WYOMING
DEPARTMENT OF EDUCATION

Creating Opportunities for Students to Keep Wyoming Strong

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To: Joint Education Committee

From: Jillian Balow, State Superintendent of Public Instruction, Dr. Bryan Shader, University of Wyoming Professor of Mathematics, and Dr. Laurel Ballard, Student and Teacher Resources Team Supervisor

Date: September 8, 2016

Re: Alignment of Public Education Efforts (Priority #5) Computational Thinking and Coding

At your last meeting, you heard from Superintendent Balow and UW Professor Bryan Shader on the importance of coding. The Superintendent also presented a proposed change to W.S. §21-9-101(b)(i) that would add "coding" into our state common core of knowledge. We are providing this memorandum to update you on our progress regarding this initiative and to again ask for your support in making this statutory change.

VISION

Preparing students for a 21st century economy by engaging all students in computational thinking and teaching them to operationalize the computational thinking through coding.

GOAL

Wyoming students in all districts and postsecondary institutions have the opportunity to learn computational thinking and coding, culminating in opportunities to connect technology professionals in industry throughout Wyoming and across the nation with our students in K-12 and higher education.

BARRIERS

The global economy requires a workforce trained in computational thinking and operationalized through coding. These knowledge and skills are quickly becoming new required literacy skills in the workplace. Employers throughout Wyoming continue to struggle with recruiting and retaining staff steeped with these knowledge

and skills. It is critical for Wyoming's education system to teach these skills to students for them to be competitive in the workforce, whether in Wyoming or anywhere else in the world. There are several key problems that must be resolved:

1. **Computational thinking and coding classes are not consistently taught throughout the K-12 curriculum in all school districts. National data evidence inequity in access to these classes correlating to demographics.**

   Solutions: Amending the Common Core of Knowledge and Skills; Updating Wyoming Content and Performance Standards; require districts to offer at least one computational thinking and coding class in high school, allowing these courses to count as math/science credits for graduation and post-secondary admissions; and finding a state leader for this topic.

2. **There is a lack of educators qualified to teach these computational thinking and coding classes.**

   Solutions: Changes to PTSB policies that address immediate, mid-term, and long-term needs; Professional Development opportunities with University of Wyoming and others; encourage more education majors to enter field.

3. **There are limited opportunities for industry to engage with students at both the K-12 and postsecondary levels to build interest for careers in technology and computer programming. National workforce data evidence a shortage in potential employees qualified for technology jobs.**

   Solutions: Prioritize this effort with the WDE's Career Readiness Initiative and DWS's Workforce Development Council; expand "Coders of the West" pilot across state; initiate partnerships between local tech businesses and school districts.

REMOVING BARRIERS:

To reach the goal of all students having the opportunity to engage in computational thinking and coding we must solve for the barriers we know exist.

Computational thinking and coding classes are not consistently taught throughout the K-12 curriculum in all school districts. National data evidence inequity in access to these classes correlate to demographics.

Given technology and coding have become drivers for economic diversification and foundational to accessing many of the high skill, high wage jobs available in the global economy, it is critical

for leadership in Wyoming to send clear signals teaching computational thinking and coding is priority throughout Wyoming's education system.

1. ***Amending the Common Core of Knowledge and Skills***
   W.S.21‑9‑101 defines the knowledge and skills all districts must provide. Here is the proposed amendment, with the changes in red:

> *W.S. 21‑9‑101.* Educational programs for schools; standards; core of knowledge and skills; special needs programs; class size requirements; cocurricular activities.
>
> (a) The board of trustees of each school district within the state shall cause the schools under its jurisdiction to provide an educational program in accordance with uniform standards defined under this section and rules and regulations promulgated by the state board of education pursuant to W.S. 21‑2‑304(a).
>
> (b) Each school district within the state shall provide educational programs sufficient to meet uniform student content and performance standards at the level established by the state board of education in the following areas of knowledge and skills:
>
> (i) Common core of knowledge and skills:
>
> (A) Reading/language arts;
>
> (B) Social studies;
>
> (C) Mathematics;
>
> (D) Science;
>
> (E) Fine arts and performing arts;
>
> (F) Physical education;
>
> (G) Health and safety;
>
> (H) Humanities;
>
> (J) Career/vocational Career and technical education;
>
> (K) Foreign cultures and languages;
>
> (M) Applied technology;
>
> (N) Government and civics including state and federal constitutions pursuant to W.S. 21‑9‑102;
>
> (O) Coding and computational learning; and
>
> (P) Financial Literacy.

