Date of Hearing: March 27, 2019

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ASSEMBLY COMMITTEE ON EDUCATION
Patrick O'Donnell, Chair
AB 182 (Luz Rivas) – As Introduced January 10, 2019

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SUBJECT: Teacher credentialing: computer science

SUMMARY: Establishes a single subject teaching credential in the subject of computer science. Specifically, **this bill**:

1) Establishes a single subject teaching credential in computer science.

2) Authorizes a person issued a single subject teaching credential in business, industrial and technology education, or mathematics before the establishment of a single subject teaching credential in computer science to teach computer science.

3) Prohibits a person pursuing a single subject teaching credential in business, industrial and technology education, or mathematics before the establishment of a single subject teaching credential in computer science from being subject to additional requirements for the single subject teaching credential in business, industrial and technology education, or mathematics as a result of the above authorization to continue to teach computer science.

4) States that nothing in the section of law amended by this bill shall be construed to prohibit a school district from employing or a person who holds a single subject teaching credential in another subject with an authorization to teach computer science from teaching computer science.

EXISTING LAW:

1) Authorizes the Commission on Teacher Credentialing (CTC) to issue single subject teaching credentials in agriculture, art, business, English, foreign language, health science, home economics, industrial and technology education, mathematics, music, physical education, science, and social science.

2) Authorizes the CTC to issue a multiple or single subject teaching credential with a specified concentration in a particular subject based upon the depth of an applicant's preparation in an important subject of the school curriculum in order to ensure excellence in teaching in specific subjects.

3) Authorizes, through regulations, holders of single subject credentials in business, industrial and technology education, or mathematics to teach computer science. (CCR Title V, 80005(a)(9)).

4) Authorizes the CTC to issue credentials for teaching specialties, including bilingual education, early childhood education, and special education. Education specialist teaching credentials are to be based upon a baccalaureate degree from an accredited institution, completion of a program of professional preparation, and standards that the CTC may establish.

5) Requires the Superintendent of Public Instruction (SPI) to convene a computer science strategic implementation advisory panel to develop recommendations for a computer science strategic implementation plan.

6) Requires the panel, by January 15, 2019, to submit recommendations for a computer science strategic implementation plan to the SPI, the SBE, and the Legislature that includes, at a minimum, recommendations on all of the following:

   a) broadening the pool of teachers to teach computer science

   b) defining computer science education principles that meet the needs of pupils in all grades

   c) ensuring that all pupils have access to quality computer science courses

7) Requires the Instructional Quality Commission (IQC) to consider developing and recommending to the SBE, on or before July 31, 2019, computer science content standards for kindergarten and grades 1 to 12 pursuant to recommendations developed by a group of computer science experts.

8) States that if a school district requires more than two courses in mathematics for graduation from high school, the district may award a student up to one mathematics course credit for successfully completing a "category C" approved computer science course. (EC 51225.35)

9) Requires the California State University, and requests the University of California, to develop guidelines for high school computer science courses that may be approved for the purposes of recognition for admission. (EC 66205.5)

FISCAL EFFECT: Unknown

COMMENTS:

Need for the bill. The author states, "Despite being a global leader in digital technology, California isn't fully preparing its own students to take advantage of these growing economic opportunities.

According to a recent study, about 71 percent of Silicon Valley tech workers are international citizens. Computer science is one of the fastest growing job fields in California, with over 75,000 open computing jobs with an average salary above $100,000. Yet Computer science is listed by the U.S. Department of Education as a teacher shortage area for California. Meanwhile, demand is high: Ninety three percent of parents want their child to study computer science, but only thirty five percent of high schools offer a computer science course.

AB 182 will create a single subject teaching credential in computer science to expand the teaching workforce and give California's students the opportunity to meet the technological demand."

