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# Comparisons of Cooperative-Based Versus Independent Learning While Using a Haptic Intravenous Simulator

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## KEYWORDS

cooperative learning;  
haptic;  
intravenous;  
simulator;  
cannulation

## Abstract

**Background:** The study's aim was to evaluate the effectiveness of cooperative team learning compared with independent learning when used with nursing students who are learning intravenous (IV) catheter insertion using a haptic IV simulator. Haptic IV simulators provide tactile feedback including palpation of a vein and resistance during venipuncture. Cooperative learning is an active learning strategy where students work together to complete a task.

**Methods:** Two convenience samples (N = 180) of nursing students were randomized into four group assignments (A, B, C, or D). A second randomization separated these group assignments into IV simulation clusters with each cluster containing one of each of the four group assignments. Three of the four group assignment members (A, B, C) were designated as the cooperative learning team, whereas the fourth group assignment member (D) was identified as the independent learner working alone. The letters (A, B, C) represented who within the cooperative team of learners was to attempt the IV simulation first (A), second (B), or/and third (C). A posttest-only experimental research design was used to compare group performance scores and number of attempts to be successful of the IV simulator.

**Results:** Thirty-six percentage of the variance for the initial performance score and 53% of the variance in the number of attempts to earn a passing performance score were related to their group assignment.

**Conclusions:** Cooperative team members performed better with fewer attempts than independent learners when using an IV simulator. Cooperative team members learned from observing and helping one another. This study provides empirical evidence that supports the efficacy of simulation as a means of learning a psychometric skill.

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One of the most common but critical and technically difficult skills performed in the clinical setting is intravenous (IV) catheter insertion (Wilfong, Falsetti, McKinnon, Daniel, & Wan, 2011). IV catheterization or cannulation is a complex

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(Jones, Simmons, Boykin, Stamper, & Thompson, 2014) and invasive procedure (DaSilva, Priebe, & Dias, 2010). According to Chang, Chung, and Wong (2002), students need opportunity to practice and learn how to perform safe and effective IV insertion or cannulation as inappropriate cannulation may have harmful effects, including infiltrations, phlebitis, or pain for the patient. More and more, the skill of IV insertion is being taught with a haptic IV simulator.

### Key Points

- Cooperative learning is an active learning strategy that promotes effective communication and teamwork.
- Cooperative learners required fewer attempts to be successful than the independent learner.

The use of haptic IV simulators can assist in learning the principles of IV cannulation (Loukas, Nikiteas, Kanakis, & Georgiou, 2011) but may be cost prohibitive for many institutions (Wilfong et al., 2011). Jung et al. (2012) note that more

effective IV learning methods that do not require consumables are needed to prepare practitioners to learn skills in IV insertion.

Cooperative learning is a form of active learning and is based on social interdependence theory (Johnson, Johnson, & Smith, 2007). The basic elements of cooperative learning include positive interdependence, promotive interaction, individual accountability, social skills, and group or team processing. Positive interdependence exists when individuals work together to promote the learning of all team members and perceive that they can reach their goals, if and only if all the individuals in the team achieve the goal. According to Johnson et al. (2007), positive interdependence results in promotive interaction or how individuals encourage and facilitate others to complete the task. Promotive interactions include exchanging resources and challenging and influencing each other's ideas as they work to achieve the team's goal. Team members are individually accountable and learn social skills including decision making, conflict management, and leadership skills (Johnson et al., 2007). Team members learn processing skills as they determine what works well for their team (Johnson et al., 2007).

Cason et al. (2015) employed a Cooperative Learning Simulation Skills Training approach with associate degree nursing and bachelor of science in nursing students (N = 186) learning nasogastric (NG) tube insertion in the nursing skill laboratory setting. This practice-to-mastery model engaged student dyads serving in the roles as operator of the simulator and student learner. Students were encouraged to help each other while practicing the NG tube insertion simulation until each student achieved a score of 100%. Once the student achieved mastery of the psychometric skill, they were assessed individually. Median scores of 100% were reported by all students after one scenario and were sustained through evaluation.

The aim of this study was to evaluate the effectiveness of cooperative learning teams, compared with independent

learners, on nursing students' performance while learning intravenous (IV) catheter insertion via a haptic IV simulator. The following research questions were addressed:

Are there differences in nursing students' initial IV insertion performance scores earned on the haptic IV simulator based on their group assignment?

Are there differences in the number of attempts needed to earn a passing performance score on the haptic IV simulator based on the students' group assignment?

There were four group assignments in each IV simulation cluster. Group assignments A, B, and C, within the IV simulation cluster, formed a cooperative learning team. Students in group assignment A were the first on their team to attempt the IV simulation. Those in group assignment B were the second on the team, and group assignment C students were the third on their team to attempt the IV simulation. Students in group assignment D comprised independent learners working alone on the IV simulator.

## Theoretical Framework

Social interdependence (SI) theory provides a theoretical base for cooperative learning (Johnson et al., 2007). SI can be positive (cooperative) or negative (competition). Positive interdependence occurs when team members work together to achieve the teams' goals and promote each other's efforts. Negative interdependence is individuals competing and obstructing each other's efforts to achieve goals. No interdependence is when individuals believe they can attain goals regardless of whether others attain or do not attain their goal. SI theory also contains elements related to interaction patterns, individual accountability, social skills, and team/group processing (Johnson et al., 2007).

Cooperative learning strategies have been used with groups of nursing students in the classroom (Goodfellow, 1995), clinical setting (Khosravani, Manoocheghi, & Memarian, 2004), and most recently in the skills laboratory (Cason et al., 2015). Studies implementing cooperative learning strategies with nursing students appeared to have positive effects on communication skills (Baghcheghi, Koohestani, & Rezaei, 2011), knowledge achievement (Everly, 2013), and building a community of learning (Ruth-Sahd, 2011).

In this study, a cooperative team of three learners (triad) worked together, whereas an independent learner worked alone to complete the same task. The task was to successfully earn a passing performance score of an 85 or higher on the haptic IV simulator. Each member in the triad cooperative team was individually responsible to earn a passing performance score while working together until all members in the triad earned a passing performance score. Using this positive interdependence structure encouraged team members to interact in a promotive way. By

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