

K-5 Computer Science

Teacher Notes

Domain Standard (Competency): Empowered Learner



The Teacher Notes were developed to help teachers understand the depth and breadth of the standards. In some cases, information provided in this document goes beyond the scope of the standards and can be used for background and enrichment information. Please remember that computer science encompasses both fundamental skills, such as computational thinking and digital citizenship, that all students should be introduced to in order to be viable citizens in a digital society as well as discrete skills that are endemic to specific career clusters.

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Empowered Learner - Overview

CSS.EL.K-2.1: Recognize that technology provides the opportunity to enhance relevance, increase confidence, offer authentic choice, and produce positive impacts in learning.

CSS.EL.3-5.1 Identify the features of current technologies and use that knowledge to understand emerging technologies.

"All parts should go together without forcing. You must remember that the parts you are reassembling were disassembled by you. Therefore, if you can't get them together again, there must be a reason. By all means, do not use a hammer."

— *IBM Manual, 1925*

Empowered Learner is a domain where students learn skills that will make them feel confident of their knowledge and skills in technology. In this domain the standards are written so that students can learn various aspects of technology and keep growing. Students will use technology to enhance their learning in all fields. In addition, they will focus on getting an in-depth understanding of technology. A computer science student is a life-long learner. By being an empowered learner, they learn not only to use technology appropriately, but they learn to keep improving their skills. They acknowledge that technology keeps changing and there is always something new to learn and something to keep up with. Part of being empowered is also appropriate and responsible use. Students should work on maintaining balance when using devices and media in their daily lives.

While learning about emerging technologies students have to know both hardware and software. This is the domain that addresses a comparison and an in-depth understanding of the past, current and future technologies. Students should be exposed to various types of hardware and an understand on how all of the pieces work together. Along with some history on how the hardware and software pieces have evolved they need to understand the current state of technology. And once this has been established students should be provided an insight into the future.

They need to understand computational thinking and use of software applications that encourage this type of thinking. An important element is reflection. Since the student is immersed in technology, they should not lose focus of the fact that technology is only one part of their life. They should reflect on their personal goals and as well as their knowledge of technology to understand how best they would like to use these tools. It is important that the student feels that the tools produced due to technology are there to empower them and also to make them successful. As such they should use the tools to serve them best and not let the tools become their masters.



CSS.EL.3-5.1.1

Identify the features of current technologies and use that knowledge to understand emerging technologies.

1. Describe how internal and external parts of computing devices function to form a system

This first element is about teaching students to about the various parts of the computer. A good way to teach this is to let students open computers and examine the various parts of the computer. Different students learn differently. To ensure that instruction meets various types of learners use different tools to introduce the ideas. Terminology is important for this element. Here point to each part of the computer and explain the purpose and the name. Different ways to teach this are:

Hands on Experimenting:

With computers it is possible that for each part there are various samples. Be on a constant look out to collect the parts which can then be used when this activity is done. For example, point of the different types of monitors that are available and the different resolution. On each table place varieties of the one part of the computer. (eg. Different types of input devices). Have students create posters on each part. Each team can pick one part and do an indepth research and refer to the samples provided on the table. While presenting the research the parts on the table can be part of the show and tell.

Instruction using Power point:

Next use a power point that shows the various parts of the computer and explains their functionality. This is the medium to demonstrate different types of the devices with the same purpose. (e.g. Different kinds of input devices, different types of printers, etc.) . For each part of the computer show them how each part works with the others.

While talking about the internal parts of the computer discuss the motherboard and the cables. Since this is inside of the computer many students do not know that this exists.

Other important ones include *power supply, CPU, Fan, memory slots, VGA cards.*

Videos: A good way to sum up this element is to show videos that teach students about the types of hardware that computers use. You-tube has plenty of videos that explain various parts of the computer. There are simple animated cartoons to complicated ones. The resources provided start from something very simple. Once which address a simple idea and give a high level overview to providing a deeper dive into that device.



Resource Links

<http://videos.code.org>

<https://edu.gcfglobal.org/en/computerbasics/basic-parts-of-a-computer/1/>

<https://itstillworks.com/12315431/the-five-main-parts-of-a-computer>

<https://computer.howstuffworks.com/inside-computer.htm>



CSS.EL.3-5.1.2

Identify the features of current technologies and use that knowledge to understand emerging technologies.

2. Model how computer hardware and software work together as a system to accomplish tasks.

The second element shows how a computer works. In many ways a computer can be thought of be like a human in action. This is a perspective that can encourage students to think how the act and how their brain works. The brain of the computer is the CPU. And the software that resides in the CPU is like the way the human thinks. And each one of the accessories of the computer can be mapped to a part of the human.

