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Virtual patient clinical placements improve student communication competence

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Virtual patient clinical placements improve student communication competence

Effective communication is a generic competency essential to clinical practice. However, access to work-integrated placements where such competencies are traditionally developed is diminishing, compelling universities to develop supplementary placement opportunities in the form of simulated learning environments (SLE). Virtual or digital patient (VP) placements are an attractive SLE model, but evidence of their efficacy for developing student communication competence is limited. In the current study, 82 second-year undergraduate speech pathology students completed one half-day placement, requiring them to use conversation interaction skills to build rapport with a VP across two 10-minute interactions, separated by clinical educator (CE) feedback and self-reflection. Each student's interactions were rated by CEs on 25 communication competencies and, following the second interaction, students completed retrospective pre-placement and post-placement self-ratings of their communication skills, knowledge and confidence. CEs' ratings of students' performance were significantly higher following the second interaction than they were following the first (median $\eta_p^2 = .710$). Furthermore, the students' post-placement self-ratings were significantly higher than their retrospective pre-placement ratings (median $d_{av} = 1.25$). These findings suggest that VP placements as simulated clinical learning opportunities support speech pathology education, and may have positive implications for all health professions.

Keywords: clinical education; communication; virtual patient; digital patient; virtual learning environment; simulated learning environment; speech-language pathology

Introduction

The work-readiness of graduates across the health professions is an emerging priority for universities. Particular concerns have been raised about the adequacy of graduates' communication skills (McLennan & Keating, 2008; Trede, 2012). Communication skills encompass effective questioning, active listening, responding appropriately to nonverbal cues, and empathy (McAllister, Lincoln, Ferguson, & McAllister, 2013). These skills are

central to understanding patient issues, collaborative treatment planning, timely detection of problems, reducing care costs, and increasing patient satisfaction (Chen, 2011; Ha & Longnecker, 2010). Work Integrated Learning (WIL) and has become an internationally recognised mechanism for higher education institutions to facilitate the development of such generic clinical skills (Ferns, Campbell, & Zegwaard, 2014).

Although placing students in the workplace is not new, WIL goes beyond work simply being intrinsically beneficial (McLennan & Keating, 2008; Smith, 2012). As a pedagogic approach, WIL is an umbrella term for activities grounded in experiential learning theories where students are expected not only to experience, but also to reflect on their interaction within a work-like environment in order to make meaning out of their learning experiences (Abeysekera, 2006; Ferns et al., 2014; Ferns & Moore, 2012). Benefits to students associated with WIL include communication skills development, and increased confidence in the ability to undertake further work of a similar nature (Ferns et al., 2014).

WIL activities can vary substantially, with Rowe, Winchester-Seeto, and Mackaway (2012) conceptualising types of WIL within the framing of locality (i.e., on-campus/off-campus) and level of engagement with the workplace or community (i.e., high or low). Traditional clinical placements are an example of (typically) off-campus WIL experiences with high levels of community engagement (Ferns et al., 2014). The current capacity of universities and employers to support these traditional placements is constrained, whilst student numbers continue to rise (Ferns & Moore, 2012; McLennan & Keating, 2008; Theodoros, Davidson, Hill, & MacBean, 2010). To address these increasing pressures, attention has turned to the use of Simulated Learning Environments (SLEs; Theodoros et al., 2010), which are predominantly on-campus forms of WIL (Ferns et al., 2014).

SLEs commonly make use of standardised trained patient actors (SPs) and computer-based, virtual patients (VPs; MacBean, Theodoros, Davidson, & Hill, 2013). The pedagogy inherent in traditional clinical placements, including opportunities for experiential learning, reflection, feedback, and repetitive practice, is shared by well-designed SLEs (Bambini, Washburn, & Perkins, 2009; Baxendale, Coffey, & Buttery, 2013; Issenberg & Scalese, 2007; Lambert & Watkins, 2013; Rogers, 2011).

