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Incorporating Computational Thinking into Library Graduate Course Goals and Objectives

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Abstract

As young people increasingly need computer science (CS) and other related STEM (Science, Technology, Engineering, Math) skills, libraries have been identified as spaces in which this learning can occur. However, librarians often perceive they lack the skills or confidence required to lead this type of education. As a result, funding sources, professional organizations, and researchers are examining the ways computational thinking (CT) can be better incorporated into graduate-level library science curriculum. Six graduate-level faculty members teaching courses related to school and public library youth services were selected as part of a larger research project. They redesigned their courses to incorporate CT concepts. In this study, we examined how CT concepts were incorporated into the syllabi objectives, how these concepts influenced the course objectives from previous iterations of these courses, and how various accreditation and state requirements influenced the development of course objectives.

The findings can inform course development of graduate-level library science curriculum. The findings also document the ways existing standards align with the developing need for computational thinking, computer science, and STEM learning within the curriculum.

Introduction

Computational thinking (CT) has been defined as "an underlying set of skills foundational to computer science (CS) though also transferable to broader applications…[including] the ability to ask and answer questions using procedural thinking; the ability to define, model, and solve complex and ill-defined problems; and the ability to create personal meaning by processing information and creating connections to transform data into understanding" (Braun and Visser 2017). A wide range of government, professional, and corporate entities have identified CT as an essential skill for today's youth. The importance of incorporating opportunities for youth to explore and learn "Ready to Code" principles in formal and informal learning spaces has also been recognized as important (Braun and Visser 2017; Smith 2016; Sykora 2014). These opportunities provide young people with familiarity with CT and a foundation that will best prepare students to learn the CS and other STEM (Science, Technology, Engineering, Math) skills required by K–12 standards (Yadav, Hong, and Stephenson 2016). School and public libraries provide a natural space for youth to develop CT skills because historically librarians have facilitated lifelong and informal learning. The American Library Association (ALA), however, found that while current librarians can and do provide rich learning opportunities for youth, librarians often perceive themselves as lacking the skills or confidence necessary to incorporate CT into their programming and curricula (Braun and Visser 2017). As a result, Phase II of ALA's Ready to Code (RtC) initiative was charged with studying how coding and CT concepts can be better incorporated into the library science graduate curriculum (Hines 2017).

Using work completed through the RtC Phase II project, this study addresses the following research questions:

1. How can Ready to Code long-term and short-term goals be incorporated in course objectives in graduate-level courses about providing school and public library youth services?
2. How does the inclusion of CT long-term and short-term goals change the course objectives in graduate-level school and public library youth services courses?
3. How do state standards and/or accreditation requirements influence the ability of educators to include CT long-term and short-term goals in graduate-level school and public library youth services courses?

This study's findings provide insight into revision and development of both curriculum and standards and, thus, shape the future practices of school and public librarians. Graduate-level faculty are critical stakeholders and can contribute to librarians' practice through examining the goals and objectives in current curriculum available to library school students in courses about providing school and public library youth services. The course goals and objectives explored through RtC Phase II reflect the diverse ways CT concepts can be incorporated into courses about school and public library youth services.

Literature Review

Introduction

This literature review includes definitions of CT, benefits of students' learning CT, their access to learning CT, and examines past research on two aspects of this study: 1) CT and STEM in Library and Information Science (LIS) education, and 2) accreditation and state standards impacting LIS curriculum.

CT Definitions

Multiple definitions for CT exist, each with its own subtle nuances, and the intricacies of the definitions depend upon who is writing the definition as well as the audience for which it is intended. Jeannette M. Wing (2010), Valerie Barr and Chris Stephenson (2011), the International Society for Technology in Education and the Computer Science Teachers Association (2011), Google for Education (n.d.), the Center for Innovative Research in CyberLearning (Basu, Mustafara, and Rich 2016), Linda Braun and Marijke Visser (2017) plus others have explored CT in the context of K–12 education and have written definitions specific to that environment. Commonalities among these definitions include:

- CT's being a systematic problem-solving process grounded in CS but transferable to general education,
- its relevance to college and career readiness, and
- its applicability to everyday life issues.

