Learning and Utilization of Generic Skills by Practitioners in the Field of Clinical Laboratory Science/Medical Technology

H JESSE GUILES, KORY WARD-COOK

OBJECTIVE: To determine whether and to what extent generic skills that are learned by practitioners are used on their clinical laboratory science/medical technologist (CLS/MT) jobs; and to determine if there are any significant differences in learning and/or using these skills by practitioners who were CLS/MT vs. Other BA/BS degree majors.

DESIGN: In the field (ITF) laboratory practitioners were surveyed as to whether or not they: 1) were CLS/MT program graduates; 2) utilized the following generic skills in their jobs: analytical reasoning, communication, computer use, data correlation, decision making, precision studies, problem solving, quality assessment, supervision, teaching, technical writing, troubleshooting, research and utilization review; 3) learned these skills as students or practitioners.

SETTINGS AND PARTICIPANTS: Data were collected from 515 CLS/MT ITF participants who were part of an ongoing longitudinal study.

MAIN OUTCOME MEASURES: Participants were asked if they were CLS/MT program graduates; whether they used the skills frequently, sometimes, rarely or never; and whether they initially learned the skills as students or developed them on the job (OTJ). Chi square analyses were performed to test for differences among groups.

RESULTS: The response rate was 44%. Frequencies for using the skills were generally over 90% with three exceptions reported as rarely or never used by the majority of the respondents, and two exceptions reported as being approximately equally used or not used by the respondents. A sizable minority (23% to 45%) of the sample reported never learning six of the skills. Significant ($p < 0.05$) chi square results occurred between learning and utilizing the following skills: computer use, participation in research, problem solving, supervision, technical writing and utilization studies. Although a consistently higher proportion of the CLS/MT graduates reported learning the skills as students and Other BA/BS graduates reported learning them OTJ, no significant differences between these sub-groups were observed for either learning or using these skills.

CONCLUSION: For this sample group, most generic skills learned as CLS/MT students and/or practitioners are applied to the ITF jobs and are generally congruent with what is being taught in CLS/MT programs. However, there are some notable exceptions.

ABBREVIATIONS: ASCP BOR = American Society of Clinical Pathology Board of Registry; BA/BS = Bachelor of Arts/Bachelor of Science; CLS = clinical laboratory scientist; CLS/MT graduate = practitioners graduating from a NAACLS approved program; LTF = left the field; MT = medical technologist; NAACLS = National Accrediting Agency for Clinical Laboratory Sciences; Other BA/BS graduate = practitioners graduating from other than a NAACLS approved program; OTJ = on the job.

INDEX TERMS: ASCP BOR; CLS/MT career patterns; CLS skills; education.

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The ability to learn and apply generic skills such as: analytical reasoning, communication skills, computer use, data correlation, decision making, participation in research, precision studies, problem solving, quality assessment, supervision, teaching, technical writing, troubleshooting, and utilization studies is often considered the apogee of competent CLS/MT program graduates and practitioners. In 2002, Guiles and Tatum looked at the acquisition and utilization of these skills by a cohort of MTS/CLS who reported that they had left the field (LTF).[1] Participants self-reported whether they were graduates of National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) Accredited programs (NAACLS BS) or held other baccalaureate degrees (Other BS/BA). No significant differences were found in the utilization of these skills by these groups in the LTF jobs, however, significant differences were found in how the groups learned the skills. The NAACLS BS graduates reported a significantly higher proportion of learning many of the skills as students than did the Other BS/BA graduates. It was proposed that these same skills be examined for CLS/MT graduates who remained in the field (ITF). The following research questions were proposed for the study: 1.) To what extent are the generic skills used ITF? 2.) To what extent is there congruency between learning and using these skills (if they are learned, are they used)? 3.) Is there a significant difference in the perception of how NAACLS BS vs. Other BS/BA graduates use the skills? 4.) Is there a significant difference in the perception of how NAACLS BS vs. Other BS/BA graduates learned the skills, e.g., either as a student or on the job (OTJ)?

