family medicine faculty, Dr Teo Boon See. After setting out the learning objectives, we ran this pilot. We observed that novice students improved on their mini-CEX scores after VIP usage when practicing with standardized patients and were more confident in history taking before stepping into an actual clinical environment (Figure 8).

¹⁰ J Kong, Teo BS, Lee YJ, P Anubharath, EJD Lee and J Sng. (2021) Virtual Integrated Patient: An AI supplementary tool for second year medical students, *TAPS*, 6(3), 87-90 [Link](#)

¹¹ J Kong & J Sng. (2020) Introducing the VIP: An AI response to clinical teaching in the time of Covid-19. *NUS Medicine* Newsletter Issue 35 (Annex A-4) [Link](#)

Since VIP's launch in 2020, its usage has continued even post-Covid and user base has expanded beyond medical students. I was also invited to speak at SUTD, IMU and Monash Medical School Kuala Lumpur to give talks and conduct workshops. The development of VIP won our team a few conference awards and Faculty Teaching Excellence Award (**Annex A1-3**).

Over the years, VIP has matured through cross-disciplinary collaboration and I have recently started to work with other researchers to instill emotions and facial expressions into avatars. There is increasing interest from industry, especially in the much touted "Metaverse" whereby I am invited to speak on future development of VIP at Temasek Holdings and other investors. There is also interest for VIP to be "OEM" or white labelled such that other users like Dentistry and Nursing adopt the back end infrastructure for their own specialisation (**see Annex B-3, 4**).

In summary, I found that using a defined framework, the tools I have developed over the years should be timed and pitched according to the levels of learners (**Figure 4**). Not every tool will work on every student and from this experience, I have learnt to differentiate effects and adapt each tool according to my learners. There is a time and place to use them and they can be deployed for online learning, even post-pandemic.

Learners' involvement in co-creating and collaborative knowledge building

I drew my personal experience after the development of the tools mentioned above and understood the importance in learners' active involvement in designing and development the platform. After developing the VIP, my team and I did extensive beta testing and usability evaluation by clinical tutors and students, which received good feedback¹². Excitedly, we rolled it out to a medical class but the VIP received a lacklustre feedback, in particular mismapping issues and lack of variety in cases. This setback made us realise that we refocus and redesign of the VIP to fix all nuances before rolling it out to classes.