Despite the variances, this study focuses on Braun and Visser's (2017) definition because it was developed based on the results of Phase I of ALA's RtC initiative, the predecessor of the initiative from which this study arises. Braun and Visser (2017) expanded upon this definition, developing long-term and short-term goals that have been incorporated into activities by the Phase II faculty for their students. Long-term goals include:

1. Libraries expose youth to CT through coding. (Exposure)
2. Libraries influence perceptions of who codes. (Perceptions)
3. Librarians facilitate CS+X (computer science incorporated across the curriculum and connected to youth interests). (CS+X)
4. Youth have access to CT wherever they learn. (Access)

Short-term goals for LIS students include:

1. Developing skills to facilitate CT and CS learning. (Facilitation)
2. Understanding the how and why of community engagement. (Community Engagement)
3. Understanding the how and why of connected learning. (Connected Learning)
4. Understanding the how and why of design thinking. (Design Thinking)[1]
5. Establishing clear learning outcomes. (Outcomes)
6. Including youth in design. (Youth Voice)

Through an environmental scan of current school and public library youth services programs, focus groups, individual interviews, and site visits, researchers in Phase I assessed the landscape of skills and activities librarians typically employ in designing and implementing rich learning experiences for their young patrons. Building on the working definition of CT, the RtC initial work compared core librarian skills and values (for example, facilitating learning in informal

[1] According to IDEO (2018), design thinking is a process for creative problem solving with phases of gathering inspiration, generating ideas, making ideas tangible, and sharing and reflecting on the process.

environments, designing responsive learning opportunities, and providing equitable access to resources and technology) to assumptions about the contributions libraries could make in CS education. The core skills and values were gathered from a variety of American Library Association standards and documents, including:

- the ALA's Core Values (ALA 2004),
- the Young Adult Library Services Association's Core Competencies (YALSA 2010) and project report on the future of library services for and with teens (Braun et al. 2014),
- the Association for Library Service to Children's Competencies for Librarians Serving Children in Public Libraries (ALSC 2015), and
- the American Association of School Librarian's *Empowering Learners: Guidelines for School Library Programs* (2009).

These assumptions are contained in the RtC long-term goals list. The comparison of core skills and values of librarians with assumptions about libraries' possible contributions to CT education provides insight into the need for librarians serving young people to have skills they might not have now—or perceive they don't have now—and for those skills to be tailored to fostering CT skills among youth. The modified skills required for RtC are described in the RtC short-term goals list.

The current emphasis on CT in K–12 could be attributed to a resurgence in CS education programs in schools after a decline in CD education during the latter part of the first decade in the twenty-first century (Partovi 2014). The number of initiatives specific to CT implementation in K–12 curriculum is rising (Grover and Pea 2013) at a time that multiple academic and technology entities have been preparing curriculum and/or educating teachers on how to incorporate CT into their curriculum. Examples of such entities are the College Board; the National Academies of Science, Engineering, and Medicine's Computer Science and Telecommunications Board; the National Science Foundation; Microsoft Research; and Google (Wing 2010).

Benefits of Students' Learning CT Skills

Benefits of promoting CT skill development in our youth are numerous. Mastering these skills prepares young people for future careers in the CS sector and other STEM fields (Grover and Pea 2013; Braun and Visser 2017). Jobs in mathematics and computing are projected to flourish in the next decade and include positions that have not yet been created (Visser and Hong 2016). As of 2017, "71% of all new STEM jobs are in computing, 8% of STEM grads are in computer science, 67% of computing jobs are outside the tech sector, [and there are over] 500,000 unfilled computer jobs across the nation" (Braun and Visser 2017, 2). According to Code.org (2017), at the time of this writing, there were "493,270 open computing jobs nationwide," but "only 42,969 computer science students graduated into the workforce."

CT skill mastery can help young people develop and refine problem-solving skills and critical-thinking skills, particularly in other curricular areas (Bundy 2007; National Research Council 2010; Wing 2010; Grover and Pea 2013; Calao et al. 2015). CT skill mastery also promotes creativity over consumption (Mishra and Yadav 2013). Components of CT, such as algorithm design, transfer to solving everyday life problems such as cooking or teeth brushing (Yadav, Stephenson, and Hong 2017). Additionally, CT extends the recent focus on the makerspace and do-it-yourself movements (Grover and Pea 2013).

K–12 Students' Access to CS Education

Despite the recent resurgence in the recognition of the importance of CS education in schools, many students still lack access. According to a recent report by Google and Gallup "more than one-third of U.S. students in grades seven to 12 do not have access to a dedicated computer science class at school…[and] overall, approximately 25 percent of seventh- to 12th-grade students report having no access to a computer science class or club at school" (2015, 9). A follow-up study revealed only 40 percent of schools provide courses addressing computer programming in some capacity (Google and Gallup 2016). Even when K–12 schools do provide CS courses, this availability does not guarantee that students will elect to take those courses offered. Some states are beginning to make a CS course a graduation requirement, but this requirement is not yet universal (Stanton et al. 2017).