Table 1. Survey and chi square classifications for using and learning generic skills

Survey responses: using the skills	**Reclassified for chi square analysis**
Frequently = once/day Sometimes = once/week	Frequently/Sometimes
Rarely = once/month Never = Never	Rarely/Never
Survey responses: learning	**Reclassified for chi square analysis**
A = Learned as an MT student	A = Initially learned as a student
B = Developed as MT	B = Developed OTJ
C = Learned as student and developed as MT	C = Combined with A
D = Never learned	D = Never learned

MATERIALS AND METHODS

Data were collected from a nationwide sample of 515 laboratory practitioners (44% response rate). Individuals in the sample group were participating in a ten year longitudinal study on career patterns of MTS by the ASCP BOR Research and Development Committee. At the time of the study, participants were in the field approximately seven years post certification. Because eligibility for the certifying exam can be obtained by several routes, the data were broken down into NAACLS BS graduates (n = 464, 90%) and Other BS/BA graduates (n = 51, 10%).

Questions were asked in terms of whether the skills were utilized frequently = at least once a day, sometimes = at least once a week but not every day, rarely = at least once a month but not every week, or never. Data were self-reported. For statistical analyses, the data were reclassified into two categories: "Frequently/Sometimes" and "Rarely/Never" (Table 1). The responses for learning the skills were as follows: A = "Learned as a MT/CLS student", B = "Developed while working as an MT/CLS", C = "Learned as an MT/CLS student and developed while working as an MT/CLS", D = "Neither learned as a student, nor developed as an MT/CLS". Before statistical analyses, choices A and C were regrouped to "Initially Learned as a Student", whereas B was renamed to "Developed OTJ" (Table 1).

The responses were analyzed in terms of the frequencies of ways in which the skills were learned and how much they were used. Three major chi-square analyses were performed: 1) CLS/MTS

learning the skills vs. using the skills in their current, ITF jobs. 2) Being a NAACLS or Other BS/BA major vs. using the skills in the ITF jobs and 3) Being a NAACLS or Other BS/BA major vs. initially learning the skills as a student or OTJ. Statistical analyses were done using the *JMP* (*SAS* Institute, Cary NC) statistical program. Significance between groups was defined as ($p \leq 0.05$) for each generic skill.

RESULTS

Various demographic characteristics of the sample are presented in Table 2. Of the 429 participants answering the questions regarding job titles, 70% (299) reported they were staff technologists, 13% (n = 55) managers, five percent (n = 23) supervisors and 12% (n = 52) held "other" job titles. The frequencies for using the generic skills in the CLS/MT ITF jobs are shown in Figure 1. Most of the skills were reported as being utilized frequently or sometimes by approximately 90% or more of the respondents. However, participation in research, technical writing, and utilization studies were reported as being used rarely or never by the majority of the respondents. Furthermore, supervision and teaching were almost as likely to be used or not used by the respondents.

The frequencies for learning the skills as a student or OTJ for the entire sample group are depicted in Table 3. Learning the skills initially as a student generally showed higher percentages, with some exceptions: supervision, teaching and technical writing had higher or equal reported frequencies for being developed OTJ as opposed to being initially learned as a student. A sizable percentage (≥ 25%) of graduates coming from both NAACLS BS and Other BS/BA programs reported

Table 2. Demographic characteristics of sample group

Characteristic	n	%	Characteristic	n	%
Gender			**Institution type**		
Female	410	80	small <100 beds	65	15
Male	101	20	medium 100-300 beds	137	32
Total reporting	511	100	large > 300 beds	116	27
			Independent lab	49	11
Job titles			POL	25	6
Staff	299	70	Academic	5	1
Managers	55	13	Industry	9	2
Supervisors	23	5	Other	23	5
Other	52	12	Total reporting	429	99
Total reporting	429	100			
Location			**Years experience**		
Urban	185	43	1-5	73	15
Suburban	155	36	6-10	368	74
Rural	91	21	11-15	36	7
Total reporting	431	100	16-20	14	3
			> 20	8	1
			Total reporting	499	100
Shift			**Schedule**		
Days	263	62	Full time	328	76
Evenings	78	18	Part time	90	21
Nights	59	14	Other	13	3
Rotating	25	6	Total reporting	431	100
Total reporting	425	100			

never learning research, teaching, technical writing, utilization studies and supervision.

