

Medical Laboratory Science Graduate Management Curriculum Development Using Managerial Survey Responses

ABSTRACT

A Midwestern MLS program conducted an online survey to assess current perception of supervisor/leads and managers/directors of their educational preparedness to perform 30 managerial tasks. The purpose of the survey is to collect data that will be used as one of the resources in developing the Master of Medical Laboratory Science (MMLS) curriculum. Results from the survey indicated that one-third or more felt at least well prepared to perform training and monitor quality while greater than one-third felt at least not very well prepared to perform other managerial tasks. These tasks included negotiating contracts and other finance tasks; human resources tasks such as interviewing applicants, hiring employees, writing job descriptions and evaluating employee performance. Other tasks that respondents felt not very well prepared were how to prepare for laboratory inspection/assessment as part of regulatory compliance tasks, equipment performance, monitoring and method validation as well as interdisciplinary team participation and managing projects. Investigators also surveyed managers/directors regarding their perceived and expected preparedness of newly hired/recently promoted managers to perform the same tasks. For all 30 tasks, expectations were higher than perceived performance.

ABBREVIATIONS: ASCLS = American Society for Clinical Laboratory Science; ASCP = American Society for Clinical Pathology; ASCP BOC = American Society for Clinical Pathology Board of Certification; BLS = Bureau of Labor Statistics; BOSR = Bureau of Sociological Research; BS = Bachelor of Science; BSMLS = Bachelor of Science in Medical

Laboratory Science; CLMA = Clinical Laboratory Management Association; CLS = Clinical Laboratory Scientist; DLM = Diplomat in Laboratory Management; HR = human resources; IRB = Institutional Review Board; LIS = laboratory information system; MLS = Medical Laboratory Science; MMLS = Master of Medical Laboratory Science; MT = Medical Technologist; NAACLS = National Accrediting Agency for Clinical Laboratory Sciences; SOP = standard operating procedure; SWOT = strengths, weaknesses, opportunities and threats analysis

INDEX TERMS: Clinical Laboratory Science, Clinical Laboratory Management, Curriculum, Education, Management Education, Medical Laboratory Science, Management Education

INTRODUCTION

A Midwestern, 3+1, university-based, Medical Laboratory Science (MLS) Program is developing a master's degree in medical laboratory science (MMLS). In deliberating the emphasis of the MMLS degree program curriculum, MLS administration/faculty, and current practitioners concluded that laboratory management is the appropriate focus. This decision was based in part on anecdotal communications to program administration that because of practitioner shortages, BSMLS practitioners are promoted to managerial positions without sufficient management-related education, experience, or available mentoring. The Bureau of Labor Statistics (BOLS) projects a 14% growth in MLS workforce needs between 2016-26¹ while the ASCP reported average clinical laboratory vacancies of 8.7% with a 19.2% expected retirement rate between 2014 to 2019.² During this time frame, the expected retirement rate of administrative personnel will be higher than that for non-administrative personnel.^{3,4}

Although the CLMA recognizes current personnel shortages and supports leadership development through education,⁵ there are no universally accepted accreditation nor professional organization MMLS references available to guide curricular development. When considering BSMLS-level management curriculum, routinely referenced resources do not provide clear direction as to specific management-related content to include.^{6,7,8} Inconsistent terminology among these routinely referenced resources may intensify this ambiguity. The NAACLS program accreditation standards require curricular inclusion of the management-related topics: government regulations and standards, administration principles and practices, quality assurance/quality improvement principles and practice, and educational methodologies.⁶ The ASCP BOC MLS exam includes questions over quality assessment and troubleshooting, purchasing, inventory control, competency, education and communication, and laboratory information systems.⁷ The ASCP DLM

certification exam addresses financial, operations, personnel, and quality management providing descriptions in the exam content outline.⁸ Examples of management-related areas in the ASCLS MLS Entry Level Curriculum include healthcare reform, regulations, general and financial management theory, information systems and human resources (HR).⁹

In a 2007 ASCLS white paper that proposed a levels-of-practice model based on highest education obtained ranging from high school to doctorate, it indicated that at the master's practitioner group, management and/or education skills are an additional focus. Suggested management skills for this practitioner group include compliance/coding/regulatory, quality management, risk/patient safety management, operations/business management, and technical management.¹⁰ The primary purpose of this study was to examine clinical laboratory administrators' self-perception of their educational preparedness to perform 30 managerial tasks, and their expected preparedness of newly hired/recently promoted managers. The 30 managerial tasks were categorized as finance, human resources, quality, regulatory, equipment acquisition/validation and other duty tasks. The resulting managerial perception data will be one resource to develop an MMLS degree program with a management focus; other resources include professional experiences and ASCLS, BOC, and NAACLS documents.^{6, 7, 8, 10}

METHODS:

