
6B

Information/Action

Credentialing and Certificated Assignments Committee

Proposed Modifications to the Supplementary Authorization in Computer Concepts and Applications

Executive Summary: This agenda item presents proposed modifications to the Supplementary Authorization in Computer Concepts and Applications. The proposed revisions reflect a change in focus from preparation to teach only basic computer use, keyboarding, and software applications to a broader preparation inclusive of a full K-12 Computer Science education. The proposed revisions would require changes to the coursework Content Areas of Study for the authorization. Further, to reflect the broader approach to this content area, the name of this Supplementary Authorization is proposed to be changed to “Computer Science.”

Policy Questions: Do the proposed modifications include appropriate content to serve as a basis for increasing the capacity of teachers prepared to provide instruction in the full range of K-12 Computer Science education classes in California schools?

Recommended Action: That the Commission approve the proposed modifications to the current Supplementary Authorization in Computer Concepts and Applications and direct staff to begin the regulatory process to enact these changes.

Presenter: Roxann Purdue, Consultant, Professional Services Division

Strategic Plan Goal

I. Educator Quality

- C) Ensure that credential processing and assignment monitoring activities accurately, effectively, and efficiently identify educators who have met high and rigorous certification standards and who are appropriately assigned.

Proposed Modifications to the Supplementary Authorization in Computer Concepts and Applications

Introduction

This agenda item presents proposed modifications to the Supplementary Authorization in Computer Concepts and Applications. The proposed revisions reflect a change in focus from preparation to teach only basic computer use, keyboarding, and software applications to a broader preparation inclusive of a full K-12 Computer Science education. The proposed revisions would require changes to the coursework Content Areas of Study for the authorization in order to serve as a basis for increasing the capacity of teachers prepared to provide instruction in the full range of K-12 Computer Science education classes in California public schools as provided in Appendix A. Further, to reflect the broader approach to this content area, the name of this Supplementary Authorization is proposed to be changed to “Computer Science.”

Background

Supplementary Authorizations allow the holder of a prerequisite general education teaching credential (e.g., Multiple and Single Subject Teaching Credential) to add one or more narrow departmentalized content area authorizations to their credential. This authorization is based on limited coursework that is not part of a Commission-approved subject matter program and does not include subject-specific pedagogy. An overview of Supplementary and Subject Matter Authorizations was presented to the Commission in August 2014: <http://www.ctc.ca.gov/commission/agendas/2014-08/2014-08-5B.pdf>. Further information about the history, scope, and implementation of Supplementary Authorizations, including those in the area of Computer Concepts and Applications, is provided in Appendix B, along with information about the number of current holders with these authorizations.

While Supplementary Authorizations have been issued by the Commission since 1979, specific Content Areas of Study required for coursework in Computer Concepts and Applications (CCA) were developed in 1987 and became effective in 1989. The Content Areas of Study requirements for coursework used to earn a Supplementary Authorization in CCA remain the same in 2015 as those originally developed in 1987: software evaluation and selection; hardware operations and functions; and classroom uses of computers.

Coursework offered in Computer Science education in California public schools has evolved rapidly since these required Content Areas of Study were developed in 1987. The Content Areas of Study requirements for the Supplementary Authorization in CCA are now primarily encompassed within the preliminary preparation for all general and special education teachers in Program Standard 11: Using Technology in the Classroom.

Proposal for a Supplementary Authorization in Computer Science

Over the past year, Commission staff has engaged in a series of conversations with representatives from the Alliance for California Computing Education for Students and Schools (ACCESS) and the Computer Science Teachers Association (CSTA) about the current preparation and authorizations for teaching the full range of K-12 Computer Science education classes in California schools. It is important to note that what is encompassed by the discipline of Computer Science education for K-12 students has changed. A common misperception has been that Computer Science education is limited to computer programming; however, as reflected in the following definition the content is actually much broader:

*Computer Science is the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society.*¹

As a result of those conversations, a concept paper (Appendix C) was developed by ACCESS in collaboration with CSTA that recommends modifying both the current Content Areas of Study coursework requirements and the title for the Commission's Supplementary Authorization in Computer Concepts and Applications. The intent of the proposed recommendations in the concept paper is to strengthen the required coursework Content Areas of Study for the authorization to ensure holders have the requisite knowledge to teach the full scope of Computer Science education classes offered in California. The concept paper was widely distributed to stakeholders for review and feedback.

Content Areas of Study Coursework Requirements for a Supplementary Authorization in CCA

There are two types of Supplementary Authorizations - Introductory and Specific. There are distinctions in both authorization and the basic credential for each type noted in Table A. The current Content Areas of Study coursework requirements vary for Introductory and Specific Subject Supplementary Authorizations. The scope of these authorizations is indicated in Table A below, which provides information for the current Introductory Supplementary Authorization in CCA and Specific Subject Supplementary Authorization in CCA to illustrate the differences in the Content Areas of Study now required for coursework to earn these two types of authorizations. Content Areas of Study coursework requirements specific to the content area of CCA are provided on the far right-hand side of the table.

¹ CSTA K-12 Computer Science Standards, 2011, <http://www.csta.acm.org/Curriculum/sub/K12Standards.html>

Table A: Current Supplementary Authorization in Computer Concepts and Applications

Authorization	Unit Requirements	Content Areas of Study
Introductory Supplementary Authorization – Computer Concepts and Applications (Only listed on Elementary Credentials for teaching departmentalized classes in grades 9 and below.)	20 Semester Units*or 10 Semester Units of Upper Division or Graduate Coursework	<ul style="list-style-type: none"> • Requires coursework covering each content area:** <ul style="list-style-type: none"> - <i>software evaluation and selection</i> - <i>hardware operation and functions***</i> - <i>classroom uses of computers</i>
Specific Subject Supplementary Authorization – Computer Concepts and Applications (Only listed on Secondary Credentials for teaching departmentalized classes at any grade level.)	20 Semester Units*or 10 Semester Units of Upper Division or Graduate Coursework	<ul style="list-style-type: none"> • Specific Subject Supplementary Authorizations have no required content areas. • All coursework must fall within the academic department for the subject category.

