

**VSBPE Agenda Item 5(PAC)****Date: Oct. 23, 2019****Item: UVM's New Program Application**

**ITEM:** Shall the VSBPE approve UVM's application to have a ROPA review of their proposed new Computer Science minor and concentration?

**AGENCY RECOMMENDED ACTION:**

**The agency recommends that the VSBPE approves UVM's application to have a ROPA review of their proposed new Computer Science minor and concentration.**

**BACKGROUND:** UVM submitted their application and cover letter to the AOE ROPA Coordinator on Oct. 14, 2019.

**RATIONALE:** UVM's application is thorough and complete.

**SUPPORTING DOCUMENTS:** Letter from President Garimella, New Program Application.



The University of Vermont

**Suresh V. Garimella**  
*President*

July 9, 2019

Vermont Standards Board for Professional Educators  
Vermont Agency of Education  
Educator Quality Division  
219 North Main Street, Suite 402  
Barre, VT 05641

Dear Members of the Vermont Standards Board for Professional Educators,

In keeping with the Vermont Standards Board for Professional Educators (VSBPE) Policy N13, I am writing to request a review of our new educator preparation program, the Computer Science Education (CSE) Minor and Concentration. The Minor and Concentration were approved by the Faculty Senate at The University of Vermont on March 25, 2019, and by the UVM Board of Trustees on May 18, 2019. A Design Document prepared by Dr. Regina Toolin provides details regarding the proposed program and accompanies this request for a review.

Thank you for your attention to this request. We look forward to continuing through the review process for the CSE Minor and Concentration.

Sincerely,

Suresh V. Garimella

University of Vermont

Application for New Program Review in Computer Science Education

October 7, 2019

Directions: Applicants seeking a new program review must submit the following to the AOE at least 6 months before the program review is conducted:

- [X] A completed Design Document: you may use the template provided below or create your own Design Document detailing the proposed program.
• [X] A formal letter requesting a review visit from the president or head of the institution
• [ ] Application fee of \$2000 - PENDING

Table with fields: Program Name, Address, Contact Name, Phone, Email, Endorsement Area Sought, Rationale. The Rationale section contains detailed text about STEM job projections, CS education standards in VT, and a joint initiative between CESS and CEMS.

*program for undergraduate and graduate students.* The fact that Vermont is a small state affords us the ability to readily connect with teachers, administrators, VT AOE staff, legislators and businesses for STEM education initiatives and partnerships. UVM is well situated to advance the new CSE minor and concentration following the approval of Act 77 legislation that supports the development of personalized learning plans and flexible pathways to graduation for all students. The new CSE minor will build on the legislature's commitment to support programming to increase educational opportunities, particularly for those students who have traditionally been underserved in CS education and careers. In addition, the creation of the new minor and concentration aligns with the state's demonstrated interest in promoting STEM education -- a strategic goal of UVM, CESS, CEMS, AOE, business leaders, and the state government.

Of central significance is the collaboration between UVM's Computer Science and Education departments in program design and implementation. This alliance provides an opportunity for innovative programming, rich dialogue, and collaborative teaching and research between faculty in both departments. This also provides an opportunity for each department to update and expand its curriculum to ensure that all students who graduate with a CSE minor or concentration will have a deep understanding of computational thinking and its significance in transforming education, as well as practical and meaningful ways to integrate CS into their teaching practice (Barr & Stephenson, 2011).

The long-term goal is to educate the next generation of computer science teachers (grades 7-12) in Vermont and across New England that will encourage and support diverse groups of students as they become computer science literate and consider computer science careers.

**Program Delivery Model:** The CSE **minor** will consist of 19 credits (6 courses) that will be primarily face-to-face with some options for online or hybrid courses. The CSE **concentration** will consist of 31 credits (10 courses) that will be primarily face-to-face with some options for online or hybrid courses.