Data for this IRB-approved study was collected as part of a larger MLS practitioner, managerial-task performance and self-reported task preparedness online survey. The Bureau of Sociological Research (BOSR) at a sister campus collaborated with investigators in developing survey questions and in administering the survey. When writing survey questions, investigators also consulted accreditation/professional organization documents, laboratory management course resources, and professional experiences of faculty with management experience. After

beta-testing a cohort known to the authors, they surveyed a convenience sample of clinical laboratory practitioners over four weeks using purchased ASCP and CLMA email databases. Survey reminder emails were not sent due to additional costs associated with database utilization. Participants self-categorized using survey- provided definitions as either a manager/director, supervisor/lead or staff MLS. This study focused on the manager/director and supervisor/lead responses. Participants self-reported how their formal education prepared them to perform 30 managerial tasks (i.e., 5=very well, 4=well, 3=somewhat well, 2=not very well, 1=not at all well, not applicable). The manager/director participants also reported the expected skill level (i.e., 5=very skilled, 4=skilled, 3=somewhat skilled, 2=not very skilled, 1=not at all skilled) and perceived preparedness level (i.e., 5=very prepared, 4=prepared, 3=somewhat prepared, 2=not very prepared, 1=not at all prepared) for the same tasks for newly hired/recently promoted laboratory managers under their supervision.

Prior to data analysis, investigators categorized tasks as education and training, finance, HR, quality, regulatory, and other duties and equipment acquisition/validation. Excel was used for initial mean determination. An ANOVA (SAS version 9.4) determined the statistical significance between the educational groups for self-reported preparedness to perform the tasks ($p = <0.05$). For overall statistically significant p-values, pairwise comparisons were made among the educational groups using Turkey's adjustment for multiple comparisons. A two-tailed t-test (SAS version 9.4) determined the statistical difference between managers'/directors expected and perceived preparedness of newly hired/recently promoted managers to perform the 30 tasks ($p = <0.05$).

RESULTS

Response Rate

The acceptable, comprehensive survey total response rate was 242 (3% overall response rate); acceptable surveys were finished in their entirety. Fifty-three respondents identified as a certified, supervisor/lead MLS (i.e., spends >50% of their time directly supervising other employees, with the primary function of assisting the clinical laboratory director/manager/section manager with day-to-day laboratory operations). One hundred twenty-three respondents identified as a director/manager (i.e., oversees all the clinical laboratory/a laboratory section's operational aspects). The remaining 66 respondents were the focus of the staff-level survey.¹¹

Demographics

The two survey respondent subsets (supervisor/lead, director/manager) represented males and females, living in rural and urban communities, with one to >30 years of experience. Respondents held a wide range of professional certifications, worked in various laboratory settings, and their education level ranged from associate to doctorate degree (Table 1).

Managerial Tasks

The survey asked managers/directors about expected and perceived preparedness of newly hired/recently promoted managers to perform managerial tasks (refer to Methods Section for respondent choices). For all task categories, managers'/directors' perceived preparedness of newly hired/recently promoted managers was lower than expected preparedness. The gap in the mean for all tasks was statistically significant ($p = <0.05$). Hence, newly hired/recently promoted managers are not meeting administrative expectations (Figures 1 and 2).

The survey asked managers/directors and supervisors/leads how well they felt their

education prepared them to perform managerial tasks when they started their first managerial position. Investigators sorted and analyzed by job category (i.e., managers/directors and supervisors/leads) and level/category of education (i.e., BS in CLS; BA/BS other/non-CLS bachelor's degree; MS in CLS/other master's degree [non-business]; Master's in business/management). Level/category of education data was not further separated nor analyzed by job category. Associate and doctorate-level participants were excluded from analysis given very low respondent numbers and because degree specifics were not captured.

Education and Training Tasks

For the four education and training tasks, one-third to half of respondents in both categories felt at least not very well prepared to develop continuing education (CE) material. For the \ tasks train laboratory and non-laboratory staff, one-third to half of both categories of respondents felt at least very well prepared to perform these tasks. When asked if they could present CE material, one-third to half of managers/directors felt at least very well prepared to perform this task. Comparing the education levels/categories, respondents with a master's in business/management felt the most prepared to perform these tasks. See Table 2.

Finance

Half or more of both respondent categories felt at least not very well prepared to perform the four finance tasks (negotiate contracts, perform cost analyses, determine productivity, and prepare budgets). Comparing the education levels/categories, respondents with a Master's in Business/Management felt the most prepared to perform these tasks. See Table 2.

Human Resources

Half or more of both categories of respondents felt at least not very well prepared to perform the six HR tasks (interview applicants, hire employees, write job descriptions, evaluate

employee performance, build employee consensus, and resolve conflict). Comparing the education levels/categories, respondents with a Master's in Business/Management felt the most prepared to perform these tasks. See Table 2.

