

Information Technology Two-Year Transfer Programs

In the last Community College Corner column, I wrote about Cyber2yr2020, the recently released curriculum guidance from ACM for associate-degree programs in Cybersecurity [3]. While the Cybersecurity guidance was being developed, a similar project was underway developing curriculum guidance at the associate degree level for transfer programs in Information Technology (IT), known as IT-Transfer2020 [5]. The chair of the IT Transfer Task Group, Markus Geissler, joins me in writing this column as we inform you about this exciting project.

IT Program Landscape

Many community and technical colleges in the United States and other parts of the world offer two kinds of two-year degree programs: applied and transfer. An applied computing program usually ends with an Associate of Applied Science (A.A.S.) degree intended to lead to entry-level employment. A transfer computing program usually ends with an Associate of Science (A.S.) degree intended to lead to smooth transfer into the third year of a corresponding bachelor's level program. Among computing-related disciplines, the most common two-year applied programs are in some form of IT; the most common two-year transfer programs are in Computer Science. Similar academic institutions in other countries offer similar preparation at different points of computing education pathways [12].

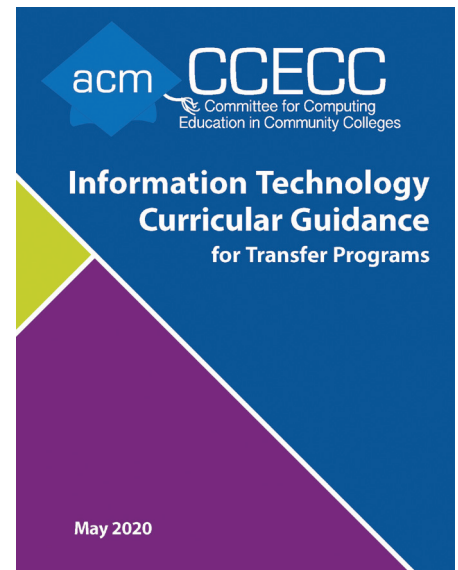
While IT transfer programs have not typically been common, that may be changing as the number of bachelor's programs in IT continues to increase.

In 2012 and 2019, SIGITE (ACM Special Interest Group on IT Education) sponsored studies into bachelor's level IT programs in the United States [9,10]. Using published ACM IT curriculum guidelines to identify IT programs distinctly from programs in other computing disciplines, the authors identified 220 IT programs in 2012, and 389 IT programs in 2019. They also reported that in 2012 there were 18 ABET accredited IT programs and in 2019 there were 39 ABET accredited IT programs in the United States [9,10]. As of this writing, there are 46 ABET accredited IT programs in the United States and 72 ABET accredited IT programs worldwide [1]. Another motivation for creating a smooth transfer process is that 46% of U.S. students who complete a degree at a four-year institution have been previously enrolled at a two-year college [11].

As the number of IT programs at the bachelor's level grows, and as more colleges are looking to offer transfer IT programs, questions arise about which content should be covered before and after IT students transfer. IT-Transfer2020 is intended to offer helpful guidance as colleges design their curriculum in collaboration with their transfer institution partners.

IT-Transfer2020 Process

ACM and the IEEE Computer Society published the Information Technology Curricula 2017 (IT2017) Curriculum Guidelines for Baccalaureate Degree Programs in Information Technology [2] in late 2017. Shortly afterward, at the direction of the ACM Education Board, the ACM Committee for Computing Education



in Community Colleges (CCECC) joined with the chair of the IT2017 Task Group to create guidance for IT Transfer programs that would clarify which IT2017 domains and subdomains these programs should address and which competencies students should possess at the point of transfer. To accomplish this the ACM CCECC formed the IT Transfer Task Group, consisting of seven faculty representing both two-year and four-year IT programs in the United States, and asked them to determine the subset of the IT2017 curricula that should be taught in IT Transfer programs that would allow sufficient flexibility to accommodate different areas of focus as dictated by their local industry needs. The following accomplished educators were appointed to the IT Transfer Task Group.

- **Dana Brown**, Bluegrass Community and Technical College, KY
- **Markus Geissler**, Cosumnes River College, CA (steering committee, task force chair)
- **Norma McKenzie**, El Paso Community College, TX

Information Technology Two-Year Transfer Programs

- *Svetlana Peltsverger*, Kennesaw State University, Marietta, GA
- *Tim Preuss*, Minnesota State Community and Technical College, Moorhead, MN
- *Mihaela Sabin*, University of New Hampshire, Manchester, NH (steering committee)
- *Cara Tang*, Portland Community College, OR (steering committee)

The IT Transfer Task Group met several times over the better part of one year, both in person and virtually, to share experiences with their existing programs and transfer relationships, to study the IT2017 guidance document, to determine an approach that would work for two-year programs, and then to parse the IT2017 guidance for competencies that should be taught during the first two years of a bachelor’s IT program. Along the way the task group gathered input from faculty who teach IT courses at postsecondary institutions as well as from industry partners to help ensure that the guidance would be appropriate for both teaching and application. In addition, the task group placed a special emphasis on ensuring that the guidance document would be practical to use for programs wishing to implement or adjust IT transfer curriculum.