**Timeline:** The Computer Science Education Minor and Concentration have been approved by the UVM Faculty Senate and Board of Trustees. We intend to offer CSE courses once we receive AOE program approval.

Please provide a 3-5 sentence summary of your existing programs and concerns from your last ROPA review, if applicable. Attach additional supporting documentation as needed.

Existing Approved Programs and Delivery Models: Secondary Education – English, Foreign Language, Mathematics, Science, Social Studies

Programs under Conditional Approval - None

Progress toward Addressing Identified Program Concerns – N/A

**Potential Impact of Proposed Program on Existing Programs:** The Computer Science Education endorsement will complement the existing endorsement programs in secondary education including English, Social Studies, Mathematics, Science (Biology, Chemistry, Earth Science and Physics) and Foreign Language (French, German and Spanish). We anticipate that many of the students in secondary education will consider Computer Science as a dual endorsement area.

Please provide a brief overview of the proposed program. Attach a curriculum map detailing the program's alignment with the *Core Teaching and Leadership Standards* (See: <https://education.vermont.gov/sites/aoe/files/documents/edu-educator-quality-core-teaching-and->

[leadership-standards-for-vermont-educators.pdf](#)) and endorsement knowledge and performance standards and additional documentation, as needed.

**Program and/or Endorsement Overview:**

**CSE Curriculum Map:** <https://docs.google.com/spreadsheets/d/1HwpmI9AEFgJ6TP2nt1yuF-3w3hoogUpk/edit#gid=1502796356>

The **Minor in Computer Science Education** is a 6-course minor (19 credits) designed for students interested in computer science education in school settings, as well as computer science education in non-formal or other settings. The minor includes 5 required courses (16 credits) in Computer Science and 1 required course (3 credits) in the Department of Education: EDSC 237 - Teaching Computer Science in Secondary School, for a total of 19 credits for the CSE minor. Only teacher education students eligible for licensure in grades 7-12 will be eligible for endorsement in Computer Science Education. Computer Science Education students will complete the following content specific courses for the Computer Science Minor in Secondary Education:

**Computer Science Education Minor Required Coursework – 19 Credits**

CS 008: Intro to Web Site Development – 3 credits
CS 021: Computer Programming – 3 credits
CS 087: Introduction to Data Science – 3 credits
CS 110: Intermediate Programming - 4 credits
CS 121: Computer Organization – 3 credits
EDSC 237 - Teaching Computer Science in Secondary School – 3 credits

Students enrolled in the **Computer Science Education Concentration** will complete ALL 3 phases of the secondary education program including university general education, secondary education general education, and professional education requirements. A summary of the coursework for the Computer Science Education Concentration includes the following:

<b>University General Education Requirements</b>	
D1 - Race and Racism in the US ( <a href="#">EDTE 056</a> )	
<b>Writing and Information Literacy</b>	3
<b>Sustainability</b> - Any course with the "SU" designation	3
<b>Quantitative Reasoning</b> - Any course with the "QR" designation	3
<b>CESS General Education Requirements</b>	
ASL, Foreign Language, or any course with the subject prefix of ASL, PHIL, REL	

