#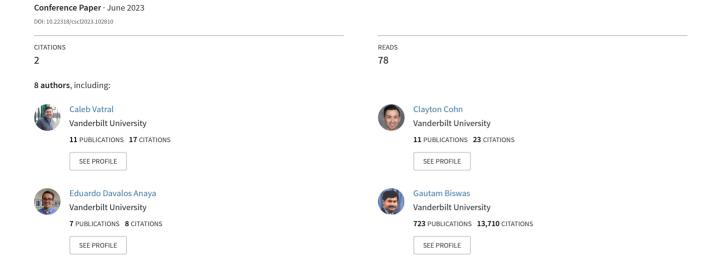 A Tale of Two Nurses: Studying Groupwork in Nurse Training by Analyzing Taskwork Roles, Social Interactions, and Self-Efficacy

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A Tale of Two Nurses: Studying Groupwork in Nurse Training by Analyzing Taskwork Roles, Social Interactions, and Self-Efficacy

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Abstract: Modern healthcare requires the coordination of a team of professionals with complementary skillsets. To help facilitate teamwork, healthcare professionals, such as nurses, undergo rigorous training of their clinical skills in team settings. In this paper, we analyze a mixed-reality, simulation-based training exercise involving three nurses in a hospital room. We perform multimodal interaction analysis to contrast strategies used in two cases where the patient expressed doubts about their medical care. By analyzing these strategies and comparing them to the student nurses' self-reflections, we show connections among the nurses' clinical roles, their self-efficacy, and their teamwork.

Introduction

In modern healthcare, diverse teams of individuals work closely to provide optimal patient care. This complex orchestration requires each team member to employ strong individual and teamwork skills. Therefore, effective training of such skills is critical to ensure success in complex healthcare environments. Often, skill training takes place in mixed-reality simulation-based training, where the nurses can practice their clinical and teamwork skills in realistic environments that are safe and repeatable. This allows trainees to develop a strong sense of self-efficacy in teamwork and self-confidence in their clinical skills that can be transferred to real clinical settings and improve patient outcomes (Hustad et al., 2019). In this work, we use a cognitive ethnographic approach to conduct a case study of three nurses training in a manikin-based simulation. By contrasting two situations where the student nurses address their patient's doubts regarding the medical care being administered, we examine how the nurses' interactions with the patient relate to their roles and self-efficacy.

Methods

Three nurses worked on a training exercise in a simulated hospital room with standard medical equipment and a high-fidelity manikin as the patient. The simulation utilized a predefined script, but a trained instructor guided the simulation by observing the nurses' actions. The nurses were tasked with evaluating the patient and performing the prescribed medical care to alleviate the conditions of an adult patient who had persistent coughing, difficulty breathing, and pleural pain. The goal was to administer two prescribed medications to relieve the patient's symptoms. All the student nurses who participated in the study provided their informed consent to collect video, audio, and eye tracking data, and the study was approved by the university Institutional Review Board. From the multimodal data collected, we derived two additional records by applying machine learning algorithms to the raw audio: (1) a simple text transcription of dialogue using the Otter automated transcription software (with manual correction of errors); and (2) an emotion recognition deep learning transformer model to the audio, which produced a 3-dimensional vector of the nurses' arousal, dominance, and valence for each utterance (Wagner et al., 2022). In this paper, we focus on the dominance value, defined as the degree of control exerted by the nurses. This concept is closely related to the speaker's confidence.

Using the multimodal data records, our research team conducted interaction analysis over six sessions (Hall & Stevens, 2015). The first sessions focused on basic interpretation of nurses' tasks and roles, guided by a cognitive task analysis of the nursing domain (Vatral et al., 2022). The next sessions focused on justifying the nurses' actions, using the video, audio, and textual transcriptions. We also used eye-tracking data to help disambiguate the nurses' focus and attention, especially when they were not speaking. The final sessions focused on analysis of the nurses' emotions and self-efficacy, using their speech and eye gaze to identify instances of social

referencing, doubt, and questioning. We used automated speech emotion to add further evidence to the nurses' feelings (Wagner et al., 2022). Our analysis focused on two contrasting clips from the complete simulation.