* All lower division units or a combination of upper and lower division units.

** The balance of the units may be in any course that falls within the academic department for that subject category. Computer classes in the Education Department may be used.

***An Introduction to Data Processing may be used for hardware operations and functions. Java, Cobol, Basic, and Pascal are examples of computer languages and do not apply to hardware but are acceptable as electives toward the overall unit requirement.

Proposed Modifications to the Content Areas of Study Coursework Requirements for a Supplementary Authorization in Computer Science

The proposed modifications to the Content Areas of Study coursework requirements for a Supplementary Authorization in Computer Science are included in Table B below. California Education Code section 44256 specifies the types of supplementary authorizations that may be added to elementary and secondary teaching credentials, grade level limitations, and the units required so those specific elements remain the same as the current requirements. However, this section of statute also provides that the Commission, by regulation, may require evidence of additional competence as a condition for instruction in particular subjects. Therefore, the only change in the first two columns is the name of the Supplementary Authorization to “Computer Science.” This change in the name of the authorization reflects the breadth and depth of the content required in the proposed modifications to the Content Areas of Study coursework requirements in the far right-hand column as indicated by underlined text.

The Content Areas of Study coursework requirements for CCA currently in regulations specifies coursework in content that has now become primarily addressed within the preliminary preparation program standards for all general and special education teaching credentials (i.e., software evaluation and selection, hardware operation and functions, and classroom uses of computers). The proposed modifications to the Content Areas of Study reflect a more comprehensive preparation with direct relevance to the full range of K-12 Computer Science education courses offered in California public schools today.

Table B: Proposed Modifications for a Supplementary Authorization in Computer Science

Authorization	Unit Requirements	Content Areas of Study
Introductory Supplementary Authorization – <u>Computer Science</u> (Only listed on Elementary Credentials for teaching departmentalized classes in grades 9 and below.)	20 Semester Units* or 10 Semester Units of Upper Division or Graduate Level Coursework	Requires coursework covering each content area:** - <u>computer programming</u> - <u>data structures and algorithms</u> - <u>computer hardware and organization</u> - <u>software design</u> - <u>impacts of computing (e.g., social, ethical, legal)</u>
Specific Subject Supplementary Authorization – <u>Computer Science</u> (Only listed on Secondary Credentials for teaching departmentalized classes at any grade level.)	20 Semester Units* or 10 Semester Units of Upper Division or Graduate Level Coursework	Requires coursework covering each content area:** - <u>computer programming</u> - <u>data structures and algorithms</u> - <u>computer hardware and organization</u> - <u>software design</u> - <u>impacts of computing (e.g., social, ethical, legal)</u>

* All lower division units or a combination of upper and lower division units.

**The balance of the units may be in any course that falls within the academic department for that subject category. Computer classes in the Education Department may be used including a pedagogy course in computer science from either department.

Examples of specific topics within each of the required content of the coursework specified in the proposed Content Areas of Study are included below for reference:

- *Programming* may be in any of a variety of languages, including but not limited to C/C++/C#, Java, Python.
- *Data structure and algorithms* include but are not limited to basic programming structures for sorting, searching, graph problems, and geometric problems.
- *Computer hardware and organization* include but are not limited to how a basic computer system is organized and how the system executes computer programs, including multilevel view of system hardware, operating systems, and software applications; and the operation and interconnection of digital devices and networks.
- *Software design* includes but is not limited to the process of planning a software system to solve a problem, which can be accomplished by multiple approaches; one current approach is object-oriented design—planning a system of interacting objects.
- *Impacts of computing* includes but is not limited to the social, ethical, and legal issues and impacts of computing, as well as the contributions of computer science to current and future innovations in sciences, humanities, the arts, and commerce. These topics are also typically covered within courses covering the other content areas.

Staff Recommendations

Staff recommends that the Commission approve the proposed modifications to the current Supplementary Authorization in Computer Concepts and Applications, including the revised Content Areas of Study for required coursework and the revised authorization name of “Computer Science.” Staff also recommends that if the Commission approves the proposed modifications that staff be directed to begin the regulatory process to enact these changes.

If any amendments to the requirements for these authorizations are included within new regulations, only teachers initially earning one of these authorizations in the future would be required to satisfy the revised Content Areas of Study and be issued the Supplementary Authorization in Computer Science. Any proposed regulations would include an effective date that provides transition time for teachers currently pursuing a supplementary authorization in CCA.

As specified in statute, all teachers who are currently authorized to teach the full range of courses in Computer Science education will remain authorized (e.g., holders of a Supplementary Authorization in CCA or a Single Subject teaching credential in Math, Business, or ITE) even if the proposed amendments are adopted within regulations.

Next Steps

If the Commission were to approve the proposed modifications described in this item, staff would begin the process to amend Title 5 of the California Code of Regulations sections 80089.1 and 80089.2.

Appendix A

Course Assignment Data for Computer Science Education in California K-12 Public Schools, 2011-2012					
Course Code	Course Name	Number of Schools	Total Course Enrollment	Number of Classes	Number of FTE Teachers
Computer Education					
2450	Computer literacy	919	82,087	3,607	575.78
2451	Computer programming	130	6,956	265	50.7
2453	Computer science	133	8,166	323	55.47
2454	Computer lab	165	11,729	521	92.48
2455	Web design	172	5,741	285	48.08
2458	Other computer education course	425	31,027	1,594	224.85
2470	AP Computer science A	84	3,149	116	22.57
2471	AP Computer science AB	8	203	9	1.82
2465	IB Computer science	2	50	2	0.21
2466	IB Information technology in a global society	5	331	15	2.48
2479	MYP Computer Technology	13	951	36	7.02
Total:	Computer Education	2,056	150,390	6,773	1,081.46
Finance and Business					
4601	Computer operations/computer science	320	27,536	1,051	184.77
4610	Keyboarding (typing)	188	15,005	750	110.69
4614	Word processing occupations	83	7,926	329	45.45
4623	Business technology	120	7,567	363	50.61
4698	Other office/computer course	198	40,428	1,640	345.58
Total:	Finance and Business - Computers	909	98,462	4,133	737.10
Information Technology					
4603	Business and electronics communications	36	2,356	216	18.77
4604	Networking	24	421	48	4.83
4605	Web site development	58	2,372	91	16.62
4606	Computer graphics and media technology	59	4,834	175	32.13
4615	Information processing	174	14,856	569	98.61
4633	Information systems management	58	2,508	185	19.9
4649	Other information technology	97	5,787	272	41.06
Total:	Information Technology	506	33,134	1,556	231.92
Grand Totals		3,471	281,986	12,462	2,050