Any course with the subject prefix of BIOL, PHYS, CHEM, ENVS, ENSC, NFS, GEOL. Or <u>GEOG 040</u> , <u>NFS 043</u>		
<b>Social Science</b>		3
Any course with the subject prefix POLS, PSYS, GEOG, HST, ANTH, SOC, or <u>SWSS 002</u> , <u>HDFS 005</u>		
<b>Professional Teacher Education Requirements</b>		
<b>Phase 1</b>		
<u>EDTE 001</u>	Teaching to Make a Difference	3
<u>EDSP 005</u>	D2: Issues Affecting Persons W/Disabilities	3
<u>EDFS 002</u>	School and Society	3
<u>EDTE 056</u>	D1: Lang Policy Issues, Race & Schools	3
<u>EDSC 011</u>	Ed Tech in Sec Ed Classroom	3
<u>EDSC 207</u>	Development: Theory & Application	4
Praxis Core Requirement		
<b>Phase 2</b>		
<u>EDSC 209</u>	Practicum in Teaching	4
<u>EDSC 216</u>	Curr, Instr & Assmt Sec Schl Tch	3
<u>EDSC 215</u>	Reading in Secondary Schools <sup>1</sup>	4
<b>Phase 3</b>		
Special Methods		
<u>EDSC 225</u>	Tchg Soc Studies in Sec Schls	
or <u>EDSC 227</u>	Tchg Science in Sec Schls	
or <u>EDSC 240</u>	Tchg English in Sec Schls	
or <u>EDSC 257</u>	Tchg Math in Sec Schls	
or <u>EDSC 259</u>	Tchg Foreign Lang in Sec Schls	
or <b>EDSC 237</b>	<b>Tchg Computer Science in Sec Schls</b>	
<u>EDSC 226</u>	Teaching Internship	12
<u>EDSC 230</u>	Teaching for Results	3
Praxis II Subject Tests		
<b>Computer Science Education Concentration Requirements – Content Requirements</b>		
CS 008: Introduction to Web Design – 3 credits		
CS 021: Introductory Programming – 3 credits		
CS 064: Discrete Structures – 3 credits		
CS 087: Introduction to Data Science – 3 credits		

CS 110: Intermediate Programming - 4 credits (Prerequisite: CS 021)
CS 121: Computer Organization – 3 credits (Prerequisite: CS 110)
CS 124: Data Structures and Algorithms (Prerequisites: Math 021, CS 064, CS 110) – 3 credits
CS 166: Cybersecurity Principles – 3 credits
CS 292: Senior Seminar – 1 credit
Math 021 – 4 credits
CS 091 – Instructing in Computer Science (Strongly recommended but not required).
In addition, all CSE students will complete a teaching methods course:
EDSC 237- Teaching Computer Science in Secondary School – 3 credits

All of the computer science and mathematics courses listed as requirements for the Computer Science Education concentration are currently offered through the Computer Science and Mathematics departments. EDSC 237 Teaching Computer Science in Secondary School is offered by the Department of Education – Secondary Education Program.

### Criteria for admission

**Computer Science Education Minor:** Acceptance into the minor with an endorsement requires an overall grade point average of 3.0 or better and a grade point average of 3.0 or better in all education and content courses.

**Computer Science Education Concentration:** Students begin the professional education component of the Secondary Education program when they enter UVM. During the first two years, coursework focuses on general education and academic concentration or minor requirements. In addition students take several education courses that build the foundation for further study in Secondary Education.

#### PHASE 1: Exploring learners’ needs and the school context

EDTE 001, ECLD 056, EDFS 002, EDSP 005, EDSC 011, EDSC 207. ECLD 056 fulfills the Diversity 1 requirement and EDSP 005 fulfills Diversity 2 requirement. At the end of **Phase 1** a student must have the following to continue in the program:

- a 2.75 overall GPA
- a 2.50 GPA or higher in the content area concentration
- a grade of B or better in all courses with an EDXX prefix
- passing scores on the PRAXIS Core Test or meet state-approved waiver requirements
- favorable reviews from faculty teaching EDSC 011 and EDSC 207

Following the introductory phase, students begin the next series of professional courses. During this phase, students will continue taking coursework in their academic concentration (Computer Science), with the goal of having courses completed prior to Phase 3.

#### PHASE 2: Exploring school context and curriculum, instruction and assessment

EDSC 209, EDSC 215, and EDSC 216. Subject methods may be taken in Phase 2 or 3, depending on the student's academic plan. At the end of this sequence, if a student has:

- a 3.00 overall GPA
- a 2.75 GPA or higher in the content area concentration
- a grade of B or better in all courses with an EDXX prefix
- meet speech competence requirement (described below)
- favorable reviews from faculty teaching in EDSC 209, EDSC 215, and EDSC 216
- resolved all Student Support Team concerns (if applicable)

Then a student will be eligible to apply formally for a student teaching placement in the Secondary Education program. Should a student fail to meet one or more of these program benchmarks, a student has the option of submitting a formal request to continue in the program.