Both school and public libraries are uniquely positioned to supplement existing and nonexistent curriculum because librarians have opportunities to circumvent traditional stringent curricula and develop innovative programming geared toward preparing today's youth for tomorrow's career options (Bertot, Sarin, and Percell 2015; Braun and Visser 2017). John Carlo Bertot, Lindsay C. Sarin, and Johnna Percell identified libraries as optimal educational environments in general "by connecting individuals to appropriate resources, connecting their interests and values to formal learning opportunities, and developing social connections to peers with similar interests, which can promote further exploration" (2015, 10).

Libraries provide free robust Internet access, device access, technology training, and customized programming for all, thereby potentially decreasing the gender and racial disparities found in the STEM workforce (Visser and Hong 2016; Braun and Visser 2017). To effectively address current gaps in access and exposure to CS education and address the perceptions of youth, parents, and educators about who can and should pursue CS, librarians must be familiar with and able to provide programming that enables youth to develop CT skills.

CT in the Context of LIS Education

Many librarians express uncertainty about their skills with respect to CT (Braun and Visser 2017). The literature lacks a thorough exploration of the degree to which librarians are familiar with CS or CT. Practitioner literature has addressed related topics of LIS education in makerspaces (Bowler 2014), design thinking (Bell 2014), and connected learning (Braun et al. 2014). LIS literature has also contained calls to increase the focus on these and other technology skills in library education (Bertot, Sarin, and Percell 2015; Braun and Visser 2017) because CT can be taught within the context of a wide range of disciplines beyond CS (Calao et al. 2015). The degree to which librarians are familiar with CS or CT remains a fruitful area of research.

Accreditation and State Standards' Impact on LIS Curriculum

LIS education programs differ by state and library type. The American Library Association (ALA) offers accreditation for Masters of Library Science (MLS) and Masters of Library and Information Studies (MLIS) programs (ALA Committee on Accreditation 2015). Depending on the state, school librarians may be required to earn certification through educator preparation programs and/or by successfully completing standardized certification exams. Additionally, some school library certification programs receive accreditation through the Council for the Accreditation of Educator Preparation.

Standards vary by program and library type, too, as general LIS programs may use national standards, including those developed by the American Association of School Librarians (AASL), while school library certification programs may use AASL's National Standards or the state education agency's standards. Additionally, some programs (e.g., McDaniel College's AASL/NCATE-accredited M.S. in School Librarianship) encourage students to take courses that emphasize related education standards, such as those developed by the International Society for Technology in Education (ISTE). Accreditations and standards serve as the foundation on which courses are developed and student mastery is assessed.

Methods

Research Questions

This study asks how short-term and long-term goals developed as part of the American Library Association's Ready to Code (RtC) initiative can be incorporated in course objectives in graduate-level courses intended to prepare librarians for serving youth in school and public libraries. The research also focuses on:

- how the inclusion of CT long-term and short-term goals changes the course objectives in graduate-level courses relating to school and public library youth services, and
- how state standards and/or accreditation requirements influence the ability of educators to include CT long-term and short-term goals in graduate-level courses for school and public librarians.

The findings can help guide LIS educators and professional organizations to develop methods of incorporating CT into existing curricula.

Participants

To answer these research questions, this paper examines six courses created by LIS faculty participants in the RtC Phase II project. The courses were taught from April to December 2017. The study was led by researchers from the University of Maryland and ALA. The six participants are tenured or tenure-track professors in universities located in five different states. The universities offer either a graduate degree in library science or a study track for school librarians. To be selected, faculty had to be full-time and had to commit to attending an ALA workshop in summer 2017. Additionally, to participate in this study, each faculty member had to teach the course in the fall of 2017. Each participant was also required to submit a letter of support from his or her program's dean or director indicating:

- that widely sharing the redesigned syllabus with other LIS schools was acceptable,
- that the faculty member would be supported by the institution, and
- how the dean or director would work to guarantee that the course would be taught more than once.

Research Process

As part of the RtC project, participants met both in person and online to develop or redesign graduate-level courses incorporating CT.

This paper uses artifacts from the RtC project, including original and redesigned syllabi and participants' reflection journals to study:

- how participants embedded CT concepts into their course objectives,
- the changes between the original and redesigned syllabi course objectives, and
- how the various state and accreditation standards impacted the changes in the course objectives.

In addition to general reflections, for the purposes of this paper the participants responded to two discussion prompts:

1) Make a specific reflection about how we formed our student learning objectives, course objectives, and course goals.
2) What are the requirements each of us has from our university/state/accreditation board for these objectives?

For this study faculty submitted their original syllabi for review by the other participants. Prior to teaching their courses in the fall, the participants discussed CT in the context of LIS education. Based on these discussions and feedback received from other participants, each participant made changes to the objectives and/or the course content before fall.