SLEs provide experiential learning opportunities by giving students direct experiences with problem-solving activities or narratives (Bearman, 2003; Rogers, 2011). These experiences provide a basis for reflection, allowing students to develop insights that can be applied to new experiences (Rogers, 2011). This reflection is supported by feedback from the simulator, Clinical Educators (CEs) and/or peers that targets specified learning outcomes to make explicit behaviours that were performed well, as well as areas for improvement (Lambert & Watkins, 2013). Depending on its timing, such feedback can facilitate reflection in action, on action, or for action (Baxendale et al., 2013; Issenberg et al., 2005). Finally, the repeated practice opportunities afforded by SLEs allow students to develop and refine skills until they become relatively effortless and automatic (Issenberg et al., 2005).

SLEs also enable educators to fulfil educational and legal responsibilities that can challenge other types of WIL experiences, including traditional clinical placements (Theodoros et al., 2010). These responsibilities include the provision of standardised, targeted and safe instruction. SLEs permit standardised instruction, as they allow educators to tightly control the nature and quantity of the experiences and feedback offered to students (MacBean et al. 2013). SLEs permit targeted instruction, as educators can tailor the student experience to provide exposure to a wide range of behaviours and outcomes (Alinier, 2007), including those that appear relatively infrequently in daily

clinical work (Theodoros et al., 2010). SLEs permit safe instruction, as educators can support the practice of skills in scenarios that might otherwise be high-risk. This allows educators to focus on students rather than patients, and gives students space to process and manage unfamiliar feelings that can emerge in novel and challenging clinical situations (Lambert & Watkins, 2013; MacBean et al., 2013; Theodoros et al., 2010). To date, SLE research has predominantly focused on the use of SPs for the development of technical and discipline specific knowledge and skills, and indicates that SLE based placements are associated with a range of positive student outcomes (MacBean et al., 2013).

After SPs, VPs are believed to be the most likely type of SLE to increase capacity in clinical education (Theodoros et al., 2010). Critical to the success of VPs is the extent to which they behave realistically, especially when used to facilitate the development of communication skills (Bearman, 2003; Persky, 2011). A VP embedded in a virtual reality platform occurs in a computer generated 3-D environment in which sensors allow simulated human interaction and through physical, emotional and cognitive responses, create new learning. Such environments can provide authentic and highly immersive learning contexts that can elicit emotions, including empathy, comparable to those experienced in real human relationships. They also offer a standardised training experience – important in the context of health care, with the sector moving towards streamlined and standardised approaches to training and workforce development. Virtual reality can address many of the ethical, financial, clinical and logistical constraints associated with the systematic delivery of training.

VP behaviour is manipulated by varying parameters such as the scenario, patient features and turn taking during communication exchanges. Scenarios within which the VP interacts can range from a patient interview, to a physical examination, laboratory

test, clinical diagnosis, or therapy session (Theodoros et al., 2010). Students' ability to modify their introductions across scenarios, for example, may be targeted by practicing an initial patient interview as well as a subsequent therapy session. Patient features, including physical characteristics, can be programmed to create a range of characters with varied responses and emotions (Lambert & Watkins, 2013). Students' listening and non-verbal skills, for example, can be practiced and assessed in interactions with virtual patients that are displaying varied levels of emotionality (Courteille, Josephson, & Larsson, 2014; Deladisma et al., 2007). Patient turns can be programmed or controlled in real-time, and can range from passive to interactive (Bearman, 2003; Persky, 2011). Students' skills in maintaining the flow of conversation, for example, can be challenged by a VP that remains silent in response to a particular request or instruction from the student. The passivity can be tailored to reflect obstinacy or a specific communication impairment such as dysphasia (Bánszki et al., 2018; Bearman, 2003). The nature of patient turns, such as negative responses, can be selected to deliberately challenge emotionality in students' reactions and responses (Bearman, 2003; Deladisma et al., 2007). The ability of the VP to elicit empathy in building a therapeutic alliance has garnered particular attention in recent literature (Lok et al., 2006).