Quality

Of the five quality tasks, one-third to half of supervisors/leads felt at least not very well prepared to investigate standard operating procedure (SOP)/policy deviations. In contrast, one-third to half of managers/directors felt at least very well prepared to perform this task. For the task of monitoring quality via quality indicators (benchmarking), one-third to half of both categories of respondents felt at least very well prepared to perform this task. For the remaining tasks (perform a SWOT analysis; analyze/monitor test utilization; and oversee process improvement), half or more respondents from both categories felt at least not very well prepared to perform these tasks. Comparing the education levels/categories, respondents with a master's in business/Management felt the most prepared to perform these tasks. See Table 2.

Regulatory

Of the six regulatory tasks, one-third to half of supervisors/leads felt at least not very well prepared to revise/write policies/procedures. In contrast, one-third to half of managers/directors felt at least very well prepared to perform this task. For the tasks of preparing for laboratory inspection/assessment and ensuring regulatory compliance, one-third to half of both categories of respondents felt at least not very well prepared to perform these tasks. For the remaining tasks (develop competency assessment materials, facilitate competency assessments, and develop/oversee document management), half or more respondents from both categories felt at least not

very well prepared to perform these tasks. Comparing the education levels/categories, respondents with a Master's in Business/Management felt the most prepared to perform all regulatory tasks. See Table 2.

Equipment Acquisition/Validation and Other Duties

Equipment acquisition/validation tasks include selecting/acquiring equipment and performing equipment/method validation. Results showed that one-third to half of supervisors/leads and half or more of the managers/directors felt at least not very well prepared to select/acquire equipment and one-third to half of both categories of respondents felt at least not very well prepared to perform this task. Comparing the education levels/categories, respondents with a Master's in Business/Management felt the most prepared to perform both equipment acquisition/validation tasks. See Table 2.

Other duties include interdisciplinary team participation, managing projects and maintaining/validating Laboratory Information Systems (LIS). For the task interdisciplinary team participation, one-third to half of both categories of respondents felt at least not very well prepared to perform this task. For the remaining tasks (manage projects and maintain/validate LISs), half or more of both categories of respondents felt at least not very well prepared to perform either task. Comparing the education levels/categories, respondents with a Master's in Business/Management felt the most prepared to perform all three tasks. See Table 2.

DISCUSSION

Initial Curriculum Development Considerations

When compared to the three other educational levels/categories, the master's in business/Management respondents self-reported being better prepared to perform ($p = <0.05$)

finance, quality improvement/assurance and other administrative duty tasks. In addition, managers/directors perceived preparedness of newly hired/recently promoted managers to perform all tasks was lower ($p = <0.05$) than their expected preparedness. Therefore, newly hired/recently promoted managers are not meeting administrative expectations. As such, the 30-credit MMLS program of study will include 15 hours of MLS program cross-listed courses (See Table 3); nine, online graduate credits offered by the Business and Technology College at a sister institution; and six elective administration/education- focused graduate credits.

Education and Training Tasks

Self-reported lack of preparedness of respondents to develop CE material indicates this topic should be included in the MMLS curriculum. The gap in the mean between managers/directors expected and perceived preparedness for this task further supports inclusion of this topic. Preparedness data indicates respondents felt adequately prepared to train laboratory and non-laboratory staff; hence, the MMLS curriculum does not need to emphasize these tasks. Exclusion of these tasks is, however, debatable because the gap in the mean between managers/directors expected and perceived preparedness is statistically significant. Lastly, self-reported preparedness data indicates managers/directors felt adequately prepared to present CE material; however, supervisors/leads data indicates inclusion of this task could be beneficial. The gap in the mean between managers/directors expected and perceived preparedness for this task further supports inclusion of this topic.

Based on the survey results, MMLS students should be exposed to the development and presentation of CE materials. These two topics will be included in the program's level-II theory courses. Students will develop a poster, a narrated PowerPoint presentation, and a case study with assessment questions. Because the BS-level curriculum already covers how to train staff,

this topic will not be included in the MMLS curriculum. Ideally, students would develop an educational plan to train an individual at their clinical site. Unfortunately, given program time constraints and distance education logistical issues, inclusion is not feasible.

Finance Tasks

Self-reported respondent preparedness to perform all four finance tasks and the gap in the mean between managers/directors expected and perceived preparedness indicate these topics should be included in the MMLS curriculum.

MMLS students will be required to complete a healthcare finance course offered through the College of Business and Technology at a sister campus. Covered topics include financial literacy, accounting and finance basics, financial diagnosis and problem solving, and financial operations/budgeting.

Human Resources Tasks

Self-reported preparedness of respondents to perform all six HR tasks and the gap in the mean between managers/directors expected and perceived preparedness both indicate that these topics should be included in the MMLS curriculum. Therefore, MMLS students will be required to complete a healthcare management course that focuses on managing people; a sister campus currently offers this course. Covered topics include leadership, ethics, staffing, teamwork, communication, and performance management.