Draft computer science strategic implementation plan recommends establishing a new single subject credential in computer science, among other measures to improve teachers' skills and authorization to teach CS. Current law requires the Superintendent of Public Instruction (SPI) to convene a computer science strategic implementation advisory panel to develop recommendations for a computer science strategic implementation plan, and requires the panel to submit recommendations for a strategic plan to the SBE by January 15, 2019. In September, 2018, the panel submitted a draft strategic plan to the SBE for consideration, and the SBE is expected to act on the plan this spring.

The draft plan makes numerous recommendations regarding teacher credentialing, authorization, and training, noting that K-12 computer science education cannot grow in California without increasing the number of teachers qualified to teach CS. The plan endorses a multi-pronged approach that addresses to credentialing, the recruitment of new teachers, teacher training, teacher communities, administrator and counselor training, awareness of California's computer science standards and institutional and financial support.

One of the measures the plan endorses is the establishment of a new single subject credential in computer science in the next three years. The draft plan notes: "Passing legislation to develop a CS single-subject credential could encourage more aspiring teachers to pursue CS teaching. To support this strategy, CCTC could develop a California Subject Examination for Teachers (CSET) or consider adopting the forthcoming CS PRAXIS® exam from the Educational Testing Service."

The draft plan notes problems with the current system of credentialing for computer science instruction at the secondary level (discussed in further detail below):

- The teachers currently authorized to teach computer science (holders of credentials in mathematics, business, and industrial and technology education) receive no preparation to teach computer science in their credentialing programs.

- The only teachers who do receive preparation to teach computer science are teachers who have completed their credentialing program in another subject and are willing to take additional coursework to earn a supplementary authorization in computer science.

- No credentialing programs in computer science exist in California, and it's unlikely that any will be developed while there is no credential for them to lead to.

Other strategies endorsed by the draft plan to improve the availability of computer science instruction include:

- Establishing a grant program for teachers to support the completion of course work for the computer science supplementary authorization, with additional incentive for teachers who work in low-income and underserved school districts and rural and urban school districts.

- Providing professional development programs for in-service teachers to learn how to teach concepts and practices aligned to the California computer science standards, differentiated for grade and skill levels.

Next month the Committee will hear a bill (AB 1410, Quirk Silva) which would create a grant program to support the above objectives of increasing the number of teachers holding supplementary authorizations in computer science and the number of elementary school teachers trained to teach computer science. ***The Committee may wish to consider*** that, since these are activities which can be undertaken immediately, while a new credential (and the preparation programs a credential would require) takes time to develop, that bill would help the state expand the availability of computer science instruction in the near term, while a credential – if one is authorized - is being developed.

Who is authorized to teach computer science in California? California has three single subject teaching credentials (mathematics, business, and ITE) authorize teachers to provide instruction in computer science. Supplementary authorizations are added to a teacher's authorization in another subject.

The CTC recently modified their Computer Concepts and Applications authorization to reflect a change in focus from teaching basic computer use, keyboarding, and software application to broader preparation in computer science education. The CTC approved the proposed modifications, including changing the name of the authorization to "Computer Science" in 2016.

To obtain a supplementary authorization in computer science, teachers must complete twenty semester units or ten upper division semester units, or the equivalent quarter units, of non-remedial course work in computer science. They may also qualify by holding a collegiate major from a regionally accredited college or university in a subject directly related to the subject to be listed on the credential. The coursework must cover the following content areas:

- Computer Programming: includes expertise in at least one modern, high-level programming language (e.g., Python, Java, C/C++/C#).
- 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: covers computer and communication 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: covers the process of planning, engineering and implementing a software system to solve a problem, typically using both a design and a programming methodology, such as 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 the arts, business, humanities, medicine, and science.
- The balance of the units may be in any course that falls within the academic department for that subject category.

Because this supplementary authorization was developed prior to the state adoption of content standards in computer science in 2018, the authorization may need to be revised again.