To compare and validate the insights generated by multimodal interaction analysis, we used data collected from a post-simulation guided student reflection designed to promote metacognitive awareness. We first presented students with their own egocentric eye-tracking footage from the simulation. Students then rewatched this footage while being asked to segment the simulation into meaningful event units (Zacks & Swallow, 2007). After event segments were marked, students were shown each marked event and responded to six reflection questions based on that event. Of particular interest to this paper were three questions: (1) the degree to which they worked individually versus as a team during each segment; (2) their level of self-efficacy during each segment; (3) self-reported confidence for the simulation overall.

Results

Initial Role Assignment

During the pre-briefing before the training exercise, the instructor assigned high-level roles to the three participating nurses. Two were assigned the role of nurses, hereafter referred to as nurse 1 and nurse 2. The third student was assigned the role of care partner, i.e., a type of unlicensed professional who can assist with a restricted subset of clinical tasks. Soon after the scenario began and the students introduced themselves to the patient, the students self-assigned themselves tasks based on their assigned roles and understanding of the situation provided by the instructor in the pre-briefing. Nurse 1 began to focus on patient assessment (information gathering) and immediate stabilization tasks. This included taking vital signs, adjusting the patient's bed, and starting to administer oxygen. Nurse 2 began to focus on intervention treatment by retrieving the patient's medications. The care partner assisted nurse 1 by retrieving equipment for oxygen delivery and reading aloud relevant information from the patient's chart.

From these initial self-assigned tasks, clear differences emerged between nurse 1 and nurse 2. While nurse 1 focused very directly on the patient, nurse 2 was narrowly focused on administering medications, and did not interact with the patient at all other than introducing herself at the patient's request. In addition, nurse 1 was team-oriented from the outset of the simulation, often asking the care partner for assistance. Nurse 2 worked more independently, leaving the bedside to go retrieve the medication, and then attempting to administer the medication on her own. This attempt at administering medication (i.e., performing an intervention) with little communication with the patient or the other nurses resulted in the patient expressing doubt about nurse 2's qualifications to administer the chosen medication using a nebulizer. This turned out to be a catalyst for a change in nurse 2's behavior and she became more team-oriented, as we will describe in the next section.

Addressing Patient Doubt

Instance 1

After nurse 2 retrieved the nebulizer from the pharmacy, she attempted to administer it to the patient. However, the patient questioned nurse 2's qualifications to perform the task. Figure 1 (left) shows the transcript of this encounter; nurse 2 and the patient went back and forth disagreeing on nurse 2's qualifications to administer the nebulizer. Eventually, nurse 2 relented and called for a respiratory therapist to administer the nebulizer.

Nurse 2 was not team-oriented, and she attempted to perform the procedure by herself with very little communication with her team and the patient. Early in the disagreement with the patient, nurse 2 used I-language to communicate. It is not until nurse 2 began to doubt herself that she switched to using team-oriented we-language. Initially there was a rise in nurse 2's speech dominance, then she began to doubt herself and asked nurse 1 for confirmation ("Right?"). At this point, her dominance suddenly drops and continues to decrease until the end of the segment. This clearly shows that nurse 2 intended to handle her tasks by herself without much communication with the other nurses and the patient. When challenged by the patient, nurse 2's confidence wavered, and she switched to a more team-oriented approach. As this switch occurred, the care partner de-escalated the situation by interjecting that they should call for assistance. The change to a team-oriented approach continued, and nurse 2 often contributed by helping her teammates when they were unsure of themselves. She made more explicit suggestions for role assignment among the team members.

Instance 2

Later in this scenario, the nurses needed to administer a second medication intravenously. After computing the dosage, nurse 1 prepared to inject the medication into the IV tubing, but the patient again expressed doubt, wondering what the medication was for. A transcript of the interaction is shown in Figure 1 (right).