**PHASE 3: Full Semester Student Teaching Experience**

EDSC 226, EDSC 230 and Subject specific methods course (may be taken during this semester if not taken previously). Students must:

- complete a full-time, semester-long internship
- complete and submit the Vermont Licensure Portfolio that documents competence with program and state licensure requirements.

**Curriculum Overview (course titles and descriptions):**

***Table 1. - Computer Science Education Minor Required Coursework – 19 Credits***

**CS 008: Intro to Web Site Development – 3 credits**

Provides a strong foundation in HTML, CSS, images, beginning web programming, and web design so that the student can create a complete functional web site.

**CS 021: Computer Programming – 3 credits**

Introduction to algorithmic problem solving and computer programming. Designed to provide a foundation for further studies in computer science.

**CS 087: Introduction to Data Science – 3 credits**

Basic techniques of data harvesting and cleaning; association rules, classification and clustering; analyze, manipulate, and visualize data using programming languages. Basic principles of probability and statistical modeling/inference to make meaning out of large datasets. Cross-listed with: STAT 087.

**CS 110: Intermediate Programming - 4 credits**

Intermediate programming concepts including common data structures, algorithms, style, design, documentation, testing and debugging techniques, and an introduction to object-oriented programming. Prerequisite: One of CS 020 or CS 021 with a grade of C- or better.

**CS 121: Computer Organization – 3 credits**

Introduction to computer system organization including performance, assembly language, machine-level data representation, arithmetic for computers, processor datapath control, memory, and input/output. Prerequisite: CS 110.

**EDSC 237 - Teaching Computer Science in Secondary School – 3 credits**

Explores multiple theories and practices of teaching, learning and assessing computer science in secondary school. The course will emphasize the nature of computer science, the structure of computer science disciplines, computer science learning standards, best practices of teaching and assessing computer science, and social and ethical issues in computer science and computer science education. Students will engage in inquiry-based, place-based and/or project-based demonstrations and lessons that represent the Computer Science Teachers Association (CSTA) learning standards and other essential practices necessary to become a master teacher of computer science.

**Computer Science Education Concentration Requirements – 31 CS Credits + EDSC 227 (3 credits)**

**CS 008: Introduction to Web Development – 3 credits**



Provides a strong foundation in HTML, CSS, images, beginning web programming, and web design so that the student can create a complete functional web site.

**CS 021: Introduction to Computer Programming – 3 credits**

Introduction to algorithmic problem solving and computer programming. Designed to provide a foundation for further studies in computer science.

**CS 064: Discrete Structures – 3 credits**

Introduction to analytic and formal methods of computer science with practical examples, including analysis of data structures, recursion relations, proof methods, and logic programming. Credit not given for more than one of CS 064, MATH 052 or MATH 054. Prerequisites: CS 020 or CS 021 or CS 110; MATH 021 or MATH 023.

**CS 087: Introduction to Data Science – 3 credits**

Basic techniques of data harvesting and cleaning; association rules, classification and clustering; analyze, manipulate, and visualize data using programming languages. Basic principles of probability and statistical modeling/inference to make meaning out of large datasets. Cross-listed with: STAT 087.

**CS 110: Intermediate Programming - 4 credits (Prerequisite: CS 021)**

Intermediate programming concepts including common data structures, algorithms, style, design, documentation, testing and debugging techniques, and an introduction to object-oriented programming. Prerequisite: One of CS 020 or CS 021 with a grade of C- or better.