Who currently teaches computer science in California? According to the draft computer science strategic implementation plan, in the 2016-2017 academic year, approximately 2,273 teachers in California taught core academic computer science courses. This number has grown steadily from 1,609 teachers in 2014-2015 and 1,996 teachers in 2015-2016. As shown in the adjacent table, most teachers leading core academic CS courses are credentialed in subjects other than mathematics, business, or ITE and hold a supplementary authorization to teach computer science. Teachers credentialed in mathematics comprise the largest number.
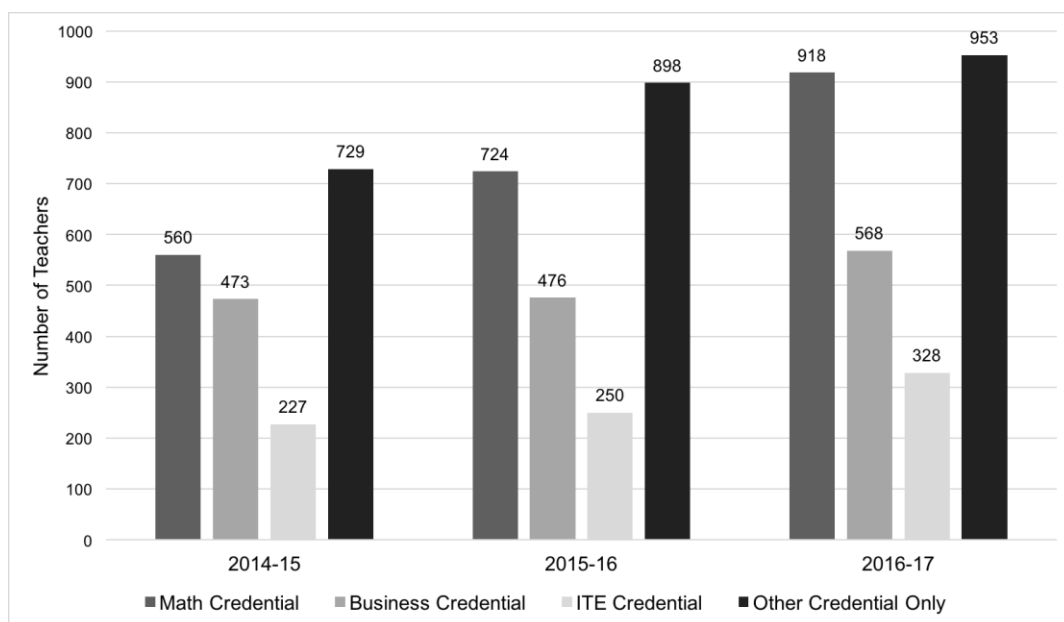
No preservice preparation programs in computer science exist in California. The draft plan notes that there are no pre-service CS teacher preparation programs in California. This is not surprising, since there is no CS credential to earn through such a program. Some content on computational thinking and CS have been added to some preparation programs in other disciplines, such as math and science. Some universities have created programs for in-service teachers to satisfy the course requirements for the supplementary authorization in CS. The plan notes that there are programs at University of California, Irvine and University of California, Riverside.

Teachers currently authorized to teach computer science receive no training in computer science in their preparation programs. The draft computer science strategic implementation plan notes that "A major weakness of the existing situation is that single-subject credentialed teachers authorized to teach CS (i.e., Math, Business, or ITE) do not have subject matter requirements that cover basic CS content. Furthermore, they are not trained in pedagogical knowledge relevant to CS, which is different from their core subject. The supplementary authorizations in CS, on the other hand, do require courses that cover CS content knowledge. Yet, there are very few opportunities for credentialed teachers to enroll in such programs and these teachers will not necessarily have had practice teaching in a CS classroom."

State rarely creates new single subject credentials. Reflecting policy considerations discussed below, it is exceedingly rare for the state to establish new single subject credentials.

The last time the Legislature authorized new single subject credentials was in the subjects of dance and theater, in 2016. This reversed a 46-year policy, widely believed to have been a result of a typo, which eliminated those credentials in 1970. According to the CTC, prior to the dance and theater credentials, the last new single subject credential created in statute was established in 1995.