Data Analysis

To analyze the data, we used directed content analysis. Directed content analysis allows researchers to build upon existing related research by providing a "code book" of pre-existing codes and definitions (Hsieh and Shannon 2005). CT long-term and short-term goals served as this code book.

As a group, we identified CT long-term and short-term goals present in the revised course objectives (Braun and Visser 2017). Objectives not categorized into the pre-existing codes were eliminated from the data set, as some courses were required to address content beyond the scope of CT and this study. Additionally, the course objectives from the original and redesigned syllabi were compared. The reflections were used as sources of data to answer the questions about course requirements and why the course objectives were revised or were not.

In their Understanding by Design framework, Grant P. Wiggins and Jay McTighe described backwards course design as "[starting] with the end—the desired results (goals or standards)—and then [deriving] the curriculum from the evidence of learning (performances) called for by the standard and the teaching needed to equip students to perform" (1998, 8). Course objectives assist with this type of course design by guiding the structure of the syllabus and assisting the instructor in determining the most-relevant types of assignments to create. This study uses the course goals and objectives as proxies for the course content on CT.

Findings

Research Question 1

How can Ready to Code short-term and long-term goals be incorporated in course objectives in graduate-level courses about providing school and public library youth services?

Introduction

To identify how the Ready to Code short-term and long-term goals were incorporated into course goals and objectives, we compiled the syllabus objectives from each of the six reworked courses included in the RtC Phase II project. These objectives were then coded according to the RtC long-term goals (1. exposure, 2. perceptions, 3. CS+X, and 4. access) and short-term goals (1. facilitation, 2. community engagement, 3. connected learning, 4. design thinking, 5. outcomes, and 6. youth voice).

Objectives Related to RtC Long-Term Goals

Twenty unique course objectives were identified relevant to the long-term goals. These were further organized into four distinct thematic groups with one objective that fell into several groups. These groups are: STEM learning, multimedia resources for learning, promoting additional learning opportunities, and emerging learning trends or initiatives. One additional objective relates to modeling professional collaboration and could apply to each of the previously described themes. The following list shows these categories and objectives, along with the long-term goal(s) correlated with each objective, identified numerically in parentheses next to each objective. Table 1 depicts each of the long-term goals with the corresponding course objectives (theme and list number).

I. STEM learning (SL) course objectives

SL Objective 1. Articulate the importance of STEM learning for youth (LT Goals 1, 2, 3, 4)

SL Objective 2. Connect with a librarian or teacher and discuss current STEM initiatives (LT Goals 1, 2, 3, 4)

SL Objective 3. Identify potential user disparities in STEM and discuss ways to mitigate these gaps (LT Goals 1, 2, 3, 4)

SL Objective 4. Demonstrate basic concepts of coding and computational thinking (LT Goal 1)

SL Objective 5. Create and/or design appropriate space or program plans for STEM learning in a library setting (LT Goal 4)

SL Objective 6. Discuss issues and trends relative to STEM programs for youth in the library (LT Goal 3)

SL Objective 7. Identify tools and resources designed to increase STEM content knowledge and connect the tools to the concept of computational thinking (LT Goal 4)

SL Objective 8. Implement computational concepts into an interactive story (LT Goal 3)

II. Multimedia resources for learning (MR) course objectives

MR Objective 1. Integrate electronic materials into libraries (LT Goals 1, 4)

MR Objective 2. Demonstrate digital tools and applications that support the teaching and learning of recent literary works, including contemporary authors' and illustrators' web-based resources (LT Goal 3)

MR Objective 3. Identify digital and web-based materials available in various subject fields (LT Goal 3)

MR Objective 4. Integrate electronic materials into libraries (LT Goals 1, 4)

MR Objective 5. Apply multimedia concepts in solving practical problems for information services (LT Goals 1, 4)

III. Promoting additional learning opportunities (LO) course objectives

LO Objective 1. Choose appropriate multimedia production tools to design and create effective media for diverse sets of users (LT Goals 3, 4)

LO Objective 2. Adapt teaching strategies to accommodate the diverse learning needs of the student population (LT Goals 2, 4)

LO Objective 3. Provide and promote ongoing learning opportunities for students, particularly in the areas of integration of information technology and information literacy (LT Goals 1, 3, 4)

LO Objective 4. Promote access to resources and information during and beyond the instructional day and school year (LT Goals 1, 4)

IV. Emerging learning trends (ET) course objectives

ET Objective 1. Participate in state and national technology initiatives (LT Goals 1, 2, 3, 4)

ET Objective 2. Evaluate and select existing and emerging technologies in support of the library program (LT Goals 1, 4)

V. Modelling collaboration (MC) course objective

MC Objective 1. Model and promote collaborative planning, cooperative teaching, and direct instruction as determined by learners' needs and state curriculum standards (LT Goal 3)

Table 1. RtC long-term goals with corresponding course objectives.