The IT2017 curriculum guidelines for bachelor’s degree IT programs did not only update the previous guidance dating from 2008, but it specifically addressed two sometimes contentious areas of discussion within and beyond the IT discipline: how to measure learning, and what is the appropriate amount of mathematics required for graduates to be successful in their IT career. To address the first issue the Task Group on Information Technology Curricula which created IT2017 used competencies [8], which allow both curriculum designers and faculty to prac-

tically target specific knowledge, skills, and dispositions in context that students will need to succeed both during their studies and throughout their professional lives. For the mathematics requirement the IT2017 Task Group took a critical look at the mathematical and logical skill sets that IT program graduates would need to succeed, and they took the bold step of reducing the calculus requirements in favor of additional statistics exposure while maintaining a limited discrete structures coverage.

Using competencies in ACM curriculum guidance documents has become increasingly popular since the ACM CCECC first published its *Information Technology Competency Model of Core Learning Outcomes and Assessment for Associate-Degree Curriculum* (IT2yr2014) [4]—guidance for two-year applied IT programs in 2014—so the IT2017 Task Group decision to use competencies was not surprising. Changing the mathematics requirement, however, certainly raised some eyebrows within the IT discipline, but with the increasing amount of technical knowledge required it made sense to defer the study of calculus beyond the first semester until such time when students might need it for job related tasks or graduate study that might require more than a basic understanding of differentials and integrals.

One of the considerations for the IT-Transfer Task Group was the relationship of IT-Transfer2020 with IT2yr2014, ACM’s curriculum guidance for two-year applied IT programs, by which the CCECC pioneered the use of competencies in ACM curriculum guidance documents. As IT-Transfer2020 focuses on two-year transfer IT programs, it grows out of a subset of IT2017 to help facilitate articulation with four-year programs based on IT2017. To assist two-year colleges which

choose to offer both applied, industry preparation and transfer programs, the task force included a comparison table focused on IT2yr2014 in the IT-Transfer2020 guidance. Table 1 summarizes ACM curriculum guidance volumes for IT programs at the Associate and Bachelor levels.

IT-Transfer2020 Content

Like IT2017, the IT-Transfer2020 guidance contains 19 domains, of which 10 are designated as Essential and nine as Supplemental. Three or more statements define the scope and thereby describe each domain. The Essential domains are covered by a total of 39 competencies, 20 of which are considered as Essential and 19 as Supplemental for IT Transfer programs. The nine Supplemental domains are made up of a total of seven Essential and nine Supplemental competencies. Since it is intended to be used in conjunction with IT2017, the IT-Transfer2020 guidance preserves IT2017’s designation of a domain as Essential or Supplemental, though four of the Supplemental domains contain competencies that have since become Essential for students to achieve during the first two years of an IT Transfer program. Figure 1 shows the Networking domain of IT-Transfer2020, with its three Essential competencies and one Supplemental competency.

IT-Transfer2020 also uses the same domain abbreviations as IT2017, such as *ITE-CSP for Cybersecurity Principles*, but since curriculum committees at many community colleges require the use of Bloom’s verbs, the IT Task Group chose to adjust IT2017 competencies, where necessary, to use Bloom’s Revised Taxonomy [7] verbs. Figure 2 shows the distribution of IT-Transfer2020 competencies across the six levels of cognition in Bloom’s Revised Taxonomy. Notably, all IT-Transfer2020 competencies are above the lowest Bloom’s level, *Remembering*. Appendix A of the IT-Transfer2020 document features assessment rubrics that include emerging, developed, and highly developed tiers to further illustrate the desired level of student achievement for each competency. Figure 3 shows the rubric for the Information Management domain.