(ii) For grades one (1) through eight (8), reading, writing and mathematics shall be emphasized under the common core of knowledge specified under paragraph (b)(i) of this section;

~~(iii) Common core of skills:~~

~~(A) Problem solving;~~

~~(B) Interpersonal communications;~~

~~(C) Keyboarding and computer applications;~~

~~(D) Critical thinking;~~

~~(E) Creativity;~~

~~(F) Life skills, including personal financial management skills~~.

2. ***Updating Wyoming Content and Performance Standards***

It will be imperative we become clear in our expectations of what is to be taught. Often there is confusion between understanding computer science education taught through computational thinking and coding and the broader concept of technology or keyboarding. If our goal is to have students learn computational thinking and coding, then they must be developed or integrated into the state standards. This provides districts the direction they need to ensure students taking these computer science courses are focused on the ability to create technology instead of just using technology or consuming digital content.

Arkansas has been a frontrunner and thought leader in developing and embedding standards. The Arkansas Computer Science Standards for Grades K-8 give students an introduction to computing concepts which are to be embedded across other content areas and are intended to support what is already being done in the classroom. Using the essential skills of computational thinking and algorithmic problem solving, students continue to develop critical thinking skills. Additionally, Arkansas developed computer science standard for a coding block that students participate in during their 7th or 8th grade year. The coding block is designed to be taught during a standalone block of time over a minimum of four to five weeks, where students examine how to formulate algorithms as well as create, analyze, test and debug computer programs in order to solve real-world problems. Students are expected to use a programming language to accomplish these tasks. These standards are not intended to be embedded in activities spread out over multiple courses.

The Arkansas Computer Science Standards for High School were developed to provide students with foundational understandings of concepts in computer science that are necessary for students to function in a fast evolving technological world. Through these standards, students are expected to develop mastery in skills and concepts related to Computational Thinking and Problem Solving; Data and Information; Algorithms and Programs; Computers and Communications; and Community, Global, and Ethical

Impacts. Using these standards students continue to move toward learning to accomplish tasks and solve problems both independently and collaboratively. These standards give students the tools and skills needed to be successful in college and careers, whether in computer science or in other fields.

3. ***Require districts to offer at least one computational thinking and coding class in high school***

   Given the important role computer science plays in our economy and the world around us, all students having access to computational thinking and coding in K-12 is critical. Access to numerous high skill, high wage jobs becomes more difficult for students. Although more districts in Wyoming are offering coding courses, it is imperative all students have access to and the opportunity to take computational thinking and coding instruction. In the K-5 grades, districts could embed the computational thinking and elementary coding into their curriculums, which would prepare students to take computational thinking and coding courses during their middle and high school years. At a minimum, all high schools throughout Wyoming should offer at least on coding class. For small districts who may not be able to hire certified computer science teachers, it will be critical for virtual education classes to be available to fill these gaps.

4. ***Allowing computational thinking and coding courses to count as math/science credits for graduation and post-secondary admissions***

   Given the current extensive lists of courses students need to take in order to meet graduation and Hathaway scholarship requirements, counting these computational thinking and coding classes as meeting part of the math or science graduation requirements would encourage more students to take these courses. To support students taking these classes and to maintain alignment between Wyoming's postsecondary institutions and K-12 system, these computational thinking and coding courses could count as a math or science admission requirement.

5. ***Finding a state leader for this topic***

   As Wyoming looks to become a leader in computational thinking and coding, it is essential to show leadership and signal the importance of developing these skills in our students. There should be a state level lead to bring together stakeholders from all parts of the education system, current computer science teachers, industry leaders, legislators, and national groups with expertise in computer science to develop and support implementation of the plans to implement computational thinking and coding in schools across Wyoming. The state level lead would also promote the expansion of computational thinking and coding through new policies to help expand computer science in the K-12 system, professional learning of teachers, district engagement and capacity building, and community event. This individual would be responsible for developing the relationships with industry professionals to make them a key partner in ensuring the

education related to computer science remain relevant. Cultivating partnerships with organizations providing after school educational opportunities for students would provide additional opportunities to enrich student's education around computational thinking and coding.

We are already working with the Professional Teaching Standards Board, the University of Wyoming, community colleges, Wyoming tech and other industry executives, Department of Workforce Services, Wyoming Workforce Development Council, Wyoming Career Readiness Council, policy leaders in other states, national experts, and educators from around Wyoming to ensure sufficient resources exist to implement coding instruction statewide.

There is a lack of educators qualified to teach these computational thinking and coding classes.

There is a clear lack of qualified educators across Wyoming available to teach these classes. Many experts qualified to teach computer science can find more lucrative employment opportunities within the private sector. Adding to this dilemma is that current educators find it difficult to become certified to teach computer science and coding courses.