Research indicates that students generally respond positively to VPs, although are sometimes frustrated by the current generation of VPs' lack of realism (e.g., their low graphical resolution or limited repertoire verbal and behavioural responses; Bánszki et al., 2018; Bearman, 2003; Courteille et al., 2014; Lambert & Watkins, 2013; Quail, Brundage, Spitalnick, Allen, & Beilby, 2016). In terms of the broad range of skills underpinning student learning, findings are equivocal. For example, in a recent meta-analysis, medical students trained with VPs significantly outperformed those trained with traditional methods on objective measures of clinical reasoning, though not on ethical

reasoning or communication skills (Consorti, Mancuso, Nocioni, & Piccolo, 2012). More recently, and specifically within the context of speech pathology training, Quail and colleagues (2016) found that students randomised to interact with a VP self-reported equivalent gains in communication skills, knowledge and confidence compared to students randomised to interact with either a SP or traditional community-based patient. Although Quail and colleagues' (2016) findings are promising, they are based solely on students' self-reports, which may not clearly reflect actual learning or development over time (Ostergaard & Rosenberg, 2013).

In the current study, the research conducted by Quail and colleagues (2016) was extended by assessing the impact of a VP placement using both objective and subjective indicators of student learners' communication competency. Specifically, it was hypothesised that:

1. Undergraduate speech pathology students would display a significantly higher level of objectively (clinical educator; CE) rated communication competence during their second interaction with a VP, compared to their first interaction.
2. Students' post-placement self- assessments of their (a) communication skills, (b) communication knowledge, and (c) communication confidence would be significantly higher than their retrospective pre-placement assessments of these skills, knowledge and confidence.

Method

Participants

BSc (Speech Pathology) students at Curtin University, Australia, complete eight placements during their four year degree. The VP placement described herein, which is a

requisite component of a clinical practice unit in the first semester of the second year of the course, is the first of these. It is focused on developing students' pre-clinical skills prior to their first community placement. Clinical skills training in the BSc (Speech Pathology) course is based on a spiralling curriculum. The second year of the course is focused on fundamental skills training. In the third and fourth years, students participate in increasingly challenging placements in which a broad range of professional competencies related to the assessment and treatment of clients must be demonstrated. These placements take place in a wide range of settings, including primary schools, disability services, acute tertiary hospitals, community development centres and remote and rural health clinics.

At the start of the academic year, all students enrolled in the unit were invited to participate in the study via email. Eighty-two students (representing 75% of the total cohort) accepted this invitation, and granted informed consent via an online survey. The mean age of this sample was 21.45 years ($SD = 5.39$ years), and over 95% identified as female. This gender distribution reflects the gender imbalance in the course and, more broadly, the discipline of speech pathology in Australia (Health Workforce Australia, 2014). Academic staff responsible for assessment in the unit were blind to the composition of the sample, and were not otherwise involved in the planning, administration or conduct of this research.

Measures and materials

VP

The VP was a computerised high-fidelity digital patient (see Figure 1), that has been described in detail by Quail et al. (2016) and Bánszki et al. (2018). It was developed by a multi-disciplinary team with experience in psychology, speech pathology, behaviour

management and software design, and is programmed to produce 77 verbal and non-verbal responses representative of dementia. During development, input from people with dementia, their family members, and industry care workers was sourced to ensure that the VP's responses were valid and authentic. The responses are organised into categories such as 'profile' (background/demographics), 'social' (greetings), 'general concern' (health and other concerns), 'agreement' and 'disagreement'. Non-verbal responses include crying, slamming fists on the table, shrugging and chuckling. Dementia specific response options include statements, questions and phrases that simulate word finding and comprehension difficulties, repetition, confusion, and paranoia.

[INSERT FIGURE 1 ABOUT HERE]

Curtin Conversation Interaction Scale (CCIS)

The CCIS was developed from discourse analyses of video recordings of students interacting with VPs and SPs that were made during the research described by Quail and colleagues (2016). This assessment and feedback tool was designed to assess the development of generic communication competencies, and contains 25 statements (e.g., '*maintains appropriate eye contact with conversation partner*' and '*demonstrates awareness of how his/her responses are affecting the communication partner*'), which are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The CCIS is subject to ongoing validation, although preliminary analyses with data collected for the current research have demonstrated that it is unidimensional and internally consistent (Cronbach's $\alpha = .96$ to $.97$).