Quality Tasks

Regarding performing a SWOT analysis, analyzing/monitoring test utilization, and overseeing process improvement, survey results and the gap in the mean between managers/directors expected and perceived preparedness for these tasks indicate that these topics should be included in the MMLS curriculum. The self-reported preparedness data also indicates that respondents felt

adequately prepared to monitor quality via quality indicators. Although the curriculum does not need to emphasize this task, exclusion of this task is, debatable because the gap in the mean between managers/directors expected and perceived preparedness for this task is statistically significant. Similarly, inclusion of topics that describe how to investigate SOP/policy deviations in the curriculum could be beneficial even though the self-reported preparedness data indicates managers/directors felt adequately prepared to perform this task.

Based on the data analysis, MMLS students will be required to complete a healthcare management course that focuses on managing processes that is offered through a sister campus. Covered topics include health services trends, healthcare operations strategy, problem solving and decision making, quality management, process improvement and patient flow. Topics on scheduling and capacity management, supply chain management, health informatics, and improving financial performance with operations management will also be included.

Regulatory Tasks

Management topics that would prepare managers/supervisors to perform regulatory tasks such as how to prepare for laboratory inspection/assessment, ensure regulatory compliance, develop competency assessment materials, facilitate competency assessments, and develop/oversee document management should be included in the MMLS curriculum based on the survey results. The self-reported preparedness data also indicates that managers/directors felt adequately prepared to revise or write policies/procedures; however, supervisors/leads data indicates inclusion of this topic could be beneficial.

At present, faculty are hesitant to include competency assessment material development for compliance purposes and facilitation of competency assessment in the MMLS curriculum because of program time constraints and curriculum focus. However, data analysis shows that

MMLS students should be exposed to the development of competency assessment materials, facilitation of competency assessment, development/oversight of document management, laboratory inspection/assessment preparation, and regulations compliance. The MMLS curriculum will cover development/oversight in the previously mentioned healthcare management course that focuses on managing processes. In addition, the BS-level curriculum currently covers regulatory compliance and revising/writing policies/procedures; the MMLS level curriculum will be supplemented with topics that cover how writing laboratory procedures. The MMLS-level Management II curriculum will also cover laboratory inspection/assessment preparation.

Equipment Acquisition/Validation Tasks

Both the gap in the mean between managers/directors expected and perceived preparedness and self-reported preparedness by respondents indicate that selecting/acquiring equipment and performing equipment/method validation are topics that should be included in the MMLS curriculum.

Currently, BS-level curriculum introduces these concepts and students complete a mock method evaluation; therefore, additional instruction/assessment over these topics will not be included in the MMLS curriculum at this time.

Other Duties Tasks

Participation in interdisciplinary teams is one of the other tasks wherein data indicates that this topic should be included in the MMLS curriculum.

Whereas BS-level students are not formally taught about interdisciplinary team participation, they do participate in interprofessional (i.e., pharmacy, nursing, medicine, other allied health professions) education sessions. Additionally, MMLS students will learn to

develop the skill of working in teams in the required healthcare management course that focuses on managing people. The required healthcare management course that focuses on managing processes will expose MMLS students to project management. Because LIS is facility-specific and a task that is considered beyond the scope of practice of an entry-level MMLS graduate, topic on LIS maintenance/validation will not be included in the MMLS curriculum.

Proposed MMLS Curriculum

The proposed Master's-level curriculum includes 15 undergraduate/graduate cross-listed MLS program credits and 15 graduate credits outside of the MLS program. For cross-listed courses, MMLS students will complete additional project-based/application assignments in addition to BS-level requirements. Application projects include a poster development/presentation, case study paper, review of research article or other faculty approved projects (i.e., develop e-learning module, virtual microscopy). After completion of the NAACCL approved curriculum that includes graduate-level, cross-listed courses, learners are eligible for certification. Learners can complete the remaining online, 15 graduate credits on a full or part-time basis (See Table 3).

LIMITATIONS

The MLS Program who performed this study is using this data as one resource for development of an MMLS program. The discussion does not include consideration for 2+2 MMLS Programs nor stand-alone MMLS programs. Also, respondents' geographic location is not included. In addition, the highest level of education attained of newly hired/recently promoted managers is not known.

FUTURE RESEARCH

For graduate management curriculum development, a need exists to determine the frequency of managers' task performance. Lastly, at the national level, researchers recommend exploring the standardization of management-related terminology and content to help guide MLS educators in curriculum development at both a BS and MMLS-level.

REFERENCES:

1. Occupational outlook handbook, medical and clinical laboratory technologists and technicians [Internet]. Washington, DC: US Bureau of Labor Statistics; 2015 Dec 17. Available from: <http://www.bls.gov/ooh/healthcare/medical-and-clinical-laboratory-technologists-and-technicians.htm#tab-6>. Accessed October 21, 2016.
2. Garcia E, Ali AM, Soles RM, Lewis DG. The American society for clinical pathology's 2014 vacancy survey of medical laboratories in the United States. *Am J Clin Pathol* 2015;144(3):432-43. doi: 10.1309/AJCPN7G0MXMSTXCD.
3. Bennett A, Garcia E, Schulze M, Bailey M, Doyle K, Finn W, et al. Building a laboratory workforce to meet the future: ASCP Task Force on the Laboratory Professionals Workforce. *Am J Clin Pathol*. 2014 Feb;141(2):154-67.
4. Garcia E, Fisher PB. The American Society for Clinical Pathology's 2015 Wage Survey of Medical Laboratories in the United States. *Am J Clin Pathol*. 2017 Apr 1;147(4):334-56.
5. Lenhoff, A. Empowering laboratory leaders to achieve excellence [interview]. *Medical Laboratory Observer*. 2017;49(9):44.
6. NAACLS standards for accredited and approved programs. Rosemont (IL): National Accrediting Agency for Clinical Laboratory Sciences; June 2016. Unique standards for Medical Laboratory Science Part VIII p. 14-15. MLS Curriculum Requirements. Accessed online 10/20/2014 at <http://www.naacls.org/getattachment/07662c8d-38ee-449a-a90f-9a7e8e8f5479/2012-Standards-Edited.aspx>.
7. Medical laboratory scientist, MLS(ASCP) international medical laboratory scientist, MLS(ASCPⁱ) examination content guideline. Chicago (IL): American Society for Clinical Pathology Board of Certification; Sept 2014.; 4 p. Accessed online 10/20/2016 at

https://www.ascp.org/content/docs/pdf/boc-pdfs/guidelines/examinationcontentguidelinemls.pdf?sfvrsn=6_

8. Diplomate in Laboratory Management, DLM(ASCP) examination content guideline. Chicago (IL): American Society for Clinical Pathology Board of Certification; Aug 2016.; 2 p.
Accessed online 5/4/2018 at https://www.ascp.org/content/docs/default-source/boc-pdfs/boc-us-guidelines/dlm_content_guideline.pdf?sfvrsn=4
9. Riding K, Polancic, J., editors. ASCLS entry level curriculum for medical laboratory scientist (MLS) and medical laboratory technician (MLT) draft. McLean (VA): The American Society for Clinical Laboratory Science; 2016.
Administration/Management/Consultant MLS Entry Level; 10 p. Accessed online 10/20/2016 at [http://www.ascls.org/images/Leadership/delegates/House of Delegates 2016/HOD Action ELCProposed 20160730.pdf](http://www.ascls.org/images/Leadership/delegates/House_of_Delegates_2016/HOD_Action_ELCProposed_20160730.pdf).
10. Beck SJ, Briden MF, Epner PL. Practice levels and educational needs for clinical laboratory personnel. Clin Lab Sci 2008; 21(2):68-77.
11. Bishop S, Honeycutt K. Medical laboratory science undergraduate management curriculum development using practitioner reported job tasks. Clin Lab Sci in press.

Figure 1: Managers/Directors Mean Expected and Perceived Preparedness of Newly Hired/Recently Promoted Managers to Perform Managerial Tasks

Figure 1 Legend

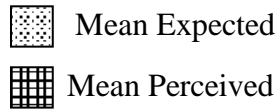


Figure 2: Managers/Directors Mean Expected and Perceived Preparedness of Newly Hired/Recently Promoted Managers to Perform Quality, Regulatory, Other Duties, and Equipment Acquisition/Validation Tasks

Figure 2 Legend

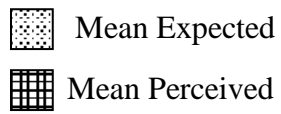


Table 1: Demographics

		Supervisors/Leads	Directors/Managers
Gender	Male	15%	31%
	Female	85%	69%
Community	Rural (<50,000 people)	27%	33%
	Urban (>50,000 people)	73%	67%
Years of Experience	0-<1	0%	0%
	1-2	2%	0%
	3-5	6%	2%
	6-10	13%	2%
	11-15	7%	5%
	16-30	32%	28%
	>30	40%	63%
Highest Level of Education	Associate's degree	6%	3%
	Bachelor's degree	81% *	69% **
	Master's degree	13%	25%
	Doctorate degree	0%	3%
Professional Certifications Held	MLT(ASCP) or CLT(NCA)	9%	3%
	MT/MLS(ASCP) + MLT(ASCP) or CLT(NCA)	2%	4%
	MT/MLS(ASCP), MT(AMT) or CLS(NCA)	61%	67%
	2 or more – MT/MLS(ASCP), MT(AMT), and CLS(NCA)	9%	3%
	2 or more – MT/MLS(ASCP), MT(AMT), and CLS(NCA) and ASCP specialist (SBB, SC, SH, or SM)	17%	16%
	CQA(ASQ) or CQIA(ASQ)	2%	1%
	DLM(ASCP)	0%	1%
	Board Certified Pathologist	0%	2%
	Not Certified	0%	3%
Laboratory Setting Employed in the Longest	Physician's office	0%	7%
	Hospital	81%	64%
	Hospital and reference	11%	4%
	Reference	2%	21%
	Other	6%	4%

*77% of these individuals earned their bachelor degree in CLS

** 80% of these individuals earned their bachelor degree in CLS

Table 2: Self-Reported Mean Preparedness to Perform Managerial Tasks Based on Education Level/Category