Table 4 presents the frequencies of learning the skills according to type of degree. The frequencies for learning the skills as students were consistently higher for NAACLS BS graduates than Other BS/BA graduates. Conversely, the frequencies for developing the skills OTJ were consistently higher for the Other BS/BA graduates than NAACLS BS graduates. Note that in this dichotomy, the frequencies for never learning certain skills are consistent with that of the overall sample (Table 2) for both NAACLS BS and Other BS/BA graduates.

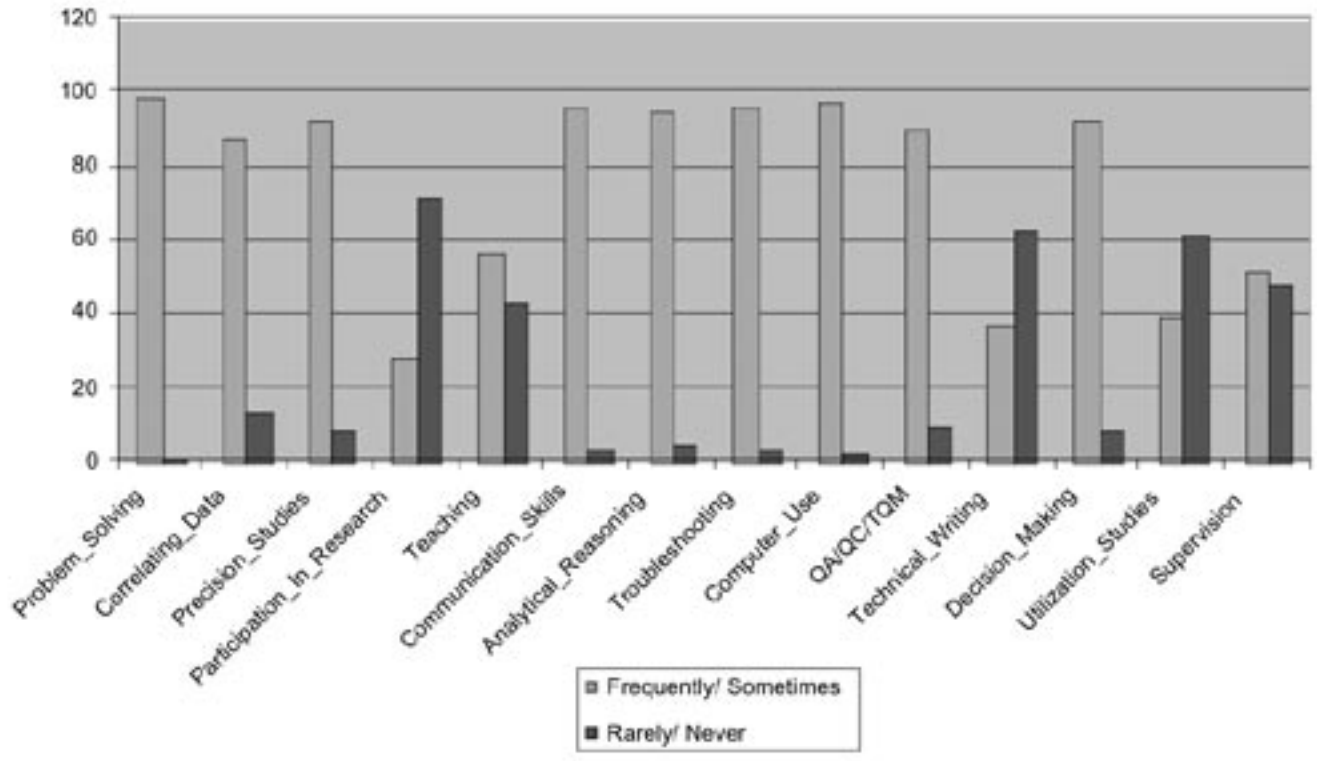
With the exception of learning computer skills ($\chi 2 = 8.060$ $p = 0.0178$), chi square analyses showed no significant differences between NAACLS BS vs. Other BS/BA graduates in either using or learning the generic skills. However, when comparing learning vs. using the skills for the entire sample group, several significant differences were observed (Table 5).