Placement Reflection Questionnaire (PRQ)

The PRQ asks students to retrospectively rate their communication skills, knowledge and

confidence prior to their first interaction with the VP, as well as their post-placement communication skills, knowledge and confidence. Ratings are made on a series of 5-point bipolar scales ranging from 1 (e.g., *not at all confident*) to 5 (e.g., *very confident*). A retrospective approach was used to avoid a ‘response-shift bias’, as described by Sullivan and Haley (2009).

Procedure

Following institutional ethics approval (Ref: RDHS-46-15), each student participant self-selected and committed to a single half-day placement block. These placement blocks were scheduled over a six-week time period. Each block began with a 45-minute small-group (3-4 student) introductory session, facilitated by a CE, where a training video of a communication interaction between a fourth-year undergraduate student and a clinic patient was shown and discussed. The student in the video had demonstrated clinical competencies in a variety of clinical placements that involved the treatment of pre-school aged children with developmental disabilities through to older Australians suffering from dementia. This student had also achieved professional entry level standards of practice in team based relationships and professional reflective practice. She was thus an exemplary role model for beginning clinical learners.

Following the introductory session, each student individually entered a clinical training room and sat on one side of a table opposite to the life-sized VP display, at eye level and at an approximate distance of two meters. This configuration attempted to simulate, as closely as possible, the setting a student would be in with a patient in a clinic room in a community health facility. The CE sat at a table behind the student at the back of the room, from where they operated the VP software on a laptop computer. The VP’s verbal and non-verbal responses were manually operated by the CE, who also completed

the CCIS for each student – VP interaction. Each student’s first interaction with the VP was approximately 15-minutes in duration, and was followed by a 15-minute feedback discussion with the CE based on the completed CCIS (1). This was designed to prompt student self-reflection and to set goals for the second interaction. After a short break, each student engaged in the second, individual 15-minute VP interaction, which was again evaluated and reflected upon with the student by the CE using the completed CCIS (2). To conclude, students individually completed the PRQ, and the CE facilitated a 45-minute small-group summary discussion and debrief.

Two experienced CEs, who were both independent of the research team, facilitated approximately half of the placements blocks each. Both had prior CE experience (though not using a VP). Before the first placement block the two CEs attended five hours of training focussed on directing and managing the VP platform, facilitating the small-group introduction and debrief sessions, and providing feedback with the CCIS.

Results

Preliminary analyses

Prior to any hypothesis testing, the bivariate relationships between all variables in the study were assessed using Spearman’s rank or point-biserial correlation coefficients (dependent on the nature of the correlated variables). As summarised in Table 1, at $\alpha = .01$ (adjusted for multiple comparisons), age, gender and placement start-time (morning vs. afternoon) were not significantly associated with any of the study’s dependent variables. However, timing of the placement during semester (early vs. late) and CE (1 vs. 2) were both significantly associated with CCIS ratings for the second interaction. Students who self-selected into placement blocks late in the semester and students rated

by CE 1 tended to achieve lower CCIS ratings on their second interaction with the VP than students in earlier placement blocks and students rated by CE 2. Descriptive statistics illustrating these tendencies are reported in Table 2.

[INSERT TABLE 1 ABOUT HERE]

[INSERT TABLE 2 ABOUT HERE]

Main analyses

We originally planned to test the first hypothesis, that students' CE-rated CCIS scores would be higher following their second interaction with the VP than following their first, with a paired samples *t*-test. However, the placement timing and CE were both significantly correlated with CCIS ratings, suggesting that the effects of interaction number (first vs second) on CCIS ratings may be influenced by these variables. Consequently, timing of placement and CE were included alongside interaction number as independent variables in a 2 x 2 x 2 mixed ANOVA, with CCIS ratings as the dependent variable.