	Education and Training				Finance Tasks				Human Resource Tasks						Quality Tasks					Regulatory Tasks						Other Duties and Equipment Acquisition/Validation			
	Train laboratory staff																												
	Train non-laboratory staff																												
	Develop continuing education material																												
	Present continuing education material																												
BS in CLS	Negotiate vendor contracts																												
	Perform a cost analysis																												
	Prepare a laboratory or department budget																												
	Determine productivity																												
BA/BS Other	Interview applicants																												
	Hire new employees																												
	Write job descriptions																												
	Evaluate employee performance																												
MS in CLS + Non-business master's degree	Build employee consensus																												
	Resolve conflict																												
	Monitor quality via quality indicators																												
	Plan, measure, and evaluate process improvement projects																												
Master's in Business/ Management	Investigate standard operating procedure/policy deviations																												
	Analyze/monitor test utilization																												
	Perform a SWOT analysis																												
	Develop competency assessment materials																												
	Facilitate/oversee competency assessment																												
	Prepare for/participate in laboratory inspection/assessment																												
	Revise or write policies and procedures																												
	Develop/oversee document management/control system																												
	Ensure compliance of regulations/standards																												
	Recommend, select, and/or acquire equipment																												
	Perform/participate in equipment/method validation																												
	Participate in interdisciplinary teams																												
	Maintain/validate the laboratory information system (LIS)																												

Table 3: Proposed MMLS Curriculum – Draft Student Independent Study Plan

Completion of MLS Program = 28 undergraduate hours and 15 graduate hours

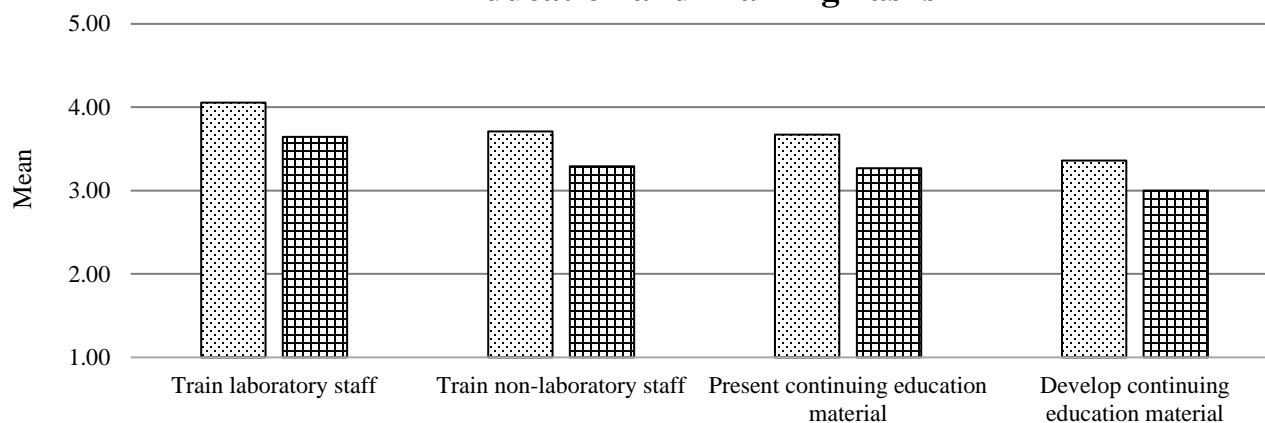
Course/Level	Credit(s)	Semester/ Year	Example Graduate Application Project (s)
Laboratory Operations (U)	1	Summer/1	N/A
Introduction to Chemistry/Urinalysis (U)	1	Summer/1	N/A
Introduction to Hematology (U)	2	Summer/1	N/A
Introduction to Immunohematology (U)	2	Summer/1	N/A
Introduction to Microbiology (U)	2	Fall/1	N/A
Clinical Chemistry/Urinalysis I (U)	2	Fall/1	N/A
Clinical Hematology I (U)	2	Fall/1	N/A
Clinical Microbiology I (U)	2	Fall/1	N/A
Clinical Immunohematology I (U)	2	Fall/1	N/A
Clinical Endocrinology & Toxicology (U)	1	Fall/1	N/A
Clinical Core Lab Practicum I (U)	1	Fall/1	N/A
Clinical Microbiology Practicum I (U)	1	Fall/1	N/A
Clinical Immunohematology Practicum I (U)	1	Fall/1	N/A
Clinical Immunology & Molecular Diagnostics (G)	2	Fall/1	Research paper w/molecular diagnostics focus
Clinical Lab Management I (G)	2	Fall/1	Case study paper w/ethics focus
Clinical Chemistry/Urinalysis II (G)	2	Spring/1	Poster project w/clinical chemistry focus
Clinical Hematology II (G)	2	Spring/1	Case study paper w/hematology focus
Clinical Microbiology II (G)	2	Spring/1	Educational e-learning module development w/microbiology focus
Clinical Immunohematology II (G)	2	Spring/1	Evaluate immunohematology focused research paper
Clinical Core Lab Practicum II (U)	1	Spring/1	N/A
Clinical Microbiology Practicum II (U)	1	Spring/1	N/A
Clinical Immunohematology Practicum II (U)	1	Spring/1	N/A
Clinical Lab Management II (G)	3	Spring/1	Write a clinical laboratory procedure
Clinical Lab Science Theory, Application, and Correlation (U)	5	Spring/1	N/A