Source: California Department of Education - Educational Demographics Office - Statewide Course Listing Report
<http://data1.cde.ca.gov/dataquest/crselist1.asp?cChoice=StCrse&subject=on&AP=on&IB=on&VE=on&cYear=2011-12&cLevel=State&cTopic=Course&myTimeFrame=S&submit1=Submit>

Appendix B Overview of Supplementary Authorizations

The Commission has issued Supplementary Authorizations for secondary teaching credentials since 1979 and for elementary teaching credentials since 1981 as specified in Education Code section 44256 (Appendix D). In addition, the Commission created Subject Matter Authorizations (effective January 1, 2005) aligned with the subject matter requirements in the federal mandate of the No Child Left Behind (NCLB) Act as an additional option for educators and school districts. Subject Matter Authorizations require 32 semester units of coursework in the content area and are compliant with NCLB but are only issued in NCLB designated core content areas. In contrast, Supplementary Authorizations require 20 semester units or 10 upper division/graduate level semester units in the content area.

There are two types of Supplementary Authorizations - Introductory and Specific. There are distinctions in the authorizations for each type noted in the table below depending on whether the authorization is Introductory or Specific and if it is added to an elementary or secondary teaching credential.

Introductory Supplementary Authorizations are issued in the same broad content areas as the Single Subject teaching credential; however, these authorizations are limited by either the grade level of the students or the curriculum level of the content. In contrast, the Specific Subject Supplementary Authorizations have the same grade level authorization as the Single Subject Teaching Credential, as indicated below.

Supplementary Authorizations by Type

Authorization Type	Prerequisite Credential*	Authorization Scope
Introductory Supplementary Authorization	Multiple Subject Teaching Credential	departmentalized instruction in the introductory subject listed on the credential in grades 9 and below
Introductory Supplementary Authorization	Single Subject Teaching Credential	departmentalized instruction in the introductory subject if the content is typically included in curriculum guidelines and textbooks for study in grades 9 and below, but the students in the class may be in grades 10-12
Specific Subject Supplementary Authorization	Single Subject Teaching Credential	departmentalized instruction in a specific narrow subject area (e.g., drama) in grades preschool, kindergarten-12, and classes organized primarily for adults

*Previously issued equivalent Standard Teaching Credentials would also serve as appropriate prerequisite credentials.

Current Requirements for Supplementary Authorizations

Individuals holding a valid, non-expired elementary or secondary teaching credential (e.g., Multiple or Single Subject Teaching Credential) may qualify to add a Supplementary Authorization upon the completion of one of the following:

- a. Twenty semester units or ten upper division semester units, or the equivalent quarter units, of non-remedial college coursework in the subject requested.
 - *Introductory* subjects require at least one course in each of the content areas listed; the balance of the ten or twenty units may be in any course within the subject category.
 - *Specific* subjects require the same unit total but there are no required content areas.
- b. A collegiate major from a regionally accredited college or university in a subject directly related to the subject to be listed on the credential.

Overview of Supplementary Authorizations in Computer Concepts and Applications

On January 31, 2001, regulations impacting the assignment of teachers who were authorized to teach classes in Computer Science or Computer Education were implemented. Prior to these regulations, an employing agency could assign any credentialed teacher whom the agency determined had the requisite knowledge and skills to teach these classes. With the addition of subsection (a) in Section 80005 in Title 5 of the California Code of Regulations (CCR), the subject area of computers was listed under three broad Single Subject teaching credential content areas: Business, Industrial and Technology Education, and Mathematics. The Commission also created the Supplementary Authorization in Computer Concepts and Applications (CCA) to allow fully credentialed teachers in other content areas to add an additional departmentalized authorization in this content area to their existing credential. Local employing agencies were no longer able to choose any credentialed teacher to teach computer science or education courses.

Because the Supplementary Authorization in Computer Concepts and Applications is not considered an NCLB core content area, this content area is only available as a Supplementary Authorization. The requirements, authorizations, and specified content areas for the Supplementary Authorizations are delineated in Title 5 of the CCR sections 80089 through 80089.2 in Appendix E. Additional references pertaining to this agenda item are also provided in Appendix F.

Data on Holders of Supplementary Authorizations in Computer Concepts and Applications

As of July 1, 2014, 3,450 teachers held a valid, non-expired teaching credential that included a Supplementary Authorization in CCA. The majority (59%) of these authorizations were issued to holders of secondary teaching credentials as a Specific Subject Supplementary Authorization for teaching CCA content in departmentalized classes at all grade levels. In contrast, approximately 41% were issued to holders of elementary teaching credentials as an Introductory Supplementary Authorization for teaching CCA content in departmentalized classes for students in grades 9 and below.

**A Proposal and Rationale to Update
the *Computer Concepts and Applications* Supplementary Authorization
to a *Computer Science* Supplementary Authorization**

**Submitted by
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**On behalf of
the Alliance for California Computing Education for Students and Schools and
the Computer Science Teachers Association**

Introduction

There is widespread support nationally, as well as a need in California, to increase the capacity of teachers for K-12 computer science education. This concept paper proposes amending the current course content requirements and changing the title of the *Computer Concepts and Applications* supplementary authorization to meet this need, thereby establishing a *Computer Science* supplementary authorization.