Table 1: ACM curriculum guidelines for IT programs

IT Curriculum Guidelines	
Curriculum Guidelines	Target Programs
IT2yr2014	Two-year applied associate-level IT programs [4]
IT2017	Four-year bachelor-level IT programs [2]
IT-Transfer2020	Two-year transfer associate-level IT programs [5]

ITE-NET Domain: Networking

Scope

1. Topology of ad hoc and fixed networks of all sizes
2. Role of the layered model in standards evolution and interoperability
3. Physical layer through routing layer issues
4. Higher layers related to applications and security, such as functions and design
5. Approaches to designing for and modeling latency, throughput, and error rate

Essential Competencies

- [NET-E01] Compare the characteristics of various communication protocols and how they support application requirements within a telecommunication system. (*Requirements and Technologies*) (*Analyzing*)
- [NET-E02] Describe different network standards, components, and requirements of network protocols within a distributed computing setting. (*Network Protocol Technologies*) (*Understanding*)
- [NET-E03] Explain different main issues related to network management. (*Network Management*) (*Understanding*)

Supplemental Competencies

- [NET-S01] Contrast various networking topologies in terms of robustness, expandability, and throughput used within a cloud enterprise. (*Technologies*) (*Analyzing*)

Figure 1: The Networking domain of IT-Transfer2020

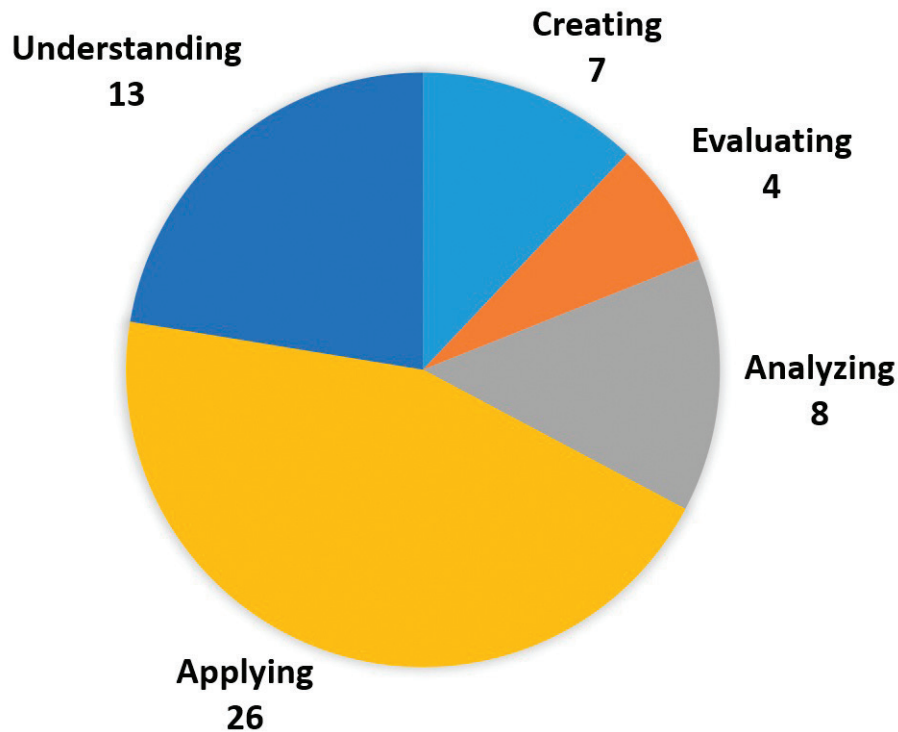


Figure 2: Distribution of IT-Transfer2020 competencies across Bloom's levels

Information Technology Two-Year Transfer Programs

ITE-IMA Domain: Information Management Rubric		
Emerging	Developed	Highly Developed
Evaluate working SQL statements for simple and intermediate queries to create and modify data and database objects to store, manipulate and analyze enterprise data. (<i>Testing and performance</i>) (<i>Bloom's level: Evaluating</i>)	Create simple and intermediate queries to construct and modify objects that store, manipulate, and analyze data. (<i>Testing and performance</i>) (<i>Bloom's level: Creating</i>) [IMA-E01]	Create working SQL statements for advanced queries to create and modify data and database objects to store, manipulate and analyze enterprise data. (<i>Testing and performance</i>) (<i>Bloom's level: Creating</i>)
Explain a physical database model based on appropriate organization rules for a given scenario including the impact of normalization and indexes. (<i>Requirements and development</i>) (<i>Bloom's level: Understanding</i>)	Design and implement a physical model based on appropriate organization rules for a given scenario including the impact of normalization and indexes. (<i>Requirements and development</i>) (<i>Bloom's level: Applying</i>) [IMA-S01]	Analyze a physical database model based on appropriate organization rules for a given scenario including the impact of normalization and indexes. (<i>Requirements and development</i>) (<i>Bloom's level: Analyzing</i>)
Summarize major database administration tasks such as create and manage database users, roles and privileges, backup, and restore database objects to ensure organizational efficiency, continuity, and information security. (<i>Testing and performance</i>) (<i>Bloom's level: Understanding</i>)	Perform major database administration tasks such as create and manage database users, roles and privileges, backup, and restore database objects to ensure organizational efficiency, continuity, and information security. (<i>Testing and performance</i>) (<i>Bloom's level: Applying</i>) [IMA-S02]	Examine major database administration tasks such as create and manage database users, roles and privileges, backup, and restore database objects to ensure organizational efficiency, continuity, and information security. (<i>Testing and performance</i>) (<i>Bloom's level: Analyzing</i>)