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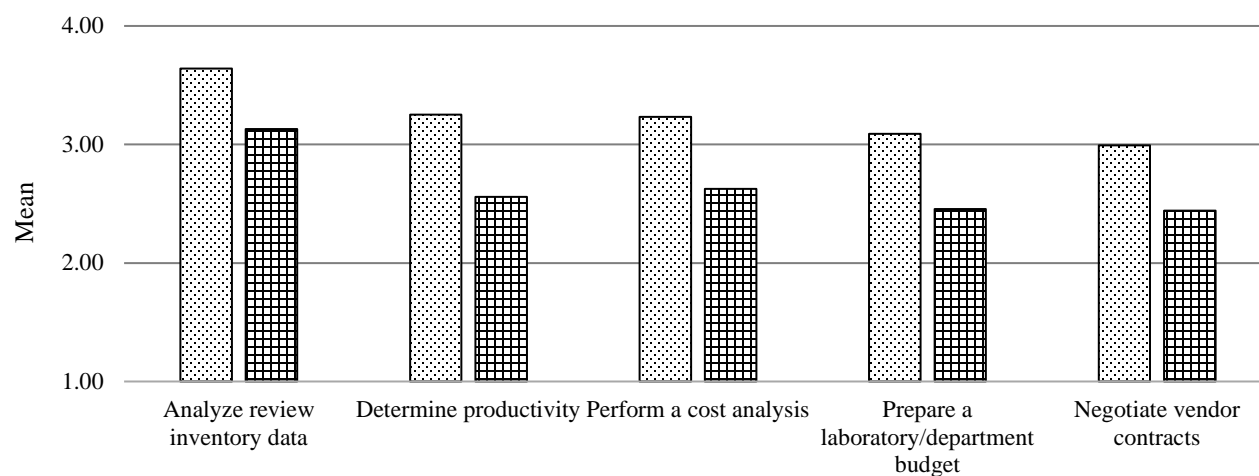
Required Graduate Courses Not Part of MLS Program

Graduate Course	Credit Hour(s)	Semester/ Year	Example Graduate Application Project (s)
Health Care Management I: Managing People Effectively	3	Fall/2	Semester project related to the clinical laboratory
Fundamentals of Funds Management and Financial Decision-Making	3	Fall/2	Semester project related to the clinical laboratory
Health Care Management II: Managing Processes	3	Spring/2	Semester project related to the clinical laboratory
Elective (e.g., management or education)	3	Spring/2	
Elective (e.g., management or education)	2	Spring or Fall/2	