DISCUSSION

The study is a short encapsulation regarding the perception of the utilization and learning of certain generic skills by CLS/MT professionals in their eighth year of practice post certification. These type of skills rank high in the hierarchy of learning and application by MT/CLS educators and employers alike,[2-9] and are embedded in the competencies for CLS/MTs as described in the new NAACLS "Standards of Accredited Educational Programs for the Clinical laboratory Scientist/Medical Technologist".[10] Results, however, did not totally parallel those reported in a previous study of MTS/CLS who had LTF.[1]

In an attempt to answer the research questions proposed for the study, several observations regarding the results were made: A sizable proportion of participants said they never used and/or learned some of the generic skills. Participation in research, for example was seldom or never used by 73% of the sample group, and never learned by 43% of the group. Other skills that were reported by the sample group as seldom used or

Figure 1. Frequency (%) of generic skill use in CLS/MT jobs



never learned were technical writing (63% not used, 26% never learned) and utilization studies (e.g., creating / following critical pathway algorithms for testing) (61% not used, and 34% never learned). It should be noted that all of the participants in the study had been in the field for at least seven years and those qualifying to take the certification exam by the experience route were in the field at least three additional years. Furthermore, the group was heterogeneous in terms of job titles consisting of bench technologists, supervisors, and managers. The lack of use of these skills in current job roles appears to be in contrast to future roles of baccalaureate level laboratory practitioners envisioned by NAACLS. On the other hand, the majority of the generic skills: problem solving, data correlation, precision studies, decision making, communication skills, analytical reasoning, troubleshooting, computer use and quality assessment, were frequently/ sometimes used by 85 percent to 99 percent of the participants.

No significant differences were observed regarding the use of these skills ITF between NAACLS BS vs. Other BS/BA graduates. This seems sensible inasmuch as the job responsibilities requiring the use of these skills should be the same for everyone. On the other hand, there was a distinct pattern of responses seen in learning the skills (Table 4). The NAACLS BS graduates consistently reported a higher frequency for initially learning the skills as students whereas the Other BS/BA graduates consistently reported a higher frequency for developing the skills OTJ. These findings should be gratifying for CLS/MT educators whose curricula embed these competencies, and to employers who want to minimize OTJ training time. The differences in frequencies between NAACLS BS and Other BS/BA graduates for all the skills evidently were not enough to make them significant (with the exception of Computer skills). These results are in contrast to the LTF study results. [1] In that study, there were several significant differences observed in learning the skills between NAACLS BS and the Other BS/BA groups. Like this study, the LTF study found NAACLS BS graduates consistently reporting a higher percent of learning the skills as students. There, however, the comparison was based upon the skills learned by NAACS BS and Other BS/BA CLS/MT practitioners who were going into other fields, so a distinct division could be made between what the participants perceived they learned at their new jobs vs. what they learned before they left the MT/CLS field. In the present study all practitioners remained ITF and thus learned the skills ITF. Therefore, there may not be as clear a demarcation to the participants regarding where they initially learned the skills.

Several significant chi square analyses were found when comparing using vs. learning the skills for the overall sample data (Table 5). The phi coefficients indicated a weak to moderate strength of the relationship for those variables that were significant (0.2054 - 0.4277). Skills with low frequencies for use ITF showed significant differences between learning vs. using the skills. It is logical to speculate that the significance could have occurred because these skills were learned but not used. The lack of opportunities to use these types of generic skills ITF reflects a common complaint of MT/CLS educators and graduates alike. In fact, the lack of opportunities for using generic, as opposed to

Table 3. Frequency (%) of learning skills reported by total sample group

Generic skill	Learned first as student	Developed OTJ	Never learned
Analytical reasoning	69	20	11
Communication skills	45	32	23
Computer use	43	40	17
Correlating data	58	27	5
Decision making	45	39	16
Participation in research	35	20	45
Precision studies	73	23	4
Problem solving	55	33	12
QA/QC/TQM	78	20	2
Supervision	18	38	34
Teaching	25	48	27
Technical writing	37	37	26
Troubleshooting	55	40	6
Utilization studies	36	30	34

technical, skills may be more prohibitive to MT/CLS career advancement and sense of self-actualization ITF.