The results of the 2 x 2 x 2 mixed ANOVA, which are presented in the upper third of Table 3, indicated that there was no three-way statistical interaction between interaction number, timing of the placement and CE ($\eta_p^2 < .001$), nor a two-way statistical interaction between interaction number and timing of the placement ($\eta_p^2 < .001$). However, significant and medium-large two-way statistical interactions between interaction number and CE ($\eta_p^2 = .099$) and between timing of placement and CE ($\eta_p^2 = .189$) were observed. These significant two-way statistical interactions indicated that the effects of interaction number and placement timing on CCIS ratings were both influenced by CE.

[INSERT TABLE 3 ABOUT HERE]

Because of this, two 2 x 2 mixed ANOVAs were used to investigate the impact of interaction number and timing on CCIS ratings at each level of CE. These ANOVAs are reported in the lower two-thirds of Table 3. Each effect was evaluated for significance at a Bonferroni corrected α of .025. There was no statistical interaction between interaction number and timing for CE 1 ($\eta_p^2 < .001$), nor CE 2 ($\eta_p^2 < .001$). For students rated by CE 1, a significant and large main effect of interaction number was observed ($\eta_p^2 = .698$), with CCIS ratings for the second interaction significantly higher than those for the first (see Table 2). For students rated by CE 2, a significant and large main effect of interaction number was also observed ($\eta_p^2 = .722$), with CCIS ratings for the second interaction again significantly higher than those for the first. These findings are consistent with the first hypothesis, that students' CE-rated CCIS scores would be higher following their second interaction with the VP than following their first. Furthermore, for students rated by CE 1, a significant and large main effect of timing was also observed, with late placement students rated significantly lower than early placement students ($\eta_p^2 = .349$). For students rated by CE 2, there was no main effect of timing ($\eta^2 = .053$). To facilitate interpretation, these results are depicted graphically in Figure 2.

[INSERT FIGURE 2 ABOUT HERE]

Three one-tailed paired samples *t*-tests (evaluated for significance at a Bonferroni corrected α of .017) were used to compare participants' retrospective pre-placement and post-placement assessments of their skills, knowledge, and confidence. As illustrated in Table 2, all three tests were statistically significant, and substantial effects (median $d_{av} = 1.25$) were observed in the direction predicted by the second hypothesis. That is, students'

post-placement assessments were consistently and meaningfully higher than their retrospective pre-placement assessments.

[INSERT TABLE 4 ABOUT HERE]

Discussion

In the current study, undergraduate speech pathology students completed one half-day placement that required them to conversationally interact with a VP on two occasions, separated by CE feedback and self-reflection. Each interaction lasted approximately 15 minutes. The CEs' ratings of the students' conversational competence were significantly and substantially higher following the second interaction than they were following the first. Furthermore, students' post-placement self-ratings of their communication skills, knowledge and confidence were significantly higher than their retrospective pre-placement ratings. These results are positive, and consistent with the two research hypotheses. They are also consistent with, and extend the work of Quail and colleagues (2016), who observed large positive increases in speech pathology students' self-reported communication skills, knowledge and confidence following a similar placement that involved just one interaction with a VP. It should be noted that the students and CEs who participated in the current study were independent to those who participated in Quail and colleagues' (2016) research. However, the same VP was used in both studies.

In the field of speech pathology, "excellent and effective communication, counselling and interpersonal skills" are described as forming the foundation of professional competence (Speech Pathology Australia, 2011, p. 6). These skills are similarly important across all health professions (Chen, 2011), and training them in SLEs ensures that students learn in safe, repetitive and controlled environments (Theodoros et al., 2010), and are better prepared and more confident by the time they begin interacting

with actual clients or patients. The CEs' significantly higher ratings of the students' communication skills after the second interaction, combined with the students' improved self-ratings, provide support for the use of VPs in SLEs developed for basic communication skills training. Such training provides a foundation for future clinical experiences, when students would otherwise be attempting to develop generic communication skills alongside more specialised skills in an often busy, demanding health care setting.