LT Goal #1 Exposure	**LT Goal #2 Perceptions**	**LT Goal #3 CS+X**	**LT Goal #4 Access**
STEM learning Objectives 1, 2 ,3, 4	STEM learning Objectives 1, 2, 3	STEM learning Objectives 1, 2, 3, 6, 8	STEM learning Objectives 1, 2, 3, 5, 7
Multimedia resources for learning Objectives 1, 4, 5		Multimedia resources for learning Objectives 2, 3	Multimedia resources for learning Objectives 1, 4, 5
Promoting additional learning opportunities Objectives 3, 4	Promoting additional learning opportunities Objective 2	Promoting additional learning opportunities Objectives 1, 3	Promoting additional learning opportunities Objectives1, 2, 3, 4
Emerging learning trends Objectives 1, 2	Emerging learning trends Objective1	Emerging learning trends Objective 1	Emerging learning trends Objectives1, 2
		Modeling collaboration Objective 1	

Trends Revealed

From the analysis of the unique course objectives, two interesting trends emerged:

1) The long-term goal of perception, "Libraries influence perceptions of who codes," was half as likely to be represented in the six courses' objectives than were the other three long-term goals.
2) When one long-term goal was applicable to an objective, it was likely that at least one—if not two—other long-term goals were also applicable.

There are two possible reasons for these patterns. The first trend, the lack of objectives falling under the goal of influencing perceptions, is likely a result of the specificity of that particular goal. While three of the four long-term goals focus on CT or general STEM concepts (CS+X), coding was not often named in the individual course objectives. It is unclear from the course objectives whether this lack is because the faculty engaged in a broader approach to teaching these concepts or because they did not include coding specifically in the course content.

The second trend observed, long-term goals often appearing together, is likely because one goal is somewhat difficult to achieve without the others. Achieving access and exposing students to CT or general STEM concepts are natural allies.

Objectives Related to RtC Short-Term Goals

Twenty-nine unique course objectives were identified relevant to RtC short-term goals. As with the long-term goals, these objectives were further categorized into thematic groups. For short-term goals the same five thematic categories used for long-term goals were used, but with one addition: general learning objectives. The following list shows these categories and objectives. For ease of reading, the number of the short-term goal(s) with which each objective correlated is also included beside the objective. This information is depicted graphically in table 2.

I. STEM learning (SL) course objectives

SL Objective 1. Articulate the importance of STEM learning for youth (ST Goal 6)

SL Objective 2. Identify potential user disparities in STEM and discuss ways to mitigate these gaps (ST Goal 1)

SL Objective 3. Demonstrate basic concepts of coding and computational thinking (ST Goal 1)

SL Objective 4. Create and/or design appropriate space or program plans for STEM learning in a library setting (ST Goals 1, 3, 4, 6)

SL Objective 5. Discuss issues and trends relative to STEM programs for youth in the library (ST Goals 1, 5)

SL Objective 6. Identify tools and resources designed to increase STEM content knowledge and connect the tools to the concept of computational thinking (ST Goal 1)

SL Objective 7. Identify the various state and national standards for science, technology, engineering, and mathematics in K–12 schools (ST Goals 1, 5)

SL Objective 8. Name a variety of STEM topics appropriate for various age groups and learning levels (ST Goal 5)

SL Objective 9. Evaluate the success of a STEM space or program (ST Goal 5)

II. Multimedia resources for learning (MR) course objectives

MR Objective 1. Demonstrate digital tools and applications that support the teaching and learning of recent literary works, including contemporary authors' and illustrators' web-based resources (ST Goal 1)

MR Objective 2. Identify digital and web-based materials available in various subject fields (ST Goal 1)

MR Objective 3. Make effective decisions related to electronic materials for children and young adults (ST Goal 1)

MR Objective 4. Evaluate and select electronic resources in specific categories (ST Goal 1)

MR Objective 5. Examine new and digital forms of instructional media, including projected and recorded materials (ST Goal 1)

MR Objective 6. Analyze instruction and organize digital materials for effective teaching (ST Goal 1)

MR Objective 7. Design and develop digital resources to support specific content delivery and encourage student engagement with the curriculum, and assess its impact on student learning (ST Goals 5, 6)

III. Promoting additional learning opportunities (LO) course objectives

LO Objective 1. Choose appropriate multimedia production tools to design and create effective media for diverse sets of users (ST Goal 1)