Computer Science

The field of computer science evolves so rapidly that it is sometimes difficult to clearly define its contents and delimit its boundaries. A definition of computer science with direct relevance to K-12 computer science education is:

*“Computer Science is the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society.”*¹

Computer science exposes students to the scientific and mathematical theories underlying the practice of computing and prepares them to create the next generation of technology innovations. Computing innovations have redefined science, engineering, and business and provide the infrastructure today for how we work, play and communicate.

For those not familiar with the discipline, and in particular for K-12 educators, there is a tendency to confuse the study of Computer science with other uses of computing technology within education – in particular:

- *Educational Technology*: use of computing to support learning across multiple disciplines;
- *Computing Literacy*: mastery of basic software applications;
- *Information Technology*: use of technologies by which people manipulate and share information in its various forms.

As a result, many schools fail to provide students with access to the key academic and scientific discipline of computer science.

The National Research Council² concluded that a basic understanding of computer science is now an essential ingredient to preparing high school graduates for life in the 21st century, and that the goals of K-12 computer science curriculum should be to:

- introduce the fundamental concepts of computer science to all students, beginning at the elementary school level;
- present computer science at the secondary school level in a way that is both accessible and

¹ *CSTA K-12 Computer Science Standards*, 2011, https://csta.acm.org/Curriculum/sub/CurrFiles/CSTA_K-12_CSS.pdf

² *Being fluent with information technology*. National Research Council Committee on Information Technology Literacy. (1999). Washington, DC: National Academy Press, http://www.nap.edu/catalog.php?record_id=6482.

- worthy of a curriculum credit (math or science);
- offer additional secondary-level computer science courses that allow interested students to study it in depth and prepare them for entry into the work force or college; and
- increase the knowledge of computer science for all students, especially those who are members of underrepresented groups.

Simply placing technology in the classroom is insufficient for teachers to develop this knowledge and these skills. Instead, our teachers must be prepared to cover the breadth of the CS discipline.

Background

Individuals who currently teach computer science in California's public K-12 schools may be authorized to do so via several teacher certification pathways:

- 1) Single Subject Teaching Credential in mathematics, business, or industrial and technology education;
- 2) Single Subject Teaching Credential in another subject with a supplementary authorization in Computer Concepts and Applications;
- 3) Designated Subjects Career Technical Education (CTE) Teaching Credential in Information Technology; or
- 4) Local assignment option from the Education Code that allows the school district to broadly assign a fully credentialed teacher outside of their authorized area, with the consent of the teacher based on a specified number of units in computer science coursework and authorization by their local governing board.

The focus of this concept paper is the second option. The *Computer Concepts and Applications* (CC&A) supplementary authorization focuses on enabling educators to teach students how to use computers as tools but not on the discipline of computer science, which instead empowers students to create the next computing tools. The CC&A supplementary authorization reads as follows³ (wording unrelated to content deleted):

Computer Concepts and Applications: •software evaluation and selection •hardware operation and functions •classroom uses of computers

- An Introduction to Data Processing may be used for hardware operations and functions.
- Java, Cobol, Basic, and Pascal are examples of computer languages and do not apply to hardware. These courses are acceptable as electives toward the overall unit requirement only.

Applicants for a supplementary authorization must satisfy one of the following requirements⁴:

1. Official transcripts showing the completion of either 20 semester units (or 10 upper-division semester units) of non-remedial course work in the subject, completed at a regionally accredited community college, college, or university:
 - 20 semester units are required if a combination of upper- and lower-division units are completed;
 - at least one course in each of the specified areas listed (for CC&A, software evaluation and selection, hardware operation and functions, classroom uses of computers), the balance of units may be in any course within the subject category;
 - a grade of "C" or higher is required in every course used to meet this requirement.
2. A collegiate major from a regionally accredited college or university in a subject directly related to the subject to be listed.

³ *Supplementary Authorization Guideline Book*, www.ctc.ca.gov/credentials/manuals-handbooks/Supplement-Auth.pdf.

⁴ *Credential Leaflets CL-629 and CL-603*, www.ctc.ca.gov/credentials/leaflets/cl629.pdf and www.ctc.ca.gov/credentials/leaflets/cl603.pdf.

Proposed Change and Rationale

The *Computer Concepts and Applications* supplementary authorization does not include adequate focus on computer science concepts and skills to inform teachers to teach any computer science classes (as distinguished from educational technology or information technology). In fact, none of the current certification pathways (with the possible exception of a collegiate major in a computing discipline as a supplement to a teaching credential) is sufficient. They do not require any computer science specific content or pedagogy, and as such do not adequately prepare to teach the discipline of computer science. As a result, none of these certification pathways, and the *Computer Concepts and Applications* supplementary authorization in particular, addresses the current economic imperative to improve student knowledge and interest in computer science.

This proposal is to update this supplementary authorization by placing greater emphasis on computer science concepts and skills so that the authorization better reflects the field of computing and provides teachers who hold credentials in other seemingly unrelated areas such as English, History, or Science a path for acquiring the content and skills to teach computer science courses at their schools.

Computer science and the technologies it enables lie at the economic heart of California's future. Businesses in nearly every sector are competing for computing talent to fill lucrative careers in technology, healthcare, entertainment, and countless other fields. It is predicted that by the year 2018, California will have 1.06 million jobs in the "STEM fields" (fields relying on science, technology, engineering and mathematics), and over half of these jobs (545,000) will be in computing. The state's economic competitiveness therefore depends on more young people studying computer science, and also a well-qualified teaching workforce to teach it. Computer science teachers need to be appropriately certified just as their colleagues in Arts, English, History, Math, Science, etc. need to be certified in their academic disciplines.

If California's students are to be competitive in the global economy, our education system must provide them with the opportunity to develop a fundamental understanding of computer science concepts and skills. This knowledge is essential if they are to thrive in a world where computing is ubiquitous. Computer science builds students' computational and critical thinking skills, showing them how to create, not simply use, new technologies. Computer science education challenges students to work together, think deeply, and to create innovative solutions to complex problems.