1. ***Changes to PTSB policies that address immediate, mid-term, and long-term needs***
   Wyoming will need to find ways to develop a system facilitating interested educators to become certified or endorsed to teach these computational thinking and coding courses. While we continue to work through this, Wyoming can implement a short-term interim solution that will allow interested and knowledgeable educators to offer computational thinking and coding classes. For instance, any math, science or career technical education business educator could be allowed to teach as long as the district superintendent provides assurances the teacher has the requisite knowledge needed to teach the class. This is a practice currently in place in Arkansas, a national leader in integrating computational thinking and coding into their K-12 system. Arkansas allows business teachers to teach coding for two years after the effective date of the law implementing coding statewide if their local superintendent allows. As long-term solutions for teacher certification in computer science become viable, the short-term solutions can be phased out.

   The Professional Teaching Standards Board (PTSB) has begun working on developing a more agile system around certifying computer science teachers. The following are options PTSB has developed.

   A. Teachers who utilize volunteers with coding knowledge and skills
      This option allows the potential to lean on community partners with industry- related background who would volunteer their time in order to teach coding related content. These volunteers would be supplementing curriculum prescribed by the teacher of record.

B. Teachers who hold a PIC permit

Professional Industry Career (PIC) permits are available so that districts have the flexibility to offer career and technical education subjects in Wyoming 6th-l2th grade classrooms. Many times, career and technical fields do not have a teacher preparation program associated with their particular skill set. Understandably, there must be some flexibility to allow skilled and experienced industry experts into Wyoming classrooms to teach these specific skills to our Wyoming students. The PIC Permit allows that needed flexibility. Requirements for a PIC permit include:

- Minimum two (2) years work experience for EACH field of occupational specialty for which the applicant is seeking a PIC. Work experience must be as a wage earner and is in addition to any educational training the applicant may have obtained in his/her field of occupational specialty.
- Verification of Employment Forms (found in the application), for EACH field of occupational specialty in which the applicant is seeking a PIC, must be filled out completely and accurately and submitted as part of the complete application packet.
- Current and valid license(s) in EACH of the applicant's occupational specialties when one is required by state or federal statutes.
- Plan for continued professional advancement.

C. Teachers who hold a standard license endorsement in computer science

Educators can add a computer science endorsement via completing a computer science program. They may add a Computer Science Endorsement to their Standard License by completing a state-approved Computer Science 6-12 program at a regionally accredited institution of higher education. The program must lead to an Institutional Recommendation upon completion. Currently this program requires 27 computer science credit hours. This should be reviewed to determine if the number of required credits can be reduced.

D. Computer science endorsement via the Demonstration of Competency

This is is a new program that has been given provisional state-approval to lead to an endorsement with PTSB. Teachers can add a Computer Science Endorsement via the Demonstration of Competency (DOC). The Requirements of the DOC are as follows:

- The DOC route can only be used to add an endorsements at the grade level for which the applicant holds a valid and current license.

- Twenty-seven semester hours of coursework from a regionally accredited institution of higher education, in the specific content area for which the applicant is seeking an added endorsement
- Nine of the 27 semester hours must have been completed within the past five years.
- A maximum of three (3) semester hours may be in pedagogy and must be at the grade level of the added endorsement.
- Only coursework with a grade of "C" or better, including a maximum of six credits of "pass" grades equivalent to a "C" or better, will be accepted;
- Receive a passing score on a PTSB approved exam (Praxis 5651 Computer Science with a passing score of 171).

E. PTSB may be able to add a permit area to rules & regulations

This option would require promulgation of rules and regulations to prescribe a course of study by which an educator could fulfill requirements to attain a permit to teach specific content such as coding.

2. ***Professional development opportunities with University of Wyoming, community colleges and industry professionals***

With such limited K-12 educator expertise related to teaching computational thinking and coding in schools, it is essential to provide those teachers with skills and interest in teaching this content with high quality ongoing professional development. The computer science field evolves so quickly, the ongoing professional development for educators is essential. Partnerships with industry professionals and postsecondary institutions can provide amazing opportunities to leverage resources throughout Wyoming to further the K-12 educator capacity for teaching computational thinking and coding.

For example, an instructor at Sheridan College collaborates with the K-12 educator teaching computer science at Sheridan High School. These collaborations include face-to-face work with the teacher and students, real-time support through instant messaging.

Moreover, the University of Wyoming is strongly committed to computing in K-12, and it is ready to partner with other groups in the state and is committed to playing an important role in preparing teachers to offer this class at their high schools, and also in supporting these teachers throughout the school year. For example, this past year UW faculty helped one of the teachers at Laramie High School offer AP Computer Science by providing materials, answering questions, and helping students directly in the classroom. UW can be creative in extending this support to teachers across the state. For example, UW has developed lectures that can be offered remotely as a Small Private Online Course. This may be ideal for high schools in remote areas of Wyoming. UW faculty can also supplement this material, offering extended explanations and assisting individual students via distance learning methods. In addition, UW faculty are facilitating virtual

teacher circles, where high school and UW teachers can share experiences and help each other with common problems. In short, UW and other community colleges are willing and able to build a community of Wyoming computing teachers.