When considering proposals such as this one, the state must balance the need for appropriately trained workforce to deliver instruction with the ability of schools to properly staff their classrooms. The state, through its policy, can create or exacerbate shortages or even result in *less qualified* individuals providing instruction to students. Define a credential too broadly and teachers may not have the all the preparation necessary to effectively teach the content; define it too narrowly and schools may not be able to find a properly authorized teacher and will either not be able to offer the coursework or may have to rely on individuals with no training at all.

An example can be found in the credentialing of special education teachers (who hold the Education Specialist credential). As noted in the 2015 report of the Special Education Statewide Task Force, convened by the CDE, CTC, and the State Board of Education:

> The preparation of Education Specialists is further fragmented because preparation programs are currently designed around specific categories of disabilities. An Education Specialist may earn an authorization to work with students who have a specific disability, but this educator cannot serve a wider range of student learners—even though there is no research to support the assumption that a label or disability category always predetermines a student's instructional need or a teacher's effectiveness.

> Furthermore, narrow authorizations tend to reduce the amount of time students with disabilities spend in general education classrooms, again because most Education Specialists are not prepared to support students in the general education settings. These rules present significant roadblocks to collaboration between general education and special education teachers and to the creation of collaborative systems. Even worse: because there is a short supply of special educators, students with disabilities are sometimes taught by substitute teachers or paraprofessionals who may not be adequately prepared to give students the services and the supports they need.

Single subject credentials also take time to develop. According to the CTC, the time required to develop standards and a new subject matter examination, after an expert panel is assembled, is about one year. They estimate that it requires about two years for institutions of higher education to establish new preservice preparation programs.

Arguments in support. TechNet writes:

> "Providing access to computer science education is a critical step for ensuring that California remains competitive in the global economy and strengthens its cybersecurity. Unfortunately, education in computer science is not offered to most Californians. Currently, only 32% of California public high schools teach computer science. In 2015, California had only 4,029 computer science graduates, and only 16% were women. Student exposure to computer science at a young age is critical to address the diversity gap in computer science fields.

> By adding computer science to the list of authorized subjects for a single subject teaching credential, AB 182 would help close that teacher shortage by creating a new, more direct pathway to authorization. Currently, teachers must be credentialed in math, business, or industrial and technology education to teach computer science. Creating a dedicated single subject teaching credential for computer science will make it easier for qualified educators to become credentialed, allowing more schools to hire computer science teachers and expanding computer science education to more students."

Arguments in opposition. The Association of California School Administrators (ACSA) writes:

> "ACSA consistently opposes additional credential requirements, especially in single subjects. We believe the current teacher credentialing system is overly complicated and costly, resulting in a deterrence to enter the teaching profession.
>
> School districts are faced with ensuring the correct credentialed employee is teaching the class to which they are credentialed. The establishment of broader credential applications allows for the placement of more teachers in front of students to make certain they are being taught by a properly credentialed teacher. Limiting computer science teachers to only teach computer science will exacerbate our math and science teacher shortage by limiting the placement of computer science teachers to only computer science classrooms."

What is the subject of computer science in grades K-12? Computer Science is a new field of study for K-12 education. The Computer Science Strategic Implementation Panel's draft report notes that there is some confusion over what constitutes computer science instruction in K-12 schools: "CS is often misconstrued with other technological terminology such as computer literacy, educational technology, digital citizenship, and information technology. These areas focus more on the use of computing systems (e.g., learning to use word processing software). In contrast, computer science calls upon students to understand why and how computing technologies work, and then to build upon that conceptual knowledge by creating computational artifacts."

The state's new CS standards define CS education as "the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society." The core concepts in computer science instruction are:

Computing systems (CS): People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form. An understanding of hardware and software is useful when troubleshooting a computing system that does not work as intended.

Networks and Information systems (NI): Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world by providing fast, secure communication and facilitating innovation

Data and Analysis (DA): Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.

Algorithms and Programming (AP): An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems. The development process to create meaningful and efficient programs

involves choosing which information to use and how to process and store it, breaking apart large problems into smaller ones, recombining existing solutions, and analyzing different solutions.