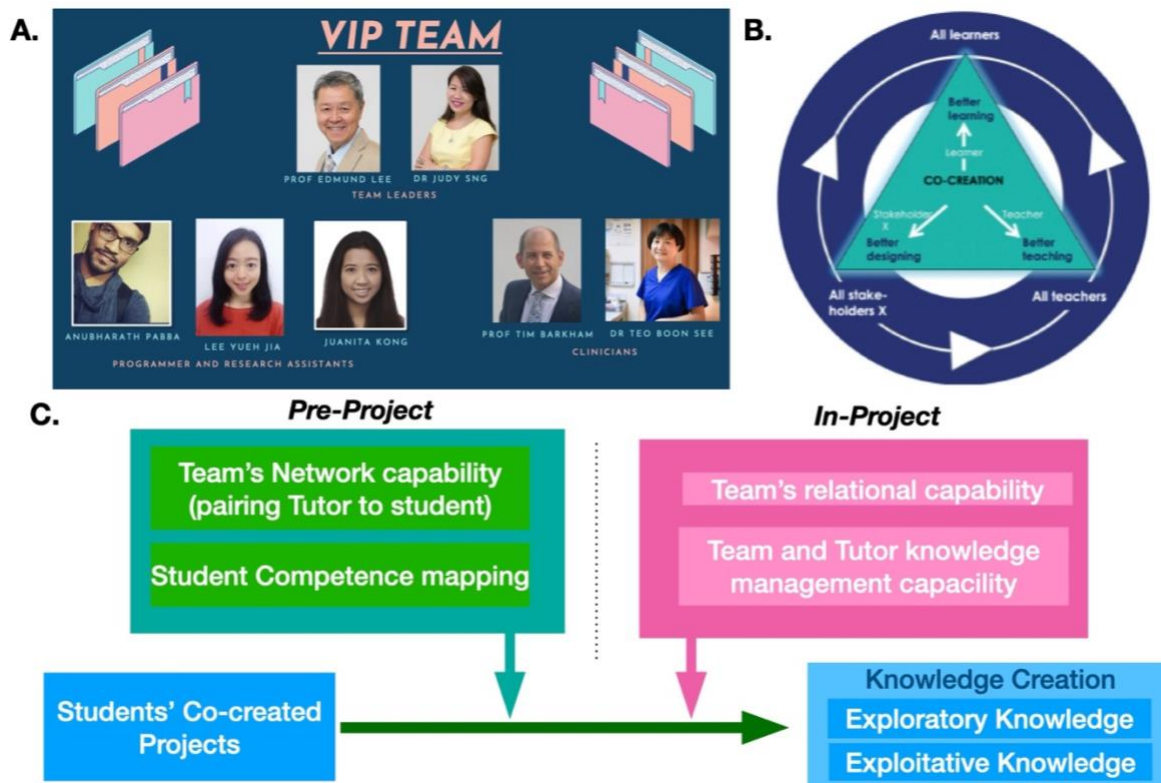


Figure 9. A, Meet the Team. The development of the VIP platform was led by Emeritus Prof. Edmund Lee and I, with two clinicians, A/Prof. Timothy Barkham and later, Adjunct Assist. Prof. Dr Teo Boon See. Two research assistants (RAs), Ms Lee Yueh Jia and Miss Juanita Kong, helped to develop the cases with clinicians and created the conversational database. Mr Pabba Anubharath is our programmer, who helped to create the artificial intelligence or AI-enabled part of the conversation engine driving VIP. **B**, The framework of co-creation requires all stakeholders (learners, teachers and Decision makers) to be involved in the development of VIP¹³. **C**, Co-creation framework capabilities on stakeholders in co-creation projects¹⁴. My RAs and I first guided the students through the process of creating cases, giving them feedback. When in doubt, they are consulted our clinicians (whom we pair them up with) to check on their accuracy. Our team are also open to their feedback and listened to their concerns. These bi-directional conversations improved the quality of making this educational tool. I, too, get a better understanding of their perspectives on the VIP and how to improve on it. Challenges presented when involving a diverse set of stakeholders during the innovation process helps us to identify four specific capabilities to address and strengthen the students' co-creation efforts. The insights gained from this experience are summarized in our framework of stakeholder co-creation capabilities.

¹² Pabba Anubharath, Yoon Ping Chui, Judy C.G Sng and Edmund J.D. Lee. (2019) Performance of Virtual Integrated Patient. 36th international conference on innovation, practice and research in the use of educational technologies in tertiary education, *ASCILITE 2019*, 2-5 December 2019, SUSS, Singapore. [Link](#)

¹³ Konings, K. D., Mordang, S., Smeenk, F., Stassen, L., & Ramani, S. (2021). Learner involvement in the co-creation of teaching and learning: AMEE Guide No. 138. *Med Teach*, 43(8), 924-936.

¹⁴ Kande Kazadi, Annouk Lievens, Dominik Mahr (2016) Stakeholder co-creation during the innovation process: Identifying capabilities for knowledge creation among multiple stakeholders, *Journal of Business Research*, 69 (2), 525-540.

Our team embarked on the idea of co-creating the VIP platform with a small number of elective year 4 students, Thomas, Kylie and Joel. As the idea of co-creation is novel to both myself, my team and the students, we agreed that it is a shared responsibility and encouraged an open exchange between my team and students (**Figure 9C**; see legend). My RAs and I first guided the students through the process of creating cases, giving them feedback. When in doubt, they consulted our clinicians, Dr Teo and Prof Barkham, to check on their accuracy. Our team are also open to their feedback and listened to their concerns. These bi-directional conversations improved the quality of making this educational tool. I, too, get a better understanding of their perspectives on the VIP and how to improve on it. Their completed products were then mounted them on the platform with the help of our programmer. The students took ownership of their work and did their own beta-testing, surveyed their friends and finally introduced it to a junior class cohort. Reflecting on this journey, the *raison d'être* of VIP is co-creation process with our multi-stakeholders.

There are several outcomes from co-creation: 1, The students participated in The Medical Grand Challenge (2020) under the Medical Innovation and Entrepreneurship pathway and shortlisted as one of the finalists; 2, The co-creation of VIP build confidence in them to foster mutual learning, autonomy and a sense of ownership (**Annex B-2, 6, 7**). They were motivated by this project and introduced 10 more juniors to us through the Wong Hock Boon programme; 3, Their abstract was submitted and accepted at a conference (**Annex B-2**)¹⁵. VIP is also featured in an anime series, *White Coat Tales*, our School's *Covid Chronicles* and several other university's publications (see below).



¹⁵ J. K. Lee, K. Leong, T. W. Ong, J. Kong J.C.G. Sng (2022) Learners' Involvement in co-creating and collaborative knowledge building in developing an educational tool, virtual integrated patient. Society for Neuroscience, 12-16 November 2022, San Diego, USA (**Annex B-2**)

Curriculum redesign for better professional outcomes

The educational requirements for many nursing roles are increasing and will continue to increase. In addition, the scope of practice of advanced practice nurses (APNs) is broadening, shifting towards having prescription privileges of varying degrees in their specific disciplines. I started my journey, from module coordinator to Education Director for Nursing, overseeing the curriculum redesign and longitudinal development of pharmacology in the nursing programme.