Figure 3: Three-tiered rubric for competencies from the ITE-IMA Information Management domain

IT-Transfer2020 especially encourages its users to bear in mind cybersecurity-related considerations: To be fully effective cybersecurity mechanisms must not only be designed and installed into all technology components and business processes, but they should also be viewed and treated as an integrated system of cyber defenses that must be sufficiently flexible to incorporate required updates and sufficiently agile to respond to evolving cyber threats. While two domains in this guidance specifically address cybersecurity content and competencies, appropriate cybersecurity-related content should be found throughout an IT curriculum.

Call for Program Examples

We are assembling a collection of examples of two-year IT Transfer programs that align an actual IT Transfer program with the competencies in IT-Transfer2020, showing the competencies that appear in each course that makes up the program. Seeing how the curricular guidance plays out in a real program can help with program updates, implementation of new programs, and articulation conversations.

If you would like to correlate your program to the IT-Transfer2020 guidelines, or to see the existing program examples, visit [6] and select the Program Examples tab. For any questions or suggestions, use the contact form at [6] (Contact tab) or email geisslm@crc.losrios.edu or cara.tang@pcc.edu. ❖

References

1. ABET. Accredited Programs, <https://amspub.abet.org/aps/category-search?commissions=2&discipline=s=43°reeLevels=B>. Accessed 2020 April 29.
2. ACM and IEEE Computer Society. *Information Technology Curricula 2017: Curriculum Guidelines for Baccalaureate Degree Programs in Information Technology*. (New York, ACM, 2017); doi: <http://dx.doi.org/10.1145/3173161>
3. ACM Committee for Computing Education in Community Colleges. *Cybersecurity Curricular Guidance for Associate-Degree Programs*. (New York, ACM, 2020); <http://ccecc.acm.org/Cyber2yr2020>. Accessed 2020 May 1.
4. ACM Committee for Computing Education in Community Colleges. *Information Technology Competency Model of Core Learning Outcomes and Assessment for Associate-Degree Curriculum*. (New York, ACM, 2014); doi: <http://dx.doi.org/10.1145/2686614>.
5. ACM Committee for Computing Education in Community Colleges. *Information Technology Curricular Guidance for Transfer Programs*. (New York, ACM, 2020); <http://ccecc.acm.org/IT-Transfer2020>. Accessed 2020 May 1.
6. Anderson, L.W. and Kratwohl, D.R. eds., *A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. (New York, Longman, 2001).
7. Frezza, S., Daniels, M., Pears, A., Cajander, Å., Kann, V., Kapoor, A., McDermott, R., Peters, A., Sabin, M., and Wallace, C. Modelling Competencies for Computing Education beyond 2020: A Research Based Approach to Defining Competencies in the Computing Disciplines. In *Proceedings Companion of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education*, (Larnaca, Cyprus: ACM, 2018), 148-174; <https://doi.org/10.1145/3293881.3295782>.
8. Lunt, B., Neupane, B., Hansen, A., and Ofori, R. Identifying and Evaluating Information Technology Bachelor's Degree Programs. In *Proceedings of the 1st Annual conference on Research in Information Technology (RIIT '12)*, (Calgary, Canada, ACM, 2012), 19-24; <https://doi.org/10.1145/2380790.2380796>
9. Lunt, B., Redfeare, B., Mitchell, E., Tenney, S., and Williams, C. Identifying and Evaluating Information

Technology Baccalaureate Degree Programs per IT2017. In *Proceedings of the 20th SIGITE conference on Information Technology Education (SIGITE'19)*, (Tacoma, WA, ACM, 2019), 5-9; <https://doi.org/10.1145/3349266.3351413>

11. National Student Clearinghouse Research Center. *Contribution of Two-Year Institutions to Four-Year Completions*, 2015; <http://nscresearchcenter.org/snapshotreport-twoyearcontributionfouryearcompletions17>. Accessed 2020 May 1.
12. Tang, C. "Community Colleges in the United States and Around the World." *ACM Inroads* 8, 1 (2017), 21-23. doi: <https://doi.org/10.1145/3007576>.



Cara Tang
Portland Community College
12000 SW 49th Ave.
Sylvania, TCB 312
Portland, OR 97219
cara.tang@pcc.edu



Markus Geissler
Cosumnes River College
8401 Center Pkwy
Sacramento, CA 95823
geisslm@crc.losrios.edu

DOI: 10.1145/3410476 Copyright held by authors/owners.