Impacts of Computing (IC): Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices. An informed and responsible person should understand the social implications of the digital world, including equity and access to computing.

According to the International Society for Technology in Education's report, *ISTE Standards for Computer Science Education,* the field of computer science will continue to rapidly evolve in sometimes unpredictable ways, and as such, plans for teaching computer science will also need the flexibility to continuously adapt.

State's first computer science content standards adopted in 2018. Current law requires the IQC to consider developing and recommending computer science content standards to the SBE. In 2018, the SBE adopted California's first set of computer science standards for grades K-12.

The standards are based on the five computer science core concepts and seven core practices:

Core Concepts	Core Practices
Computing systems	Fostering an inclusive computing culture
Networks and the internet	Collaborating around computing
Data and analysis	Recognizing and defining computational problems
Algorithms and programming	Developing and using abstractions
Impacts of computing	Creating computational artifacts
	Testing and refining computational artifacts
	Communicating about computing

Each standard includes a descriptive statement as well as examples for classroom application. As students progress through the standards from grades K–12, the standards call for students to build conceptual knowledge through active engagement in creative problem solving activities with an awareness of cultural and societal contexts. Computer science core concepts and practices in the standards are vertically aligned, coherent across grades, and designed in developmentally appropriate grade spans. The 9–12 grade span also includes an additional set of standards, referred to as 9–12 Specialty, which provides options for extending a pathway in computer science with content containing increased complexity and depth, and which may be used to create electives that are outside an introductory course.

In addition, the standards contain significant themes of equity, "powerful ideas," computational thinking, and breadth of application.

Access to computer science education in California schools. The draft Computer Science Strategic Implementation Plan notes that California students face significant problems of access in the study of computer science, noting that at the secondary level, very few high schools offer CS courses, as shown in the table below.

The draft plan also notes that data from The College Board regarding enrollment in advanced CS courses show that while California is one of the top ten states with the highest per capita AP CS A participation,

California High Schools Offering CS Courses, 2016-17

Course Name	% of Schools offering course
Exploring Computer Science	12%
Computer Science	12%
AP Computer Science Principles	3%
AP Computer Science A	10%
Robotic Technologies	13%

Source: Draft CS Strategic Implementation Plan, 2018

compared to other disciplines the number of California students who take AP CS exams is extremely low. In 2017, 8,679 California public school students took the AP CS A exam and 7,636 California public school students took the AP CS Principles exam. These numbers are far less than the number of students who took exams for AP Biology (34,984), AP Calculus AB (48,473), AP Chemistry (20,008), AP Statistics (30,196), AP English Language & Composition (84,960), and AP US History (69,729).

Race, gender, and income disparities in CS course access. According to a May 2015 report issued by the Level Playing Field Institute titled, *Path Not Found: Disparities in Access to Computer Science Courses in California High Schools*, access to computer science courses varies considerably. The report found that in California public high schools:

- Of the more than half a million high school students in the largest 20 districts, just 1% are enrolled in any computer science course.

- Nearly 75% of schools with the highest percentage of underrepresented students of color offer no computer sciences courses.

- African-American and Latino students make up 59% of California high school public school students but were just 11% of the 2014 AP Computer Science test takers.

- Only 4% of schools with the highest percentage of low-income students offer AP Computer Science courses.

- Only 8% of schools with the highest percentage of English Learners offered AP Computer Science courses.

- Of the high school students who took the AP computer science exam in 2015, only 26 percent were female, 973 were Latino, and 148 were African American.

The draft plan also notes that female enrollment in CS courses, from the introductory level through advanced courses, is roughly half that of male enrollment:

Course Name	% of Total high school enrollment	% Male Enrollment	% Female Enrollment
Exploring Computer Science	1.0%	69%	31%
Computer Science	0.8%	64%	36%
AP Computer Science Principles	0.2%	70%	30%
AP Computer Science A	0.5%	72%	29%
Robotic Technologies	0.7%	71%	29%

Recommended amendments. Staff recommends that this bill be amended to delete its current contents and instead require the establishment of a working group to determine whether the development of a single subject computer science credential is warranted, and if so, to consider requirements for the credential. There is precedent for requiring this kind of process in order to give stakeholders an opportunity to work out the kinds of issues identified by the opponents of this measure.