LO Objective 2. Adapt teaching strategies to accommodate the diverse learning needs of the student population (ST Goals 1, 3)

IV. Emerging learning trends (ET) course objectives

ET Objective 1. Participate in state and national technology initiatives (ST Goal 5)

ET Objective 2. Evaluate and select existing and emergent technologies in support of the library program (ST Goal 1)

ET Objective 3. Describe "new literacies" and discuss how to incorporate the concepts into a library space or program (ST Goals 1, 3, 4, 6)

V. Modelling collaboration (MC) course objective

MC Objective 1. Model and promote collaborative planning, cooperative teaching, and direct instruction as determined by learners' needs and state curriculum standards (ST Goals 1, 3, 4)

VI. General learning (GL) course objectives

GL Objective 1. Create programming plans and other materials to promote learning (ST Goal 1)

GL Objective 2. Employ existing and emerging technologies to access, evaluate, and disseminate information for possible application to instructional programs (ST Goals 1, 5)

GL Objective 3. To bridge theory and practice through active dialogue between theoretical perspectives from class readings and practical work at service sites (ST Goal 1)

GL Objective 4. To gain a multidisciplinary understanding of the philosophies, resources, and technologies that support youth services (ages 0–18) in both library and non-library settings including: youth development, youth advocacy, and empowerment (ST Goals 1, 6)

GL Objective 5. To develop an awareness of power dynamics between collaborating institutions and community groups serving youth and their stakeholders (ST Goals 2, 4)

GL Objective 6. To gain strategies and skills for successfully navigating tensions, conflicts, and negotiations in developing collaborations between libraries and community groups (ST Goals 2, 4, 6)

GL Objective 7. To become proficient at navigating multiple roles that youth leaders must take as caring adults, from setting expectations to encouraging enthusiastic participation (ST Goal 4, 6)

Table 2. RtC short-term goals with corresponding course objectives.

ST Goal #1 Facilitation	**ST Goal #2 Community Engagement**	**ST Goal #3 Connected Learning**	**ST Goal #4 Design Thinking**	**ST Goal #5 Learning Outcomes**	**ST Goal #6 Youth Voice**
STEM learning Objectives 2, 3, 4, 5, 6, 7		STEM learning Objective 4	STEM learning Objective 4	STEM learning Objectives 5, 7, 8, 9	STEM learning Objectives 1, 4
Multimedia resources for learning Objectives 1, 2, 3, 4, 5, 6				Multimedia resources for learning Objective 7	Multimedia resources for learning Objective 7
Promoting additional learning opportunities Objectives 1, 2		Promoting additional learning opportunities Objective 2			
Emerging learning trends Objectives 2, 3		Emerging learning trends Objective 3	Emerging learning trends Objective 3	Emerging learning trends Objective 1	Emerging learning trends Objective 3
Modeling collaboration Objective 1		Modeling collaboration Objective 1	Modeling collaboration Objective 1		
General learning Objectives 1, 2, 3, 4	General learning Objectives 5, 6		General learning Objectives 5, 6, 7	General learning Objective 2	General learning Objectives 4, 6, 7

Trends Revealed

ST Goal 1, “Developing skills to facilitate CT and CS learning,” was by far the most represented among the course objectives. This finding makes sense; many of the courses focus on educational aspects of youth librarianship, and facilitating learning is a recognizable part of this focus. More surprising was the breadth of the skills to facilitate learning implied by the objectives. These included, but were not limited to, formal and informal education strategies, ways of developing lessons and programming, and skills in conducting assessments of user needs.

The least represented short-term goal was ST Goal 2, "Understanding the how and why of community engagement." The reason for this low representation is unclear. Perhaps the faculty implicitly include communities in content and, therefore, did not feel that communities had to be explicitly mentioned in the objectives. Another possible explanation is that, although communities are included in content, mentioning communities in the course objective is not considered essential. Increasing content on community engagement may possibly be an area for improvement in these courses.

Overall, the analysis of the different objectives in the courses selected by the faculty for redesign in the context of the Ready to Code long-term and short-term goals points to the broad ways objectives can be written while still achieving individual course goals.

Research Questions 2 and 3

How does the inclusion of computational thinking long-term and short-term goals change the course objectives in graduate-level school and public library youth services courses?

How do state standards and/or accreditation requirements influence the ability of educators to include computational thinking long-term and short-term goals in graduate-level school library and public library youth services courses?

Drawing from both the course syllabi and the faculty reflections, we found that the objectives in the old and new iterations of these courses did not differ significantly. Table 3 represents the different courses and indicates whether the objectives changed. The table also contains basic information on each course (title, new or revised, state, and type of degree program).