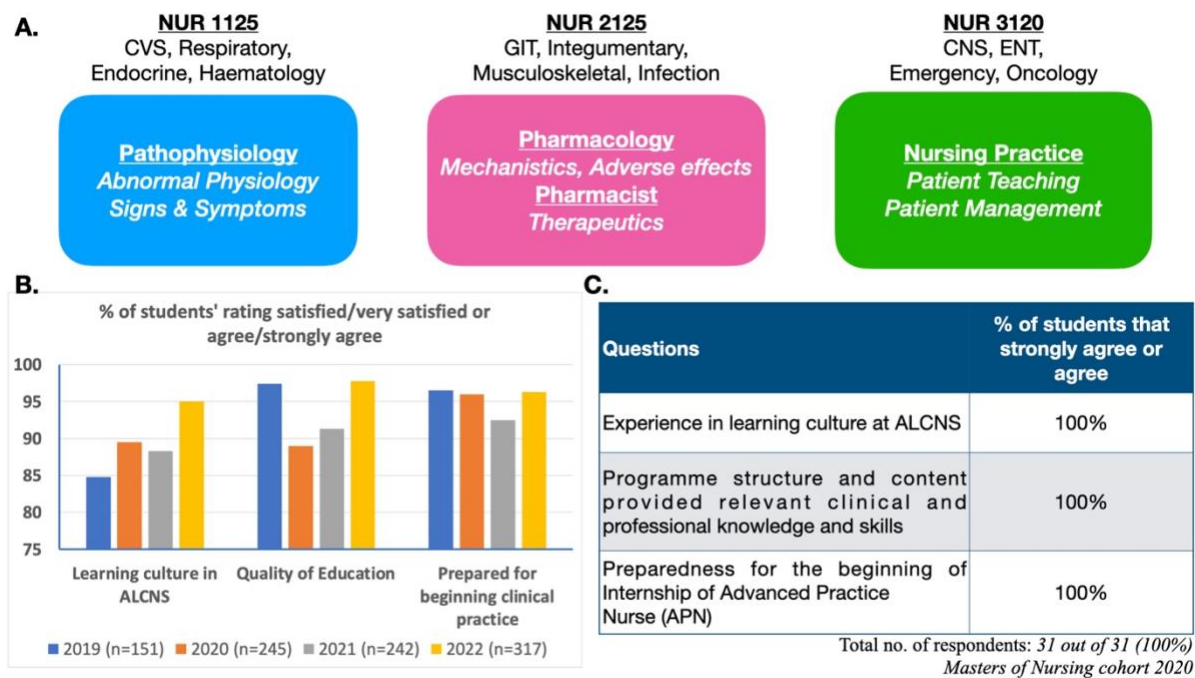


Figure 10. A, With the revamp of undergraduate nursing curriculum, the modules are taught according to body systems. Through regular meetings, we seek to understand how each pillar (pathophysiology, pharmacology and therapeutics and nursing practice) integrated in our teaching and to support students' learning the most. **B**, As a result, our curriculum revamp paid off with improvement in our students' rating of their learning culture, quality of education and how they feel prepared when going into clinical practice. **C**, Exit survey of APNs (Cohort 2020 after 2019 revamp) and their satisfaction of their education to prepare them for their APN career paths.

The nursing undergraduate curriculum revamp progressively became more integrated over the last decade. I influenced my department co-lecturers to teach in a more applied manner and also our nursing partners to take into consideration our unique roles and contributions in the new curriculum (**Figure 10A**). The efforts paid off when we see the students' increasing satisfaction in their undergraduate training, preparing them for their nursing careers (**Figure 10B**).

The last decade has seen developments in nonmedical prescribing, with the introduction of prescribing rights for healthcare professionals, such as pharmacists and APNs. Drawing experiences from other countries which already embarked on this journey, I led and worked together with APNs in the steering committee (**Annex D-1 and D-2**) to ensure that this target can be achieved. Through stepwise revamps, we can see the students' satisfaction in their postgraduate training and how they feel their education at NUS prepared them for their advanced nursing careers (**Figure 10C**).

Wider Adoption of VIP

The VIP has been a tool for students and tutors across our medical school and adopted by other healthcare professional courses like Nursing, Pharmacy and Dentistry (**Annex B-1, 3, 4**). Our user base has been expanded beyond Singapore and I have given regional talks and conducted workshops^{16,17} (promotional video: scan code or click [link](#)).



Future directions

Continual refinement of the Nursing Curriculum

Singapore hopes to have by 2030 up to 700 Advanced Practice Nurses (APNs) with prescribing rights. I will continue to work on the curriculum redesign, providing good and sound quality education so that our graduates can meet the core competencies of safe and professional prescribing and to meet our target number of APNs.

VIP future development

I am working with the School to increase number of symptoms to the full repertoire necessary for a graduating medical student. VIP is widening its user base internationally and VIP will have further exciting development beyond even my own imagination!

Masters of Medical Education

I would be applying for a Masters in medical education to further develop my research interest in understanding how AI can impact our students and medical education.

¹⁶ Asia Pacific Medical Education Conference 2022: Our Heritage, Our Strength: Future Proofing Healthcare Professionals – Trends, Issues, Priorities, Strategies. Symposium 4: Implications of artificial intelligence enabled technology in medical education. Virtual Integrated Patient (VIP): An AI-Enabled Chatbot and Its Use in Medical Curriculum. 12-16 January 2022. Virtual Conference. [Link](#)

¹⁷ Monash Malaysia Medical Education Conference 2022: Transformation of Medical Education in the Digital World. Symposium and Workshop. 25 June 2022. Virtual Conference. [Link](#) and [PDF](#)