Although promising, the findings of this study should be interpreted with some caveats. For example, we had no comparison or control group, which means that attributing the effects reported herein to the VP placement should be done with an appropriate level of caution. A more robust design, which could perhaps be justified based on the results of Quail et al. (2016), would be a non-inferiority trial. In such a trial, the hypothesis that a VP placement experience is not unacceptably less efficacious than a traditional placement experience could be tested (Schumi & Wittes, 2011). We are not aware of any published studies that have used this approach in contexts similar to ours, although one appears to be currently underway (Imms et al., 2017). For us, the intent of this study was to evaluate a VP placement already embedded in the accredited curriculum of the speech pathology course at Curtin University in a relatively non-intrusive manner. Furthermore, there was no scope in this study to investigate the possible generalisation of skills learned in the VP placement to different contexts or circumstances. Finally, we don't yet understand how VP placements may best be utilised within the suite of clinical experiences available to students across a typical speech pathology degree. These are matters that require further research.

With increased higher education and private sector investment, further VP development, curriculum implementation, and research is expected (Theodoros et al.,

2010). For example, there is potential for the development of a range of VP characters, contexts, and responses that reflect real-world diversity and complexity across a range of practice areas, as well as opportunities for research into the efficacy of using VPs for conflict resolution and the development of other complex communication skills (MacBean et al., 2013). Research into the longer term impacts of training with VPs also requires consideration (Ostergaard & Rosenberg, 2013).

The outcomes of the current research may also have implications for VP use in any discipline where communication training is a priority (e.g., early stages of medical education, Courteille et al., 2014), and training programs for carers of individuals with communication impairments. However, given the specific demographics of the student sample in this study (i.e., second-year undergraduate speech pathology students), the efficacy of VP placements in other contexts and with other populations requires further investigation.

Factors beyond the VP placement may have impacted upon the CCIS ratings in this study. Analyses indicated that students rated by CE 1 later in the semester attained significantly lower CCIS scores than students rated earlier in the semester. This could suggest that either (a) CE 1 became more critical or conservative with experience; (b) students who self-selected (or were assigned, due to failing to self-select by a specified date) into the later placement blocks were either weaker, or less motivated than those who self-selected into the earlier placement blocks; or (c) some combination of both. Alternative (a) speaks to the need for greater ongoing moderation amongst CEs, particularly if their evaluations are to be used for the purposes of summative assessment. No such timing effect was observed for CE 2. Students self-selecting their placement block might also have introduced bias and future research should address this with complete randomisation.

Additional development, validation and optimisation of the CCIS instrument is also required. The current data indicated that not all CCIS items had strong loadings on the primary underlying factor (e.g., items about including relevant personal and professional information in introductions and expressing thanks for the VP's time). Additionally, several items may be redundant, as indicated by their high correlations with other items (e.g., items assessing the appropriate use of facial expressions and maintaining appropriate levels of eye contact were correlated above .75 at both time points, suggesting they could be combined into a single item). Furthermore, the number of response options provided may need to be increased in order to better discriminate between different levels of student performance. Given that the CCIS was created in response to the ongoing need for communication skills assessments with increased rigor and integrity, refining the CCIS assessment tool for use in replication and extension studies and/or for the purposes of teaching, learning and assessment is a goal for future research.

This study has extended the current evidence base supporting and validating VP placements as successful simulated learning opportunities for students to practice and improve their proficiency in building effective interpersonal interactions. Specifically, this study demonstrated how VPs can be used to effectively develop speech pathology students' competence in the area of communication skills. Such findings provide endorsement for future VP placements in tertiary education, and are timely when considered in the context of increasing student numbers and constrained community work-integrated placement availability.

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Table 1. Correlations between the study's dependent variables and key participant and placement characteristics.

	CCIS		PRQ Skills		PRQ Knowledge		PRQ Confidence	
	Int 1	Int 2	Retro	Post	Retro	Post	Retro	Post
Age	.14 ^a	.22 ^a	.23 ^a	.05 ^a	.14 ^a	-.05 ^a	.24 ^a	-.19 ^a
Gender	.12	.17	.15	.01	.10	.10	.09	.01
Start time	.07	-.05	.06	.10	.05	.19	-.01	-.02
Timing	-.28	-.29 ^{**}	-.03	-.09	.02	-.05	-.10	-.22
CE	.12	.31 ^{**}						

Note. $n = 82$ for all variables, except age ($n = 75$). Binary variables coded as: gender (female = 0, male = 1), placement start time (morning = 0, afternoon = 1), timing of placement during semester (early = 0, late = 1), and CE (CE 1 = 0, CE 2 = 1). Int = Interaction; Retro = Retrospective.