There is widespread support nationally to increase the capacity of teachers to meet the need for increased K-12 computer science education. The National Science Foundation has taken leadership on this issue in their CS 10K initiative to train 10,000 teachers to teach computer science in 10,000 schools. Moreover, at the present time, 20 states have a computer science teaching endorsement of one form or another. Eight of these states currently require the endorsement for teachers of some computer science courses (Texas for all computer science courses, Wisconsin for courses with more than 25% programming content, the six others for AP computer science courses only). The need for a *Computer Science* supplementary authorization in California is in keeping with this national trend.

California policymakers, business leaders, and educators are increasingly understanding the value of computer science education, as evidenced by the eight bills related to computer science education, mostly curricular related, proposed in the California legislature this year (2014) alone – see Table 1. Yet, curriculum alone is not enough. As more emphasis is placed on integrating computer science throughout the curriculum, we need to ensure that California teachers are adequately prepared to teach rigorous computer science coursework.

Table 1: 2014 California Legislation wrt K-12 Computer Science Education

Passed	Considered
AB 1764 (Olson/Buchanan): allows computer science to count toward advanced math credit in districts that require >2 math for graduation	AB 1530 (Chau): requests the Superintendent of Public Instruction to identify and recommend model CS curriculum for K-6 for adoption by the State Board of Education
SB 1200 (Padilla): requests UC/CSU to establish guidelines for CS classes that satisfy college admission requirements	AB 2110 (Ting): requires the Instructional Quality Commission to incorporate CS content into math, science, history, and English curriculum frameworks
AB 1539 (Hagman): requires the Instructional Quality Commission to develop K12 CS content standards 6 for adoption by the State Board of Education	AB 1540 (Hagman): allows dual enrollment in high school and community college computer science courses
AR 108 (Hagman): recognizes the week of December 8, 2014 as CSEdWeek (Computer Science Education Week)	AB 1940 (Hagman): defines STEM courses to include CS and establishes or expands AP courses with STEM curriculum

Proposed Update to Supplementary Authorization

The *Computer Concepts and Application* supplementary authorization is, in fact, redundant today. As technology is quickly evolving, our students’ ability to adapt to this technology is eclipsing what teachers know and what they are prepared to teach. Students growing up in the 21st century are “digital natives”—they already know how to evaluate and select software for their needs; they are often the “sys admin” for their family’s home computers and thus understand hardware. Moreover, California pre-service teachers are required to be trained in classroom uses of technology and computers, so the third content area is redundant with basic teacher preparation.

The current *Computer Concepts and Applications* supplementary authorization does not ensure that teachers have the requisite knowledge base and skills in computer science and computational thinking to adequately teach computer science in California’s classrooms. Despite this, teachers interested in teaching computer science courses at the high school level are still being directed to obtain this mostly irrelevant authorization.

Two national organizations have proposed content knowledge standards for computer science teachers.

- The Computer Science Teachers Association (CSTA) published *Ensuring Exemplary Teaching in an Essential Discipline: Addressing the Crisis in Computer Science Teacher Certification*⁵. In this report, CSTA recommends that computer science teachers who *do not* have an academic background in computer science (e.g., either a minor or a bachelor’s degree or higher) should complete advanced coursework in the following academic areas:
 - a. *programming*
 - b. *object-oriented design*
 - c. *data structures and algorithms*
 - d. *computer hardware and organization*

CSTA also recommends a computer science teaching methods course or it’s equivalent.

⁵ <http://www.csta.acm.org/Communications/sub/DocsPresentationFiles/CertificationFinal.pdf>.

- The International Society for Technology in Education (ISTE) published the *ISTE Standards for Computer Science Educators*⁶ for evaluating the skills and knowledge that computer science educators need to reach, inspire and teach students in computing. ISTE’s standards recommend the following content knowledge:
 - a. *data representation and abstraction*
 - b. *design, develop and test algorithms*
 - c. *digital devices, systems and networks*
 - d. *impact of computing in the modern world*

The ISTE standards also include standards for effective teaching and learning, learning environments, and professional knowledge and skills.

Note that these standards make clear, and this proposal agrees, that computer science is not focused entirely upon programming or “coding”, a view that has been largely debunked by current content and pedagogical research. Programming is merely one of the foundational tools required in a student’s computational toolbox.

Based on the recommendations of these nationally recognized organizations, now is the time for California to update the *Computer Concepts and Applications* supplementary authorization for the 21st century to a **Computer Science** supplementary authorization. Briefly, the update should consist of the following content areas:

Computer Science: •computer programming •data structures and algorithms •digital devices, systems and networks •software design •impacts of computing

These content areas are briefly expanded here:

- *Programming* should include expertise in at least one modern, high-level programming language.
- *Data structures and algorithms* covers data representation, abstraction, searching and sorting in the context of solving problems using programming and computational tools.
- *Digital devices, systems and networks* should cover devices and the systems they compose, including the concepts and abstractions that enable stand-alone, networked, and mobile digital devices to operate and communicate.
- *Software design* refers to the process of planning, engineering and implementing a software system to solve a problem, typically using both a design and a programming methodology. Programming methodologies that facilitate design include object-oriented and functional approaches.
- *Impacts of computing* includes the social, ethical, and legal issues and impacts of computing, as well as the contributions of computer science to current and future innovations in sciences, humanities, the arts, and commerce. These topics are typically covered within courses covering the other content areas.

An understanding of pedagogy and effective teaching methods and practices is critical for successful instruction in computing classrooms. In particular, computer science educators should learn teaching practices identified as being equitable and effective for rigorous and active learning for *all* students⁷⁸. This is particularly important for the discipline of computer science, where research has shown the centrality of pedagogy needed for the successful engagement of girls and

⁶ http://www.iste.org/docs/pdfs/20-14_ISTE_Standards-CSE_PDF.pdf

⁷ Darling-Hammond, L. (2008). *Powerful Learning: What we know about teaching for understanding*. San Francisco, CA: Jossey-Bass.

⁸ National Research Council. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning*. Washington, DC.: National Academies Press.

students of color⁹. Such teaching methods could be integrated into courses covering the content areas, offered specifically for teachers, or it could be achieved by an independent computer science teaching methods course. However, since supplementary authorizations do not currently require additional pedagogical knowledge, we have only indicated the requisite content knowledge for a **Computer Science** supplementary authorization above.