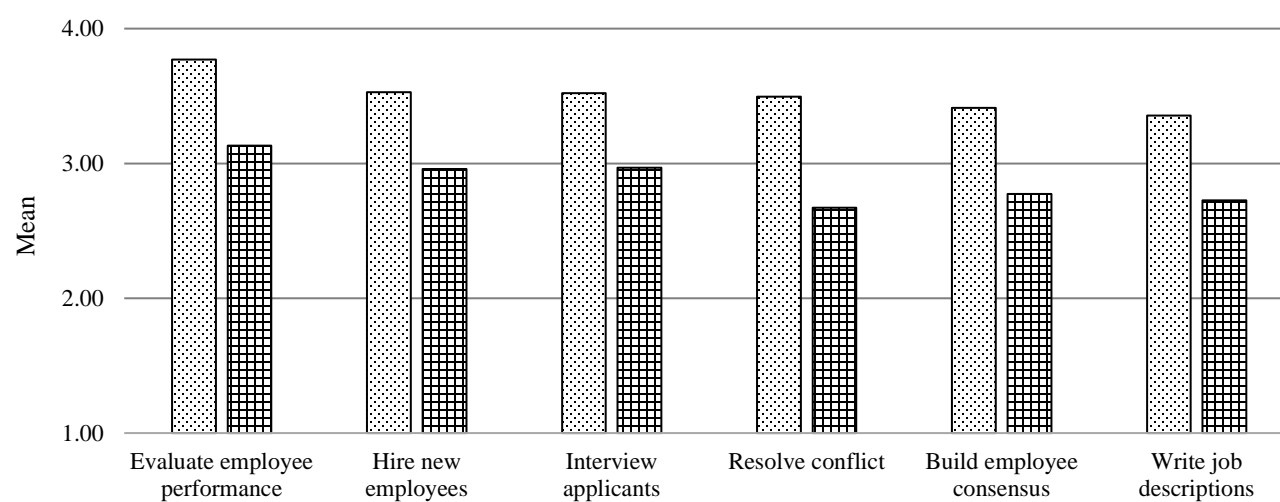
Education and Training Tasks



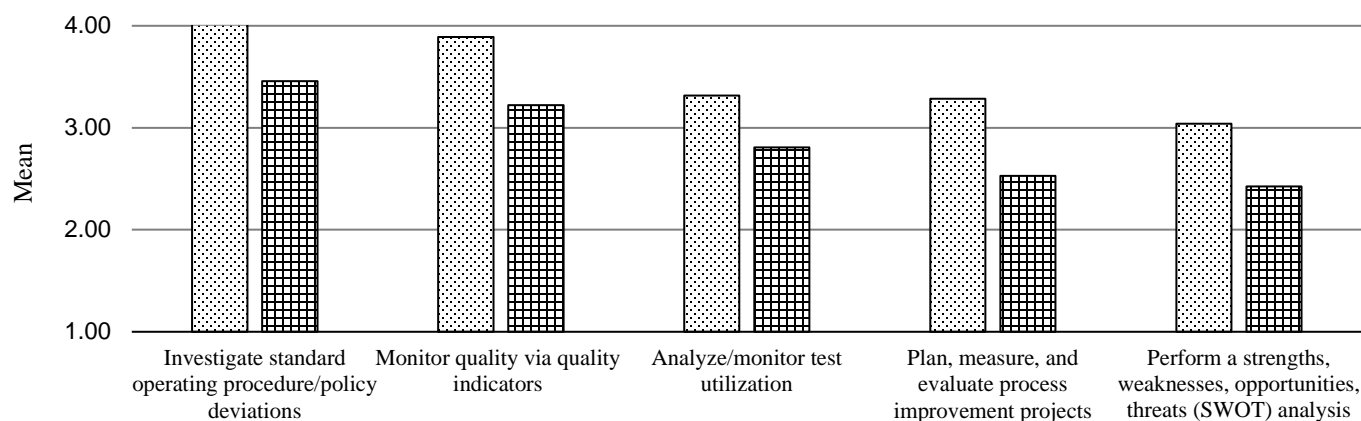
Finance Tasks



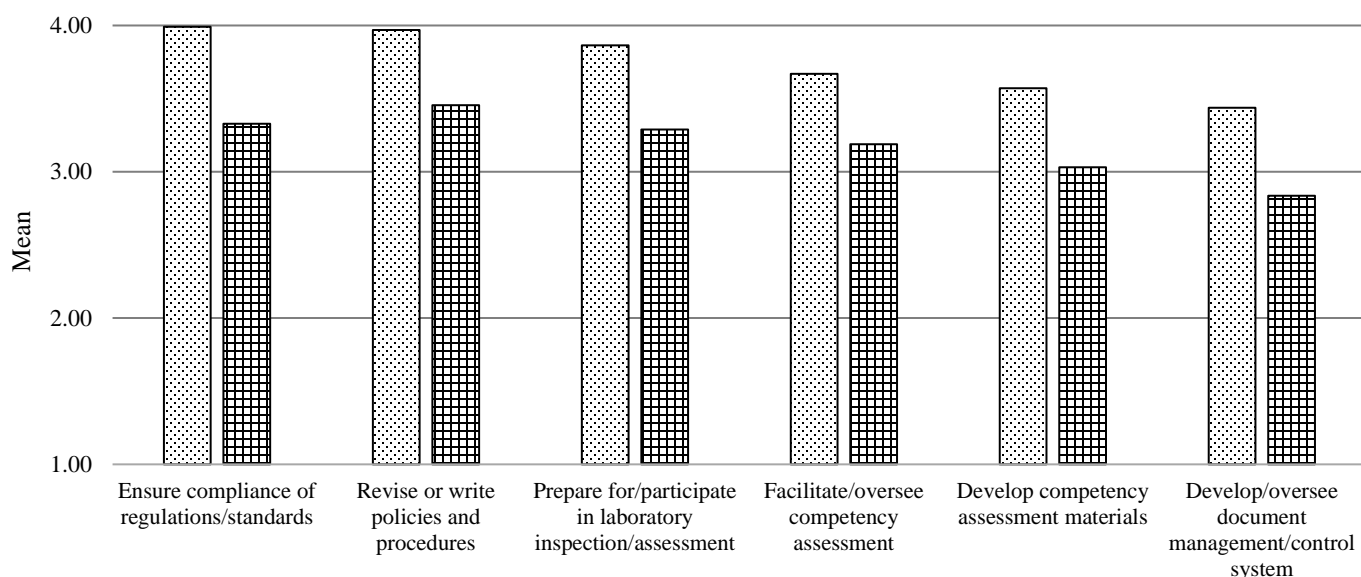
Human Resource Tasks



Quality Tasks



Regulatory Tasks



Other Duties and Equipment Acquisition/Validation