**CS 121: Computer Organization – 3 credits (Prerequisite: CS 110)**

Introduction to computer system organization including performance, assembly language, machine-level data representation, arithmetic for computers, processor datapath control, memory, and input/output. Prerequisite: CS 110.

**CS 124: Data Structures and Algorithms (Prerequisites: Math 021, CS 064, CS 110) – 3 credits**

Design and implementation of linear structures, trees and graphs. Examples of common algorithmic paradigms. Theoretical and empirical complexity analysis. Sorting, searching, and basic graph algorithms. Prerequisites: CS 110 with a grade of C- or better; CS 064 or MATH 052.

**CS 166: Cybersecurity Principles – 3 credits**

Introduction to cybersecurity, fundamental security design principles, programming flaws, malicious code, web and database security, cryptography algorithms and hashing functions; overview of computer networks and common network threat vectors. No credit if taken after CS 266. Prerequisites: CS 008, CS 021.

**CS 292: Senior Seminar – 1 credit**

Oral presentations that pertain to the ethical practice of computer science in government, industry, and academia. Topics may include computer security, copyright, and patent law. Prerequisite: Senior standing in Computer Science.

**Math 021: Calculus I – 4 credits**

Introduction to calculus of functions of one variable including: limits, continuity, techniques and applications of differentiation and integration. Prerequisites: MATH 010, or strong background in secondary school algebra and trigonometry. Credit not given for more than one course in the pair MATH 019, MATH 021 unless followed by MATH 022 or MATH 023.

**CS 091 – Instructing in Computer Science (Strongly recommended but not required).**

Assist in instruction of undergraduate computer science courses under the direct supervision of a faculty member. Duties may include grading, office hours, laboratory and/or recitation instruction, or other related activities. Instructor permission required. Prerequisite: Instructor Permission.

In addition, all CSE students will complete a teaching methods course:

**EDSC 237 - Teaching Computer Science in Secondary School – 3 credits**

Explores multiple theories and practices of teaching, learning and assessing computer science in secondary school. The course will emphasize the nature of computer science, the structure of computer science disciplines, computer science learning standards, best practices of teaching and assessing computer science, and social and ethical issues in computer science and computer science education. Students will engage in inquiry-based, place-based and/or project-based demonstrations and lessons that represent the Computer Science Teachers Association (CSTA) learning standards and other essential practices necessary to become a master teacher of computer science.

**Desired impact of program:** The long-term goal is to educate the next generation of computer science teachers (grades 7-12) in Vermont and across New England that will encourage and support diverse groups of students as they become computer science literate and consider computer science careers.

Please provide a brief overview of the proposed program(s) assessment system including how the program anticipates using assessments as part of its overall evaluation system. Attach additional documentation, as needed.

**Assessment System Overview:**

Upon completion of the Computer Science Education Minor and Concentration students will be able to:

1. Plan and implement instruction that demonstrates knowledge of computer science principles and practices and allows secondary students to use computer science in problem-solving and decision-making situations.
2. Keep current with the use of technology in education and issues related to legal and ethical use of technology.
3. Design and implement activities that reinforce verbal and written technical communication skills central to computer science.
4. Use the basic steps in algorithmic problem-solving to design solutions.
5. Use effective management strategies for teaching computer science.
6. Use appropriate instructional strategies for teaching computer science.

**Key Assessments:**

The primary assessment for the CSE minor and concentration will be a culminating capstone project administered during the final course (EDSC 237 Teaching Computer Science in Secondary School). The CSE resource portfolio corresponds to a specific topic that pertains to the secondary computer science curriculum. The goal is to develop lesson plans, projects, assessments and rubrics for a given topic that demonstrate exemplary computer science instruction emphasized in the minor and concentration and that promotes the use of computer science in problem-solving and decision-making situations.