As specified within the California Education Code, all teachers who are currently authorized to teach computer science courses will remain authorized after this updated supplementary authorization goes into effect. A credential holder always retains the authorization they were initially issued even when new standards or requirements take effect. Further, this current proposal only seeks to amend the content knowledge required for the supplementary authorization to provide a viable option for earning a computer science focused authorization in the future. This proposal does not include removing the authorization from future Single Subject Teachers in Mathematics, Business, or Industrial Technology Education though we do encourage a full review of the subject matter requirements and pedagogy standards that support an authorization for teaching computer science.

There is an unprecedented focus on the pressing need for more and better computer science education in our schools. This focus is driven by the increasing ubiquity of computing technologies in our lives and by the economic imperative of a growing shortage of workers to fill the current and predicted jobs. It is also driven by the acknowledgement that we need to move our education system beyond teaching students to be passive users and consumers of the tools of innovation to being the creators of the technology the world will use. In California, our goal is to ensure that our teachers are well prepared to address the learning content for which they are responsible. If we are to ensure that our teachers are prepared to teach the skills and concepts of computer science, we must revise the current supplementary authorization for computer science teachers to ensure that it is both relevant and rigorous.

Now is an opportune time for the California Commission on Teacher Credentialing to reexamine and modernize the certification pathways for California's computer science educators, beginning by updating the supplementary authorization to focus on computer science and strive to meet the needs of our students in the 21st century.

⁹ Jane Margolis, Joanna Goode, Gail Chapman, and Jean J. Ryoo. 2014. That classroom 'magic'. *Commun. ACM* 57, 7 (July 2014), 31-33. <http://doi.acm.org/10.1145/2618107>

Appendix D

California Education Code section 44256.

Authorization for teaching credentials shall be of four basic kinds, as defined below:

(a) "Single subject instruction" means the practice of assignment of teachers and students to specified subject matter courses, as is commonly practiced in California high schools and most California junior high schools. The holder of a single subject teaching credential or a standard secondary credential or a special secondary teaching credential, as defined in this subdivision, who has completed 20 semester hours of coursework or 10 semester hours of upper division or graduate coursework approved by the commission at an accredited institution in any subject commonly taught in grades 7 to 12, inclusive, other than the subject for which he or she is already certificated to teach, shall be eligible to have this subject appear on the credential as an authorization to teach this subject. The commission, by regulation, may require that evidence of additional competence is a condition for instruction in particular subjects, including, but not limited to, foreign languages. The commission may establish and implement alternative requirements for additional authorizations to the single subject credential on the basis of specialized needs. For purposes of this subdivision, a special secondary teaching credential means a special secondary teaching credential issued on the basis of at least a baccalaureate degree, a student teaching requirement, and 24 semester units of coursework in the subject specialty of the credential.

(b) "Multiple subject instruction" means the practice of assignment of teachers and students for multiple subject matter instruction, as is commonly practiced in California elementary schools and as is commonly practiced in early childhood education.

The holder of a multiple subject teaching credential or a standard elementary credential who has completed 20 semester hours of coursework or 10 semester hours of upper division or graduate coursework approved by the commission at an accredited institution in any subject commonly taught in grades 9 and below shall be eligible to have that subject appear on the credential as authorization to teach the subject in departmentalized classes in grades 9 and below. The governing board of a school district by resolution may authorize the holder of a multiple subject teaching credential or a standard elementary credential to teach any subject in departmentalized classes to a given class or group of students below grade 9, provided that the teacher has completed at least 12 semester units, or six upper division or graduate units, of coursework at an accredited institution in each subject to be taught. The authorization shall be with the teacher's consent. However, the commission, by regulation, may provide that evidence of additional competence is necessary for instruction in particular subjects, including, but not limited to, foreign languages. The commission may establish and implement alternative requirements for additional authorizations to the multiple subject credential on the basis of specialized needs.

(c) "Specialist instruction" means any specialty requiring advanced preparation or special competence, including, but not limited to, reading specialist, mathematics specialist,

specialist in special education, or early childhood education, and such other specialties as the commission may determine.

- (d) "Designated subjects" means the practice of assignment of teachers and students to designated technical, trade, or career technical courses which courses may be part of a program of trade, technical, or career technical education.

(Amended by Stats. 2008, Ch. 223, Sec. 3. Effective January 1, 2009.)

Appendix E

Title 5 of the California Code of Regulations §§80089, 80089.1 and 80089.2

§80089. Adding Supplementary Authorizations to Teaching Credentials Used Predominantly in Secondary Schools.

- (a) The holder of a valid teaching credential specified in Education Code Section 44256(a) may have one or more of the subjects listed in Sections 80089.1 and 80089.2, added as a supplementary authorization. The candidate or an approved institution shall verify completion of either (1) or (2) below:
- (1) 20 semester hours or 10 upper division semester hours of non-remedial collegiate coursework in a subject listed in Sections 80089.1 or 80089.2, or
 - (2) a collegiate major in a subject directly related to each subject listed in Sections 80089.1 or 80089.2. A "C" grade or above in any course used to meet provisions of this section shall be required. Non-remedial coursework for the purposes of this section shall be defined as coursework that is applicable to a bachelor's degree or a higher degree at a regionally accredited college or university.
- (b) Authorization.
- (1) A supplementary authorization added under the provisions of Section 80089.1 authorizes the holder to teach that subject at any grade level; preschool, kindergarten, grades 1-12, or in classes organized primarily for adults;
 - (2) A supplementary authorization added under the provisions of Section 80089.2 authorizes the holder to teach at any grade level (preschool, kindergarten, grades 1-12, or in classes organized primarily for adults) only the subject matter content typically included for that subject in curriculum guidelines and textbooks for study in grades 9 and below.
- (c) Applicants who are progressing toward completion of supplementary authorization requirements as they existed on July 1, 1996, shall have until July 1, 1998, to apply for said authorizations.