Table 3. Course details and revisions of objectives.

Course Title	New or Revised Course	State/Degree[2]	Course Objectives: Revised/Not Revised/New Course (No Revision)
Electronic Resources for Youth	Revised	Georgia Master of Library and Information Science	Revised
Multimedia Resources and Services	Revised	Texas Master of Library Science with School Library Certification	Not Revised (Due to course restrictions; see explanation in paragraph below)

[2] In many cases, these schools have additional programs in school media or youth services, such as specializations, course tracks, and other types of certificates and degrees. We have listed the one most relevant to the topic of this paper.

Digital Resources for Teaching and Learning	Revised	Georgia Master of Education in School Library Media	Not Revised (Due to course restrictions; see explanation in paragraph below)
STEM and Youth Learning in the Library	New	Florida Master of Library and Information Science	New Course (No Revision)
Design and Production of Multimedia	Revised	New York Masters in Library and Information Studies with School Library Certification	Not Revised
Youth Services Community Engagement	Revised	Illinois MS in Library and Information Science	Revised

Depending on the course, the lack of changes occurred because: 1) faculty did not have the ability to change the course objectives because of university, state, or accreditation requirements; 2) the course was newly developed with objectives intentionally addressing CT and coding; or 3) course objectives were broad enough in the previous iteration and, thus, could be interpreted through the CT and coding lens without revisions.

Two objectives were added to courses: "Demonstrate basic concepts of coding and computational thinking" and "To identify and understand exemplary approaches to supporting youth, including services and programs."

One objective was broadened from "create pathfinders, webquests and other materials to facilitate access and promote learning" to "create programming plans and other materials to promote learning."

Two objectives were eliminated entirely: "Develop, manage, and organize electronic materials collections" and "Develop plans for addressing technology needs and acquiring funds."

The school program requirements and formats of the six courses differed greatly. For example, one of the courses was an MLIS elective developed specifically for the RtC project. Three courses are core school library or MLIS courses meeting requirements of either the university or the state's accreditation body. The faculty member who developed the elective course noted that, because it is an elective, she was granted significant freedom, but that "if I decide to make the course permanent, I'll need to submit the course for approval by the graduate school (and, ultimately, the state)." Another professor teaching an existing course without requirements imposed by the university or other entities also noted that she might have additional limitations in the future if she decides to incorporate the course into an existing school library certification program.

A professor of a core course noted her objectives "were formed for [her]," aligned with the state board requirements for school library certification, and that the process for revising course goals was lengthy and unable to be accomplished within the study's time frame. She also noted "they are not…true SLO's, as they are standards that must be addressed and not goals that must be assessed." Another professor noted she was challenged to work within an existing course description and objectives "because to change either is a long process." She did note that "the interpretation of these objectives and the teaching of them is at the discretion of the instructor."

Our analysis of faculty reflections revealed that the degree to which the course had to be aligned with state standards significantly impacted a participant's decision to modify or retain existing course expectations or objectives. This finding points to a limitation of the study; it is difficult to compare the objectives of courses that have different institutional requirements. However, this finding also reveals a potential way that professional organizations should encourage faculty to incorporate computational thinking into LIS courses: by focusing on CT goals that could be achieved in various ways. The diversity of LIS curriculum development indicates that professional organizations' developing one rigid set of core standards for CT in graduate-level courses is unlikely to be effective. However, this study demonstrated that faculty teaching courses with different requirements and focuses could have different objectives that still aligned with a core set of long-term and short-term goals related to CT.

Discussion and Conclusion

As the participants' reflections related to the third research question demonstrated, an important consideration in analyzing these findings is the breadth of courses included in the RtC Phase II project. Table 4 includes official course descriptions for all six courses. These descriptions reveal the wide range of subject matter and expectations.

Table 4. Titles and official descriptions of courses included in RtC Phase II.

Course Title	Course Description
Electronic Resources for Youth	Electronic Resources for Youth will focus on development of coding and computational thinking skills as well as evaluation, selection, management, and use of computer based materials in programming for children and young adults. Issues such as copyright and technology planning will also be explored. This course will expand your thinking about the integral role of electronic resources in library settings for children and young adults. You will learn coding and computational thinking skills and develop a range of ideas to effectively integrate these concepts into programming for children and young adults. Choices allow graduate students with varied backgrounds and interests to select activities that meet their professional needs.
Multimedia Resources and Services	Existing and emerging multimedia information technologies with emphasis on the design, production, and organization of multimedia resources for K–12 settings: classrooms, libraries, media centers, and network-accessible information sites.
Digital Resources for Teaching and Learning	An overview of current digital resources (tools, applications, etc.) to support the teaching and learning of children and young adults in diverse classrooms. Non-fiction and digital resources