On the other hand, it is not logical to speculate that significance occurred because skills that were never learned were being used. One exception to that logic may be computer skills. This may also help to explain the significance seen for computer skills between NAACLS BS program graduates and Other BS/BA graduates. During the 1990s, the personal computer revolution took hold. It is believed that CLS/MT programs recognized this early on and saw a relationship between abilities on personal computers and the transfer of such skills to laboratory / instrument computer systems. Thus requirements for computer use were quickly established in MT/CLS curricula in the early 1990s. Other BS/BA programs may not have had such an immediate need to incorporate computer skills in their curricula. However, these Other BS/BA graduates still had to adapt to the laboratory / instrumentation computers they found OTJ. Thus they may have perceived that they used their computer skills before they learned them.

The findings of the study have implications for both educators and employers. It appears that most of these skills are appropriately placed inside of MT/CLS curricula, as they do appear to be part of the professional role of current CLS/MT practitioners. On the other hand, some skills may be overemphasized in today's CLS/MT BS curricula (e.g. research, supervision, utilization studies) in relation to job responsibilities. This is in contrast to the findings of the LTF study where virtually all of the skills were reported as being used in the non-laboratory jobs. If the "best and brightest" are leaving the field, it may be that they see this lack of opportunity for self- actualization ITF, and feel they can achieve it by leaving. MT/CLS employers have an opportunity to stop this drain of practitioners by providing mechanisms for their employees to use the skills they possess, and rewarding their MT/CLS employees accordingly. Such provisions could include establishing a system of job levels / career mobility (with appropriate remuneration) that recognizes expertise, education, and performance. Otherwise, these practitioners will apply the skills they learned ITF, to jobs outside the field that do provide such opportunities.

Table 4. Frequency (%) of learning generic skills by major

Generic skill	Learned first as a student		Developed OTJ		Never learned	
	NAACLS BS	Other BA/BS	NAACLS BS	Other BA/BS	NAACLS BS	Other BA/BS
Analytical reasoning	69	65	20	27	11	8
Communication skills	47	33	31	45	22	22
Computer use	46	20	38	62	16	18
Correlating data	67	67	27	30	6	3
Decision making	48	30	36	52	16	18
Participation in research	35	31	21	25	44	44
Precision studies	73	64	23	33	4	3
Problem solving	57	36	31	54	12	10
QA/QC/TQM	70	69	28	31	2	0
Supervision	18	14	48	53	34	33
Teaching	26	15	48	52	26	33
Technical writing	38	34	36	41	26	25
Troubleshooting	55	47	39	47	6	6
Utilization studies	36	32	29	43	35	25

The three categories (i.e., Learned first as a student, Developed OTJ, and Never learned) add up to 100% in both the NAACLS BS group and the Other BA/BS group.

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Table 5. Chi square results – learning vs. using skills in CLS/MT jobs for total sample group

Generic skill	Chi square	Probability?	Phi co-efficient
Analytical reasoning	0.279	0.8697	0.0528
Communication skills	4.379	0.1120	0.2092
Computer use	15.534	<0.001*	0.3941
Correlating data	0.727	0.6951	0.085
Decision making	0.592	0.7439	0.0769
Participation in research	15.593	<0.001*	0.3949
Precision studies	2.054	0.3581	0.1433
Problem solving	1.465	0.4807	0.0544
QA/QC/TQM	0.427	0.8079	0.0653
Supervision	11.835	0.0027*	0.3440
Teaching	20.633	<0.001*	0.2054
Technical writing	7.967	0.0186*	0.2822
Troubleshooting	3.302	0.1919	0.1817
Utilization studies	18.292	<0.001*	0.4277

Phi coefficient is an indicator of the strength of the relationship of significant differences between the variables.

*Significant Difference ($p < 0.05$)

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