In this case, nurse 1's approach differed from nurse 2's. Nurse 1 was quick to admit that she was unsure about the medication, and immediately asked her team if they knew. This was consistent with the behavior nurse 1 had exhibited throughout the scenario, often asking her teammates for information or help. Her measured speech dominance was also consistent with this team-oriented strategy. Nurse 1 began this interaction with low dominance, unsure about the medication and how to answer the patient's question. Her dominance scores increased when her team suggested calling the pharmacist or looking up the information. This team-oriented approach raised nurse 1's confidence temporarily; but her dominance decreased again after she looked up and read verbatim the description of the medication from an electronic search. This combined with her low dominance at the end of the situation suggests that she was still unsure about the medication. This low confidence prompted nurse 2 to interject with the correct interpretation of the medication's use, resolving the patient's doubts.

Instance 1		**Instance 2**	
NURSE 2	(*Removes oxygen tube and begins to cover* PATIENT *face with a nebulizer mask*)	NURSE 1	(*Begins to hook up the medication syringe into the patient's IV tubing.*)
PATIENT	Are you a respiratory therapist?	PATIENT	What's that for?
NURSE 2	No, I'm not. I'm a nurse though.	NURSE 1	Umm. (*Looks up at* NURSE 2 *and* CARE PARTNER.) Do you guys know exactly what this is for?
PATIENT	You know how to give nebulizer treatments?	PATIENT	Well, I don't want you to give it to me if you don't know what it's for! What if its arsenic?
NURSE 2	Yes. (*Long pause.* NURSE 2 *looks up a* NURSE 1.) Right?	NURSE 2	We can call the pharmacist.
PATIENT	Really?	NURSE 1	Yeah, let me call the pharmacist. (*Walks away from the bedside.*)
NURSE 2	Yes, I do.	PATIENT	You can't just look it up?
PATIENT	The last time I did one they called the respiratory therapist.	NURSE 1	Yeah, I could just look it up. Let me do that.
NURSE 2	We can call them if that makes you feel more comfortable.		…
PATIENT	Well, are you licensed to give nebulizer medications?	NURSE 1	It's a steroid that can treat inflammation, severe allergies, flares of chronic illnesses.
CARE PARTNER	No, we're not. Do you want to call?	NURSE 2	So, this is an anti-inflammatory that should help your lungs.
NURSE 2	We can call.		
NURSE 1	Yeah, we'll call.		

Figure 1. *Transcript of the two instances of patient doubt during the simulation.*

Comparing Multimodal Interpretations to Self-Report

We compared the interpretation of student behaviors from the previous section with the students' post-simulation reflections. Since these reflection ratings and interpretations were given by the students themselves, they represent a way of comparing and validating our analysis of the nurses' behaviors against their own judgments.

The results from post-simulation reflections match well with the analysis previously presented. During her reflection, nurse 2 recognized the same individual orientation in her taskwork behavior that we interpreted, stating, "*I tend to get focused in on get[ting] tasky things, such as medication administration, done before worrying about the patient interactions*." This early individual focus was again confirmed by nurse 2's reported low team-orientation score, rating herself a mean of 2.0/5. In contrast, our analysis of nurse 1 suggested she took on a more team-oriented focus early in the simulation. However, nurse 1's reported team-orientation score was lower than what our analysis inferred, rating herself a mean of 2.0/5 during this early part of the simulation. This discrepancy between our analysis and her self-reported scores could be explained by nurse 1's lack of self-confidence. She rated herself a 2.5/5 for overall confidence during the simulation, indicating uncertainty in her abilities, and may have been unsure of her performance as a team member during this segment. This presents the opportunity to provide more reassuring and positive feedback in a debriefing to make the nurse feel more confident and continue to build on her teamwork processes.

