Development and Integration of LIS Simulation into First Year MLS Curricula

John Jimenez, Tami Alpaugh, PhD, MLS(ASCP)

Center for Allied Health Programs

MEDICAL LABORATORY SCIENCES

Abstract

The incorporation of simulation-based learning activities is not a new concept in the field of medical laboratory science. Studies have shown that simulation experiences incorporated into the academic curricula provide students with a means to learn in an environment where they are free to make mistakes, while also developing their skills and boosting self-confidence. Currently, there are no studies found in the literature related to Laboratory Information System exposure or experience for Medical Laboratory Science students during their program coursework. This specific study focused on the use of a Laboratory Information System as a means to supplement the education of first year Medical Laboratory Science students enrolled at the University of Minnesota. The simulation activity was integrated into the student's regularly scheduled hematology laboratory course and split into two different parts. The first part of the activity served as an introduction into the purpose and function of the LIS in the clinical laboratory, while the second part focused on manual review and entry of results obtained from an in-lab Sysmex hematology analyzer into the LIS. To assess the efficacy of the simulation activity, student responses were obtained through the use of surveys conducted both before and after each part of the activity and analyzed using the Wilcoxon signed rank test. The results obtained from the Wilcoxon signed rank test showed a statistically significant change in student understanding of LIS functionality after completing part 1 of the activity. Results also indicated that student understanding of how diagnostic tests are ordered in the laboratory were also significantly improved. When asked if students were looking forward to using this LIS for future laboratory courses, student responses were overwhelmingly positive. Based on the results obtained from this study, we can conclude that this simulation experience was very effective in introducing students to the purpose and functionality of an LIS in the clinical laboratory. Future directions for this research should involve introducing more simulation-based learning experiences into student curriculum to prepare them for their professions upon graduation from the program.

Introduction

The incorporation of simulation-based learning activities is not a new concept in the field of medical laboratory science. Studies have shown that when simulation activities are incorporated into the academic curricula, student confidence and self-perception increases following the activity (Goolsby, 2014). Virtual simulation provides students with a safe learning environment where there can be no direct harm to patients (Kok, 2021). Although incorporation of simulation has been on the rise in various areas of education, the inclusion of simulation in the field of Medical Laboratory Science is still a growing area of study (Webb, 2022). The COVID-19 pandemic drastically changed the method of delivery for higher level education which, for the majority was presented in a face-to-face lecture format. E-learning methods of education were adopted throughout many educational systems as a means to protect students against possible infection. Studies have shown that students had a positive perception of the e-learning format (Naciri, 2021). E-learning has now become widely adopted following the COVID-19 pandemic due to the positive results seen by educators and positive perception of this method by students. Other studies have shown that synchronous distance education did not differ greatly from traditional education, and in some cases resulted in higher satisfaction rates among students enrolled in these online courses (Liyun, 2020). A flexible learning environment allows students to take in material at their own pace, without the stressors of time and space constraints. As e-learning methods continue to expand in health science curricula, there is a growing need to provide students with a new way to learn material away from the classroom. Simulation-based laboratories may provide the solution to fill the gap when students are not actively engaged in a traditional classroom setting.

Virtual and in-person laboratory simulations are a means of exposing students to concepts that can then be further elucidated in a real-world scenario. These simulation experiences have become quite advanced, providing students with an effective means of honing their skills online, incorporating the concepts of e-learning and laboratory simulation (Kok, 2021). Experiential learning through practice with simulation has been recommended for students in the field of nursing as preparation for new graduates (Mabry, 2019). The concept of simulation has been shown throughout the literature as an effective means of enhancing student knowledge in the field, and can be used by students as a valuable study tool that helps with retention and leads to higher exam scores (Donkin, 2019).

There are no studies found in the literature related to Laboratory Information System (LIS) exposure or experience for medical laboratory science (MLS) students during program coursework. This specific study focuses on the use of a LIS to supplement the education of first year MLS students enrolled at the University of Minnesota. A simulation activity using the LIS was developed and integrated as part of the coursework for MLSP 5212. Students completed preparatory work online prior to the lab session, then engaged in a hands-on simulation activity during two separate laboratory sessions. The first part of the activity introduced students to the LIS and pre-analytical components of the laboratory exercise, while the second part involved post-analytical components of the laboratory exercise. Effectiveness of the preparatory work and the overall simulation experience was assessed using both qualitative and quantitative approaches in the form of surveys administered to students before and after each component to assess student engagement and learning outcomes.

Materials and Methods

The simulation activity was split into two different parts of components. In part one, students were tasked with creating a requisition and printing a label through our LIS. In part two, students then used the LIS to manually enter and review patient results. Both parts were accompanied with a short video that the students were instructed to review before attending the laboratory session associated with each part. The videos demonstrated how to use our LIS program, as well as providing additional information on the functionality of LIS. When students enter the lab, they should feel more comfortable using the system, having already had some exposure to it through the video presentation. The results used in part two were obtained from student samples collected during part one of the activity. A complete blood count and differential (CBC Diff) on the student samples were performed on the Sysmex hematology analyzer currently in use in the hematology laboratory.

Pre- and post-activity surveys were integrated as part of the coursework for the students currently enrolled in MLSP 5212. The surveys were used to understand prior student experience and understanding of LIS in the laboratory, as well as assessment of their learning and confidence with using the LIS following completion of the simulation activity. These surveys followed a five-point Likert scale, with one indicating a response of strongly agree and five indicating a response of strongly disagree. Surveys also included open ended questions with which students could provide more information related to their experience during the simulation. Some of the literature reviewed for this activity was used as a means to guide the manner in which the survey questions were written and presented to the participants.