Note: Authority cited: Section 44225, Education Code. Reference: Sections 44256 and 44349, Education Code.

§80089.1. Subjects Added as Supplementary Authorizations (Specific Subjects).

- (a) The following listed subjects may be added as supplementary authorizations to a valid teaching credential specified in Education Code Section 44256(a):

Accounting including finance	Geosciences
Agricultural mechanic	Graphic Arts
Animal science	Industrial crafts and plastics
Anthropology	Instrumental music
Auto mechanics	Interior design (home economics)
Biological Sciences	Journalism

Chemistry	Literature
Child development (home economics)	Marketing/entrepreneurship
Clothing and textiles (home economics)	Metals (industrial arts)
Comparative political systems and international relations	Office technologies including word processing and business communications
Computer concepts and applications	Ornamental horticulture
Consumer education (home economics)	Painting and drawing
Crafts, including jewelry and ceramics (art)	Photography
Dance	Physics
Drafting	Plant science
Drama	Plastics (industrial arts)
Economics	Psychology
Economic and consumer education	Sociology
Electronics	Speech
English Composition	US Government and US Civics
Family life and parenting (home economics)	US History and California History
Family life education including drug, alcohol and tobacco use prevention (health science)	Vocal Music
Food and nutrition (home economics)	Woods (industrial arts)
Forestry and horticulture	World History
Geography	

- (b) A supplementary authorization in a specific subject of Science may be added to a valid teaching credential specified in Education Code Section 44256(a). The course of study for Biological Sciences or Chemistry or Geosciences or Physics must include each of the components for that area. One of the courses must include a laboratory component.
- (1) Biological Sciences, including: Molecular and Cellular Biology, Biology of Organisms, and Evolution.
 - (2) Chemistry, including: Structure and Stability, and Chemical Reactions.
 - (3) Geosciences, including: Astronomy, Geology, Meteorology and Oceanography.
 - (4) Physics, including: Energy - Mechanics, Energy - Heat Energy - Electricity and Magnetism, Wave Motion and Atomic and Nuclear Physics.
- (c) A supplementary authorization in each of the specific subjects of Child development (home economics), Clothing and textiles (home economics), Food and nutrition (home economics), and Interior design (home economics) must include a laboratory component.
- (d) A supplementary authorization in the subject of Family life education including drug, alcohol, and tobacco use prevention (health science) must include the following components: sexually transmitted disease including HIV/AIDS, human development and

human sexuality, parenting education, violence prevention, and drug, alcohol and tobacco use prevention and cessation.

Note: Authority cited: Section 44225, Education Code. Reference: Sections 44256 and 44349, Education Code.

§80089.2. Subjects Added as Introductory Supplementary Authorizations.

(a) Candidates seeking supplementary authorization in any language other than English shall, in addition to the requirements specified in Section 80089, submit verification of having either (1), (2), (3), or (4) below:

- (1) passed the oral language portion of the Bilingual Certificate of Competence Examination in the language to be listed on the credential. Such verification shall be in the form of a letter from any institution or other educational agency, approved by the Commission as an assessor agency for the Bilingual Certificate of Competence. Whenever a written assessment instrument for a language other than Spanish is not available, a panel may be used by assessor agencies to assess a candidate's knowledge of the target language competencies, in accordance with Commission guidelines regulating assessment for languages other than Spanish, or
- (2) passed the speaking and listening sections of Test 6 of the Crosscultural Language and Academic Development/Bilingual Crosscultural Language and Academic Development (CLAD/BCLAD) Examinations described in Section 80015.3 in the language to be listed on the credential; or
- (3) oral proficiency in the language to be listed on the credential at a level equivalent to that of a person with a bachelor's degree with a major in that language. This level of proficiency shall be verified by a letter from the Chair of the Language Department of a regionally accredited 4 year college or university; or
- (4) oral proficiency in the language to be listed on the credential at the level required to complete a Bilingual Emphasis or Bilingual Crosscultural Language and Academic Development (BCLAD) Emphasis Credential Program as verified by a letter from a person authorized to issue such verification by the college or university that offers such a program.

(b) The following listed subjects may be added as introductory supplementary authorizations to a valid teaching credential specified in Education Code Section 44256(a).

- (1) Introductory Agriculture, including at least one course in each of the following areas: animal science, plant science, and agricultural mechanics;
- (2) Introductory Art, including at least one course in each of the following areas: drawing and painting, art history or appreciation, and crafts;
- (3) Introductory Business, including at least one course in each of the following areas: business management, business marketing or introduction to business, computer concepts and applications, economics, business communications or business English, and accounting;
- (4) Introductory English, including at least one course in each of the following areas: composition, literature, and grammar or language structure;

- (5) Introductory Language Other Than English (Specify), including at least one course in the language covering each of the following areas: grammar, composition, conversation, and literature;
 - (6) Introductory Health Sciences, including at least one course in each of the following areas: substance abuse (including alcohol, drug, and tobacco), family life education (including human sexuality, HIV/AIDS, and sexually transmitted diseases), nutrition, comprehensive school health systems or programs, and health education theory, behavior, or foundations;
 - (7) Introductory Home Economics, including at least one course in each of the following areas: food and nutrition, clothing, child development, and family life and parenting;
 - (8) Introductory Industrial Arts, including at least one course in each of the following areas: drafting or graphic arts, woods or metals, and electricity or electronics;
 - (9) Introductory Mathematics, including at least one course in each of the following areas (all course work shall be at least at a level for which intermediate algebra is a prerequisite): college algebra, geometry, and development of the real number system or introduction to mathematics; or three courses in calculus or other mathematics courses for which algebra and geometry are prerequisites;
 - (10) Introductory Music, including at least one course in each of the following areas: vocal music, instrumental music, music history or appreciation, and music theory;
 - (11) Introductory Physical Education, including at least one course in each of the following areas: team sports and games; fundamental and creative movement skills (such as dance and gymnastics); human movement, motor development, and/or motor learning; and individual, dual, nontraditional and global sports and games (such as aquatics, conditioning, and archery);
 - (12) Introductory Science, including at least one course in each of the following areas: biological sciences, chemistry, geosciences, and physics; and (13) Introductory Social Science, including at least one course in each of the following areas: United States history, California history, world history, geography, and United States government.
- (c) Introductory Home Economics Supplementary Authorizations must include a laboratory component in one of the listed subject areas. The course of study must cover both subject areas of food and nutrition but a single course may be used to meet the requirement. The course of study must cover both subject areas of family life and parenting, but a single course may be used to meet the requirement.
- (d) Introductory Science Supplementary Authorizations Authorized by 80089.2(b)(12) shall include a one year sequence of courses in at least two of the listed subject areas. At least one course must include a laboratory component.