Next, the simulation reflections also supported our analyses of doubt in instance 1. Our analysis shows that nurse 2 entered this scenario with the intention of handling the situation herself. After being challenged by the patient, her confidence wavered, and she adopted more team-oriented behavior. During this instance, nurse 2 self-reported working as "mostly individual", rather than as part of a team (2/5 on a Likert scale). However, after this segment, we saw a consistent increase in her team-orientation rating with a moderate positive correlation with time ($rho = 0.46$). Consistent with our analysis, nurse 2 changed her behavior to a teamwork orientation.

Finally, the simulation reflections were also supportive of our analysis of doubt in instance 2. Our results showed that nurse 1 entered this instance with low self-efficacy, and she relied on her teammates to resolve the situation. This is consistent with her reflection, where she reported working "*Mostly as a team*" during this segment (4/5 on a Likert scale). In addition, her low confidence in this scenario is consistent with both her reported self-efficacy during this segment at 3.3/5 and overall confidence at 2.5/5. Finally, our inference that nurse 1 relied on her team because of her low self-efficacy was also confirmed by her reflection, where we saw a moderate negative correlation between nurse 1's self-efficacy and team-orientation ($rho = -0.54$). In fact, across all three nurses we saw this same pattern of higher reliance on the team when self-efficacy was low ($rho = -0.33$).

Discussion

Overall, a major conclusion from these results for nursing instruction is that students' self-efficacy and teamwork are inversely correlated. At first glance, this is reasonable, especially for novice learners. We might expect that novices rely on one another when they are unsure of themselves. However, there are two primary reasons that this represents an important takeaway for nursing instructors. First, it is important for instructors to consider that self-reported teamwork increased when the nurses were unsure of themselves. When students lacked confidence, other students stepped in *post hoc* to support the role in question. A better approach may involve more metacognitive processes, such as *planning and assessing* the situation jointly before taking on tasks. This involves a complex series of supports that includes effective communication, coordination of tasks, and helping one another in maintaining their confidence levels. When instructors see such naïve teamwork, it may be important to point out to students that they are missing other key components of effective teamwork. Second, it may be important for instructors to inform students that they need to work as a team even when their self-efficacy is high. When the students were confident in themselves, they tended to work far more independently. This was particularly evident in nurse 2, who rarely communicated with her team or the patient when her self-efficacy was high. It is important for nurses to be confident in their abilities and what they can offer to the care team while also communicating effectively with both the patient and the rest of the care team.

Conclusions

In this paper, we presented a case-study using multimodal data and interaction analysis to generate insights about the connections between student nurses' role playing, self-efficacy, and teamwork during training. We contrasted the strategies adopted by two student nurses when faced with situations of patient doubt, which lowered the self-efficacy of both nurses. The nurses turned to their team for assistance, but in different ways. We also highlighted implications for instructor debriefing based on these results. This work had some limitations due to its exploratory nature and the use of a partial case analysis of small segments. In future work, we will generalize our approach by applying similar methods to additional learners and varied training scenarios. Future work will also focus on developing more machine learning-based automated analysis methods. It is our hope that with continued research and development, we can provide tools to help support healthcare team training more broadly.

References

Hall, R., & Stevens, R. (2015). Interaction analysis approaches to knowledge in use. In *Knowledge and interaction* (pp. 88-124). Routledge.

Hustad, J., Johannesen, B., Fossum, M., Hovland, O. (2019). Nursing students' transfer of learning outcomes from simulation-based training to clinical practice: a focus-group study. *BMC Nursing*, 18:53.

Vatral, C., Biswas, G., Cohn, C., Davalos, E., & Mohammed, N. (2022). Using the DiCoT framework for integrated multimodal analysis in mixed-reality training environments. *Frontiers in artificial intelligence*, 5, 941825. doi: 10.3389/frai.2022.941825

Wagner, J., Triantafyllopoulos, A., Wierstorf, H., Schmitt, M., Eyben, F., & Schuller, B. W. (2022). Dawn of the transformer era in speech emotion recognition: closing the valence gap. *arXiv:2203.07378*.

Zacks, J. M., & Swallow, K. M. (2007). Event segmentation. *Current directions in psychological science*, *16*(2), 80-84.