Data was analyzed using a Wilcoxon signed rank test through the statistical analysis software IBM SPSS. Data was compared across both parts of the activity as well as intra-activity. A total of 29 students participated in the activity. One student was excluded from the data analysis, as they had not completed all of the assigned surveys that were central to the study. The final number of students used for analysis was 28.

Results

	Negative Ranks			Positive Ranks					
	n	Mean rank	Sum of ranks	n	Mean rank	Sum of ranks	Ties	Z	p
(LIS activity helped me understand purpose/function after Part 1)-(Understanding of LIS before Part 1)	20	12.05	241	2	6	12	6	-3.788[b]	<0.001[a]
(LIS activity helped to select/order tests after Part 1)-(Understanding how lab tests are ordered before Part 1)	22	13.59	299	3	8.67	26	3	-3.725[b]	<0.001[a]
(Self-confidence after Part 2)-(Self-confidence after Part 1)	13	8.31	108	4	11.25	45	11	-1.576[b]	0.115
(Desire to use LIS for future activities after Part 1)-(Desire to use LIS before part 1)	4	5	20	5	5	25	19	-0.333[c]	0.739
(Understanding of reference ranges after Part 2)-(Understanding of reference ranges before Part 2)	3	8	24	17	10.94	186	8	-3.189[c]	0.001[a]
(Activity helped me better understand LIS after Part 2)-(Activity helped me better understand LIS after Part 1)	9	6.11	55	2	5.5	11	17	-2.138[b]	0.033[a]
(Understanding of Critical Values after Part 2)-(Understanding of Critical Values before Part 2)	2	7.5	15	17	10.29	175	9	-3.386[b]	<0.001[a]
(Desire to use LIS for future activities after Part 2)-(Desire to use LIS for future activities after Part 1)	5	5.5	27.5	5	5.5	27.5	18	0.000[d]	1

Table 1: Wilcoxon Signed Rank Test of Student Responses

Survey Question	Median ± SEM (IQR) – Part 2 Response	Median ± SEM (IQR) – Part 1 Response
I am looking forward to using this LIS for my future laboratory courses in the MLS program	2 ± 0.107 (1)	2 ± 0.107 (1)
The pre-lab handout and tutorial video in the Canvas site presented the material effectively to prepare me for the LIS activity during heme lab	2 ± 0.108 (1)	2 ± 0.104 (0.25)
The LIS simulation experience integrated well with the hematology laboratory course material	1.5 ± 0.109 (1)	2 ± 0.104 (0.18)
The LIS simulation experience helped in my self-confidence as a future MLS	2 ± 0.188 (1)	2 ± 0.166 (1)

Table 2: Median Student Responses to Survey Questions

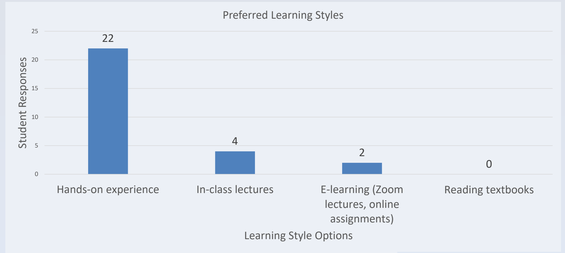

Figure 1: Student Responses to Preferred Learning Styles

Discussion

Before analyzing any of the data, prerequisites needed to be established such as inclusion and exclusion criteria, leading to some adjustments that needed to be made to our sampled students. Students that did not complete all of the surveys were excluded from any data analyses. Students also responded to surveys twice. Their responses were scrutinized for acceptability and duplicate responses were removed from our data logically. In total, 1 student was removed completely for the analyses, leaving a total of 28 students with which to perform our data analyses.

Based on the Wilcoxon Signed Rank analysis (Figure 1), students appeared to respond very well to the simulation activity. Most of the students stated that hands-on experience was their preferred learning style (Table 1), which I believe made the activity more of an enjoyable experience rather than another assignment to complete. Regarding the ratings of self confidence in their skills as Medical Laboratory Scientists, student opinions did not seem to differ very much between both parts of the activity. Students feel very confident in their skills, which was evident during the simulation activity. All of the students seemed well prepared to complete the exercise, and their responses to the pre-activity materials were also overwhelmingly positive.

The surveys assigned to the students included open ended questions where feedback on the activity could be provided. Many of the students touched on similar themes. Students particularly enjoyed the manual entry of their own Complete Blood Count results, giving them a chance to use the concepts they've learned in their lecture courses and apply them to themselves. Many students made mention that the length of time between both parts of the activity may have been detrimental to their learning, suggesting that the two parts be scheduled in a closer timeframe. Other students suggested working with multiple samples instead of solely their one assigned sample, serving as more evidence that the students felt comfortable working with the LIS.

Some of the limitations involved with this specific study include the small sample size of the students. This simulation activity involved 28 students from the University of Minnesota Medical Laboratory Science profession. Future suggestions would involve expanding this research to more students at various universities to increase the sample size and collect more robust data. Another limitation of this study was the use of unvalidated surveys. Survey questions were developed using previous research studies as a guide. Development of validated surveys may help standardize student responses and clear up any confusion among the students regarding questions and responses. Obtained results in this study may have also suffered from distortion effects, such as central tendency bias or social desirability bias. The use of different survey methods may also be explored in an attempt to mediate any perceived biases by students in their responses.

Conclusion

In summary, our findings suggest that the incorporation of a simulation-based learning activity to introduce students to the purpose and function of a Laboratory Information System was of great success. Students provided valuable feedback and suggestions to improve the activity for future entrants to the program. Our data shows that the majority of students agreed that the activity incorporated well into their current hematology curricula.

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