^a = Spearman's rank correlation coefficient. Values without superscript = point-biserial correlation coefficient.

^{**} $p < .01$, two-tailed.

Table 2. CCIS means and standard deviations by interaction number (first vs. second), timing of placement during the semester (early vs. late) and CE (1 vs. 2).

	Interaction 1	Interaction 2	Total
Timing of Placement	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Full Sample (<i>N</i> = 82)			
Early (<i>n</i> = 37)	66.00 (13.56)	76.61 (11.99)	71.30 (12.16)
Late (<i>n</i> = 45)	59.33 (9.50)	69.62 (11.13)	64.48 (9.84)
Total	62.34 (11.91)	72.77 (11.98)	67.56 (11.40)
Students rated by CE 1 (<i>n</i> = 48)			
Early (<i>n</i> = 20)	69.58 (13.38)	78.00 (12.69)	73.79 (12.74)
Late (<i>n</i> = 28)	55.11 (7.76)	63.75 (7.73)	59.43 (7.19)
Total	61.14 (12.60)	69.69 (12.24)	65.41 (12.10)
Students rated by CE 2 (<i>n</i> = 34)			
Early (<i>n</i> = 17)	61.79 (12.89)	74.97 (11.26)	68.38 (11.09)
Late (<i>n</i> = 17)	66.29 (8.01)	79.29 (8.96)	72.79 (7.80)
Total	64.04 (10.81)	77.13 (10.26)	70.59 (9.70)

Table 3. Analysis of variance results for the effects of interaction number (first vs. second), timing of placement during the semester (early vs. late) and CE (1 vs. 2) on CCIS ratings.

Factor	<i>F</i>	<i>df</i>	<i>p</i>	η^2
Full Sample				
Interaction	193.17	1, 78	< .001	.712
Timing	5.12	1, 78	.026	.062
CE	3.27	1, 78	.074	.040
Interaction * Timing	< 0.01	1, 78	.989	< .001
Interaction * CE	8.58	1, 78	.004	.099
Timing * CE	18.22	1, 78	< .001	.189
Interaction * Timing * CE	0.02	1, 78	.898	< .001
Students rated by CE 1				
Interaction	106.19	1, 46	< .001	.698
Timing	24.70	1, 46	< .001	.349
Interaction * Timing	0.02	1, 46	.894	< .001
Students rated by CE 2				
Interaction	83.17	1, 32	< .001	.722
Timing	1.80	1, 32	.189	.053
Interaction * Timing	< 0.01	1, 32	.951	< .001

Table 4. Summary of differences between students' retrospective pre-placement and post-placement assessments of their communication skills, knowledge and confidence.

	<i>M (SD)</i>		95% CI	<i>t</i>	<i>p</i> ^a	<i>d_{av}</i>
	Retrospective	Post-				
	Pre-Placement	Placement				
PRQ Skills	2.62 (0.91)	3.63 (0.73)	[0.80, 1.23]	9.40	< .001	1.23
PRQ Knowledge	2.61 (0.78)	3.70 (0.60)	[0.90, 1.27]	11.78	< .001	1.58
PRQ Confidence	2.51 (1.02)	3.65 (0.81)	[0.89, 1.38]	9.36	< .001	1.25

Note. *N* = 82 for all outcome variables. 95% CI = 95% confidence interval of the difference between two related means. *d_{av}* = Cohen's *d_{av}*, the standardised difference between two related means (calculated using the average of the two condition standard deviations as the standardiser; Lakens, 2013).

^a = one-tailed.

Figure 1. 'Jim' the virtual patient.

Figure 2. The effects of interaction number (first vs. second) and timing of placement during the semester (early vs. late) on the CCIS ratings of CE 1 (left panel) and CE 2 (right panel).