The workgroup would be charged with determining the need for the proposed credential, including:

1. Statewide demand for educators trained in computer science.
2. Alternative preparation programs or methods for meeting the supply of educators needed for appropriately prepared and certificated computer science educators.
3. How well existing credentialing programs authorizing an educator to teach computer science reflect the 2018 statewide-adopted K-12 computer science standards.
4. The work of the 2018 state computer science implementation advisory panel.

A majority of the workgroup would be comprised of diverse and experienced certificated educators currently teaching computer science in public schools. The workgroup would be composed, at a minimum, of representatives from the following groups:

1. a representative from a labor union representing certificated educators
2. a representative from an organization representing school administrators with experience as a computer science program administrator
3. an experienced representative from an institution of higher education that currently teaches in a computer science degree program
4. an experienced representative from a public institution of higher education that is currently a teaching professor/faculty in an accredited teacher preparation program
5. an elementary public-school educator who teaches computer science with a minimum of 3 years of experience
6. a public middle-school educator who teaches computer science with a minimum of 3 years of experience
7. a secondary public-school educator who teaches computer science with a minimum of 3 years of experience

The Commission would be required to provide a report of the workgroup's findings pursuant to this section to the appropriate policy and fiscal committee of the Legislature, the Governor, and the Superintendent of Public Instruction on or before January 31, 2021.

Implementation of the workgroup would be contingent upon an appropriation in the annual Budget Act or another statute.

Prior and related legislation. AB 1410 (Quirk-Silva and O'Donnell) of this Session would establish the Computer Science Access Initiative, to provide grants to LEAs for the purpose of increasing the number of teachers authorized and trained to instruct pupils in computer science.

AB 20 (Berman) of this Session would establish a Computer Science Coordinator position at the CDE.

AB 182 (Luz Rivas, 2019) of this Session would create a single subject credential in computer science.

AB 2329 (Bonilla, 2016), Chapter 693, Statutes of 2016, requires the SPI to convene a computer science strategic implementation advisory panel to develop recommendations for a computer science strategic implementation plan.

SB 675 (Chang, 2019) of this Session would enact the Computer Occupations and Developing Education (CODE) Act, pursuant to which the State Board of Education would administer a grant program promoting the teaching of computer science courses in the public secondary schools.

AB 2275 (Dababneh) of the 2015-16 Session would have authorized a person who holds a single subject teaching credential in business, industrial and technology education, mathematics, or science or a designated subjects career technical education teaching credential to teach courses in computer science to all pupils. This bill was held in the Assembly Education Committee.

AB 1539 (Hagman, 2014), Chapter 876, Statutes of 2014, requires the IQC to consider developing and recommending to the SBE, on or before July 31, 2019, computer science content standards for kindergarten and grades 1 to 12, pursuant to recommendations developed by a group of computer science experts.

AB 1764 (Olsen), Chapter 888, Statutes of 2014, states that if a school district requires more than two courses in mathematics for graduation from high school, the district may award a student up to one mathematics course credit.

REGISTERED SUPPORT / OPPOSITION:

Support

Alliance for California Computing Education for Students And Schools
California Hispanic Chambers Of Commerce
Code.Org
Computer Science Teachers Association
EnCorps, STEM Teachers Program

Entertainment Software Association
Microsoft Corporation
National Center for Women and Information Technology
Project Lead the Way Inc.
Riverside Unified School District
Society of Hispanic Professional Engineers, Greater San Fernando Valley
Technet-Technology Network
Black Girls Code
Children Now, California STEM Network
CompTIA
Internet Association
Project Lead the Way
Silicon Valley Leadership Group
Silicon Valley Organization
Upwork
Valley Industry Commerce Association

Opposition

Association of California School Administrators

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