Course Title	Course Description
	are included. Students will design, develop, and produce digital resources appropriate to their situation.
STEM and Youth Learning in the Library	The purpose of this course is to introduce theoretical and practical aspects of incorporating youth-focused STEM (science, technology, engineering, and mathematics) concepts in all types of libraries. Understanding how to collaborate with other educators, learning state and national STEM standards and how they relate to library programming, and developing innovative programming ideas to incorporate into library settings will be major topics of discussion.
Design and Production of Multimedia	Provides an overview of the theories, tools, and techniques involved in the design and production of digitized information communication and interaction in varied formats; introduces students to practical technological methods related to digital capture and manipulation of textual, audio and video information and materials.
Youth Services Community Engagement	This service-learning course will examine youth services by exploring how young people's information and educational needs are met by community institutions and organizations. We will draw upon youth services librarianship and youth informatics concepts to explore youth informatics in after school programs, community center programs, and other institutions that serve young people. A significant portion of coursework will take the form of service learning or community-based research via approved projects that match students' interests. 2-Credit students will be enrolled for the last eight weeks of the term. 4-Credit students will be enrolled for the full term, and during the first half of the course will examine the implementation of coding and computing programming in youth services community informatics settings.

It is evident how varied these courses' approaches to technology were. Additionally, requirements for writing objectives differed considerably, from strict alignment with state standards to complete faculty freedom. These two points emphasize the challenges both educators and researchers experience when making global assumptions and recommendations. Conversely, the variety in technology approaches and objective development highlights how faculty teaching completely different courses can incorporate critical skills such as CT and coding concepts into their syllabi. Indeed, the consistency of the themes of the objectives identified in our category system—STEM learning, multimedia resources for learning, promoting additional learning opportunities, emerging learning trends, modelling collaboration, and general learning—across such different courses points to the fact that topics relating to CT are already embedded in the courses examined.

This study and the RtC project in general demonstrate ways that faculty can address the challenge of incorporating technological concepts such as CT and coding in their curriculum for preparing librarians for providing school and public library youth services. Given the RtC faculty members' experiences with developing objectives within different course structures, institutional and state requirements, and personal strengths, we recommend faculty consider the following when preparing technology courses for their school and public library youth services students.

1. State-required and institution-required objectives are often not explicitly about STEM, CT, or coding but frequently can be interpreted through thematic lenses that relate to these essential skills. (Additionally, while not explicitly the topic of this paper, faculty also found when teaching from these objectives that objectives can be creatively interpreted when integrated into course content. While some assignments and assessments may be predetermined, often lectures, discussions, and student-participation activities provide avenues to introduce new concepts within more rigid structures.)
2. Collaboration with faculty at other institutions allows for critical reflection about current courses, incentive to redesign courses, and support for learning and integrating new concepts. Again, this study showed that faculty did not necessarily need to change course objectives to see the important trends of CT emerge from their syllabi, but feedback enabled the professors to see their courses from new and different perspectives.
3. Computational thinking and coding fit naturally with the library field's existing ways of providing technology access and exposure for youth. While these concepts may sound foreign to LIS students (and perhaps even faculty), the core principles of CT and coding align well with principles already embraced by many librarians, such as design thinking and connected learning. According to IDEO (2018), design thinking is a process for creative problem solving with phases of gathering inspiration, generating ideas, making ideas tangible, and sharing and reflecting on the process. Mizuko Ito and colleagues have described connected learning as an approach to education that "advocates for broadened access to learning that is socially embedded, interest-driven, and oriented toward educational, economic, or political opportunity" (2013).
4. Paying attention to trends in technology, including CT and coding, ensures that LIS educators prepare graduate students to embrace these concepts in the field, thereby effectively serving their young patrons.
5. As mentioned, many of the long-term and short-term goals discussed in the Ready to Code literature are already represented in LIS curricula—although perhaps not explicitly stated as RtC goals. In addition to seeing these connections for themselves, faculty should ensure that students understand how the skills that they are learning fit into the context of CT.

We acknowledge that six courses is a small sample size in the context of the total number of courses offered in MLS, MLIS, school library, and other related graduate-level programs. However, the diversity of the courses examined points to how critical CT is to a broad range of subjects important in LIS education. The objectives listed here, and the categories and themes identified through these objectives, will, ideally, serve as a jumping-off point for faculty designing new courses or reinterpreting current syllabi. The field of librarianship is continuing its history of providing critical 21st-century skills to young people—this time, in the context of CT and coding. This study provides a window into ways in which graduate-level LIS courses can incorporate these concepts despite potential challenges in doing so.

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