Note: Authority cited: Section 44225, Education Code. Reference: Sections 44256 and 44349, Education Code.

§80089.3. Introductory Subject Matter Authorizations.

- (a) The holder of a valid teaching credential specified in Education Code Section 44256(a) and
- (b) may have one or more of the subjects listed in subsection (b) added as an introductory

subject matter authorization. Equivalent quarter hours may be used to meet the semester hour requirement. The candidate shall verify completion of either (1) or (2) below:

- (1) a collegiate major from a regionally accredited college or university in a subject or in a subject directly related to each subject from subsection (b) to be listed, or
 - (2) 32 semester or 48 quarter hours of non-remedial collegiate coursework in a subject listed in subsection (b). Included within the 32 semester or 48 quarter hours is a minimum of three semester or four quarter hours in each of the specific content areas listed for the subject in subsection (b) except for Science which requires a minimum of six semester or eight quarter hours in each of the specific content areas listed. A grade of "C" or above in any course used to meet the provisions of this subsection shall be required. Non-remedial coursework for the purpose of this section shall be defined as coursework that is applicable toward a bachelor's degree or a higher degree at a regionally accredited college or university.
- (b) The following subjects may be added as introductory subject matter authorizations to a valid teaching credential specified in Education Code Section 44256(a) and (b):
- (1) Art, with the content areas of art history including aesthetics and appreciation, two-dimensional art including drawing, painting, and printmaking, three-dimensional art including sculpture and ceramics, and photography/computer generated imagery;
 - (2) English with the content areas of grammar or language structure, advanced composition, speech, drama or theatre, and literature;
 - (3) A Language Other Than English (specify) with the content areas of grammar, composition, culture, conversation, and literature;
 - (4) Mathematics with the content areas of algebra, advanced algebra, geometry, probability or statistics, and development of the real number system or introduction to mathematics;
 - (5) Music with the content areas of vocal music including the analysis of repertoire and literature appreciation for developing musicians, instrumental music including the analysis of repertoire and literature appreciation for developing musicians, aural musicianship, keyboard, music history including music appreciation, world music, conducting, and music theory;
 - (6) Science with the content areas of biological sciences, chemistry, geosciences, and physics; and
 - (7) Social Science with the content areas of United States history, California history, world history, world civilization or world cultures, physical geography, and United States government.
- (c) A subject specified in subsection (b) as an introductory subject matter authorization authorizes the holder to teach only the subject matter content typically included for that subject in curriculum guidelines and textbooks approved for study in grades 9 and below to students in preschool, kindergarten, grades 1-12, or in classes organized primarily for adults.

Note: Authority cited: Sections 12001 and 44225, Education Code. Reference: Sections 44225(e), 44256 and 44349, Education Code; and 20 U.S.C. Sections 6319(a) and 7801(23).

§80089.4. Specific Subject Matter Authorizations.

(a) The holder of a valid teaching credential specified in Education Code Section 44256(a) and (b) may have one or more of the subjects listed in subsection (b) added as a specific subject matter authorization. Equivalent quarter hours may be used to meet the semester hour requirement. The candidate shall verify completion of either (1) or (2) below:

(1) a collegiate major from a regionally accredited college or university in a subject directly related to each subject from subsection (b) to be listed, or

(2) 32 semester or 48 quarter hours of non-remedial collegiate coursework directly related to the requested subject listed in subsection (b) except for history which requires a minimum of 16 semester units in both world history and U. S. history. A grade of "C" or above in any course used to meet the provisions of this subsection shall be required. Non-remedial coursework for the purposes of this section shall be defined as coursework that is applicable toward a bachelor's degree or a higher degree at a regionally accredited college or university.

(b) The following subjects may be added as a specific subject matter authorization to a valid teaching credential specified in Education Code Section 44256(a) and (b):

- | | |
|----------------------------|-----------------------|
| Art History/Appreciation | History |
| Biological Sciences | Instrumental Music |
| Chemistry | Literature |
| Civics/Government | Photography |
| Dance | Physics |
| Drama/Theatre | Plant Science |
| Economics (social science) | Three-Dimensional Art |
| English Composition | Two-Dimensional Art |
| Geography | Vocal Music |
| Geosciences | |

(c) A subject specified in subsection (b) as a specific subject matter authorization authorizes the holder to teach courses in the specific subject in departmentalized classes in grades preschool and K-12 or in classes organized primarily for adults.

Note: Authority cited: Sections 12001 and 44225, Education Code. Reference: Sections 44225(e) and 44256, Education Code; and 20 U.S.C. Sections 6319(a) and 7801(23).

Appendix F

References

1. *Supplementary Authorizations for Single Subject Teaching Credential*
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2. *Supplementary Authorizations for Multiple Subjects Teaching Credential*
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<http://www.ctc.ca.gov/credentials/leaflets/cl629.pdf>
3. *Supplementary Authorization Worksheet*
Credential Information Leaflet CL-696b:
<http://www.ctc.ca.gov/credentials/leaflets/cl696b.pdf>
4. *Supplementary Authorization Guideline Book, Edition May 2012*
<http://www.ctc.ca.gov/credentials/manuals-handbooks/Supplement-Auth.pdf>
5. Policy Issues Pertaining to Supplementary and Subject Matter Authorizations Added to General Education Teaching Credentials – Agenda Item 5B, August 2014:
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