The CSE Resource Portfolio includes the following components:

1. Narrative explaining overall the rationale, background and goals (enduring understanding, essential questions, proficiencies, learning outcomes) of the instructional sequence that align to the CSTA computer science standards and VT proficiencies.
2. Curriculum Map – outlining all lessons, projects and assessments
3. Curriculum Resources – a list of all the resources utilized in the portfolio design
4. Instructional strategies/lesson plans (6-8 lesson plans utilizing the secondary lesson plan template)
  - Traditional CS lesson
  - Inquiry-based lesson
  - Project-based/Place-based inquiry
  - CS-based historical lesson
  - Societal issue related to legal and ethical uses of CS and to develop a plan of action
  - Integrated lesson that demonstrates the integration of computer science and instructional technology and at least one of the following subjects: mathematics, science, English or social studies.
5. Assessment and Grading
  - Pre-post assessment given at the beginning of the unit plan.
  - Traditional assessment (e.g. quiz, unit exam)
  - Performance-based or project-based assessment with rubrics
7. Summary and Reflection of the Portfolio Development Process

In addition, students majoring in Computer Science Education (concentration) will complete and pass all sections of the VT Licensure Portfolio as requirement for the Secondary Education degree and Vermont State Licensure. See this link for a description of the VLP:

<https://sites.google.com/site/vermontslicensureportfolio/portfolio-directions>

**Essential Data to be collected:**

Program assessment will include data collection on the number of students enrolling in the minor as well as year of entry and completion of the minor. The CSE coordinator will collect and analyze scores from the EDSC 237 capstone project to identify strengths, challenges, and emerging patterns that may indicate revision to the capstone project and possibly the minor course sequence. The coordinator will collect and analyze program data to assess overall program viability.

**Proposed Evaluation System:**

**Grading Scheme for CSE Minor and Concentration:**

A	92-100
A-	90 - 91
B+	88-89
B	82-87
B-	80-81
C+	78-79
C	72-77
C-	70-71
D+	68-69
D	62-67

D-	60-61
F	Below 60

Please provide a brief overview of the resources available to support the proposed program. Attach additional documentation, as needed.

**Resources Overview:**

A. Faculty

Faculty associated with core courses in the Computer Science Education minor and concentration include the following people: Regina Toolin, Department of Education; Lisa Dion, Computer Science Department; Robert Erickson, Computer Science Department

B. Library Support

Current collections, materials and other resources in the Department of Education and Bailey Howe Library are sufficient to meet program needs. The Bailey Howe Library currently subscribes to a number of relevant journals in Education and Computer Science.

C. Equipment Needs

Equipment currently available through departments associated with the core courses is sufficient to meet the needs of the program. In particular, the existing Technology Lab located in the Departments of Education and Computer Science provide a range of equipment (e.g., I-Pad carts, computer access for students) and faculty supports (e.g., support for Smart Boards and other equipment located in DOE designated classrooms). No new equipment needs are anticipated at this time, other than those already identified by the DOE as a whole.

D. Physical Space

Classroom and student study space: Classrooms and study space already in existence will be sufficient for the proposed minor and concentration. No new spaces are being requested.

F. Laboratory and other space

Because of the nature of the minor, no additional laboratory or research space is needed. Field placements made through the practicum will utilize existing school and community sites.

**Key Policies and Resources in place to support the new program:**

The Computer Science Education Minor and Concentration have undergone multiple levels of evaluation and approval at the University of Vermont including the College of Education and Social Services (CESS) and College of Engineering and Mathematical Sciences (CEMS) Curricular Affairs Committee approval process, the Faculty Senate Curricular Affairs approval process, Provost Office approval process, and the UVM Board of Trustees Approval Process. The final Board approval was secured in May 2019.

The CSE minor and concentration will be housed in the Department of Education (CESS) under the leadership of Kimberly Vannest (Chair) and coordinated at the program level by Regina Toolin (Secondary Education) in collaboration with Robert Erickson and Lisa Dion (Computer Science). Necessary faculty, classroom space, labs, and administrative support will be provided in the same manner as other programs in our colleges.