Additionally, professors from the departments of Mathematics and Computer Science at the University of Wyoming currently have funding from the National Science Foundation for teacher professional development to prepare them to offer AP Computer Science in high schools. This past summer, five Wyoming teachers received professional development as part of this effort, and there is funding for two more cohorts of 20 students each. More teachers can also be accommodated, though perhaps not fully funded. What this means is that in the next two years we can place 45+ teachers with the knowledge to to teach AP Computer Science in Wyoming high schools.

Industry has also been willing to step up to the plate. This past summer high school educators had the opportunity to attend a coding camp with high school students team taught between community college instructors and industry professionals as part of the Coders of the West Pilot. These teachers, alongside students, learned the basics about coding through Javascript, HTML, and CSS languages over a two-week period.

3. ***Encourage more education majors to enter field***

   Wyoming can also look to enlisting and incentivizing students into specializing in computational thinking and coding teachers during an educator's pre-service training through developing specific pathways. Students studying to become math or science teachers could take at least a few computer science courses during their teacher prep program. Wyoming could also incentivize partnerships between school districts and the College of Education to create a direct pathway for these teachers, especially in high-need district.

There are limited opportunities for industry to engage with students at both the K-12 and postsecondary levels to build interest for careers in technology and computer programming. National workforce data evidence a shortage in potential employees qualified for technology jobs.

1. ***Prioritize this effort with the WDE's Career Readiness Initiative and DWS's Workforce Development Council***

   Supporting the growth of the technology industry along with developing a strong associated workforce has become a priority in facilitating economic diversification. Both the WDE's Career Readiness Initiative and Department of Workforce Services's (DWS's) Workforce Development Council have elevated technology, including coding, as priority focus areas. Supporting these efforts, which have tech industry expertise at the table, provide key information on their workforce needs along with what they are willing to do to facilitate growing the potential workforce.

2. ***Expand "Coders of the West" pilot across state***

   The Coders of the West pilot program has been designed to test a statewide model for project-based learning around computational thinking and coding which connects the industry professionals with students in K-12 and higher education. This past summer students in Cheyenne and Sheridan participated in a two week coding camp and during the school year will participate in an internship to work side by side with software development professionals to build a career exploration system designed for middle school students. The pilot is geared towards students learning about the software development industry, the opportunities that are available, and gaining the skills they need to be successful in the workforce.

   This pilot has been developed as a collaborative partnership between the Sheridan College, Laramie County Community College, Sheridan CSD#2, Sheridan #1, Laramie #1, GEAR UP, WDE, Gannet Peak Technologies, and Sheridan Programmers Guild.

3. ***Initiate partnerships between local tech businesses and school districts***

   Engaging students throughout the education system in career exploration around computer science and providing for opportunities to engage computer science professionals with students would likely spark new interests in pursuing these careers. This can be done as simply as providing opportunities for students to talk or job shadow these industry professionals to developing internships for students to actively work alongside and within the industry.

TIMELINE

The timeline is dictated by the school calendar. We believe these are the major milestones:

<u>Standards & Course Development</u>

September - October 2016: Work with high school and district administrators to determine who is interested in moving forward with offering AP Computer Science courses.

June 2017 - June 2019: Standards development for new computational thinking and coding

June 2019-May 2020: Technical assistance for schools and educators to embed standards or develop courses aligned to new computational thinking and coding standards

<u>Teacher Certification & Professional Development</u>

October 2016 - Ongoing: Communication with school districts on the various ways pre-service and current educators to become certified to teaching computational thinking and coding

March 2017: Teachers sign up for professional development for teaching AP Computer Science courses

April - July 2017: Planning for short-term education computer science certification solution

June 2017 - June 2019: Short-term solution for education certification in computer science implementation

July 2017: 2-week or 3-week professional development for teachers, delivered at UW

Coders of the West Pilot

September 2016: Internship for 2016-2017 Coders of the West Pilot begins

September 2016 - February 2017: Planning for 2017-2018 Coders of the West Phase II

March 2017: Students apply to the 2017-2018 Coders of the West

General Planning for Computational Thinking and Coding in Education

January - March 2017: Statutory changes made

April 2017: Determine computer science in education task force membership

May 2017: Statewide computer science in education task force has initial meeting

Thank you for your time and consideration.

Cc: Legislative Service Office