This can be explained using a scenario:

Say the eyes see an object and wants to pick it up. How does the human do it? Can this be done by a computer? The eye communicates to the brain which then communicates to the hands, to the fingers to then pick up the object. The communication between the brains and the eyes is like the keyboard and the CPU when a user types something in a computer. The software that resides inside the computer is much like the thought process that goes on when a human wants to pick an item. This idea can be done as a fun activity.

Students can role play how computers work together. They can pick an activity like Fetch-Execute Cycle and demonstrate it.

Resource Links

<https://www.khanacademy.org/computing/computer-science/how-computers-work2/v/khan-academy-and-codeorg-hardware-and-software>

<https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/working-together>

<http://www.onlinecmag.com/computer-hardware-and-software-interact/>

<https://classic.csunplugged.org/class-simulation-computer-unfinished/>

http://cse4k12.org/how_computers_work/index.html



CSS.EL.3-5.1.3

Identify the features of current technologies and use that knowledge to understand emerging technologies.

3. Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

This element teaches students how to troubleshoot common problems. Below is the list of common problems that occur. These are simple easy ones to create in the classroom with a basic computer, monitor, mouse and keyboard. Create the problems and demonstrate to students how to troubleshoot the problems and fix it.

First step to explain to students the steps to troubleshooting.

The seven steps to troubleshooting are:

- Analysis
- Problem replication / identification
- Action Plan
- Implementation
- Testing
- Documentation

The common problems that could occur are:

1. Cables

Loose or broken pins. By closely examining the cables it is possible to identify if something is broken or bent or loose.

2. Mouse

The mouse could be a bad (no signal) or the wires could be broken. Sometimes the buttons could be stuck making the mouse not work and give bad signals to the computers.

3. Keyboard

The keyboard should be a dirty with particles stuck between the keys. Or the keys are loose or stuck. The cables could be broken

4. Overheating

A common problem that occurs when the vents are blocked, or the fans are not working. Sometimes the power supply does not work. Keeping the computer in a cool place sometimes helps cool the system. Often adding too many peripherals could cause the system to get heated.

The above problems are hardware related problems. This one and the upcoming ones are software related that happen inside the computer



5. Error Messages

Error messages like when the computer does not start – beeps and there is a black screen

Web page will not load

Computer freezes (Use ctrl-alt-del) to close the offending software

Internet does not work

Windows blue screen comes up

6. Viruses & Spyware

Sometimes a virus infects a computer and then installing and running an anti-virus software is needed to clean the system up.

7. Hard disk defragmentation

If the computer runs slow while loading computer programs or the computer shuts down often then the hard disk gets de-fragmented. Running defragmenting software like scan disk shows students the problem and how the software can fix the problem.

8. Cleaning

All computer parts need regular cleaning. Dust, pollution and poor handling of the computer parts can cause problems.

Resources:

<https://edu.gcfglobal.org/en/computerbasics/basic-troubleshooting-techniques/1/>

<https://www.computerhope.com/basic.htm>

<http://www.kathleenamorris.com/2011/08/01/troubleshooting-computer-problems/>



CSS.EL.3-5.1.4

Identify the features of current technologies and use that knowledge to understand emerging technologies.

4. Develop and apply keyboarding skills, utilizing current technology.

“Practice only makes for improvement” – Les Brown

The fourth element is about teaching student good keyboarding skills. The best way to teach this is to use a typing software. Students at the elementary grade level should be exposed regular and if possible daily typing lessons. Depending on the grade the teacher is working with the typing assignment can vary. For earlier grades using the typing software students can write simple sentences. The older students can write short paragraphs to small essays and stories using the typing software.

Students should be exposed to activities such as daily drills as they work on acquiring typing skills.

Some important tips while teaching typing:

1. Timely. It is important to start early in the year. And ensure that no bad habits have crept in and to instill good typing habits.
2. Regulate the practice. By that have specific days and times of the week that students practice their typing skills. Have them practice specific drills for a set period of time.
5. 3.Repetition is key. Find ways to repeat the information that you are teaching them. This makes the skill stick. Use typing as a medium to reinforce a concept learnt in science or social studies or language arts.
3. Warm-ups. Students should start with a warm-up that reinforces the skills they learnt in the past and gets them ready for the activity of the day.
4. Make it personal. The more students can relate to what they are typing more likely that they will stick to it and complete the assignments.
5. Breaks. Have students take 30 second breaks between each drill / activity. Encourage them to stretch particularly exercise the small muscles in the fingers that are exerted.
6. Make up fun games. Below in the resources section are several typing game-based software that can be used to increase engagement. However, students can interact or communicate with each other using their typing skills. Write a letter to a friend in your classroom or to your mom. Write up your favorite recipe and share with a friend in your class are good examples of this.
9. Make it fun! Engagement makes learning faster. Aim for it to be fun at least 50% of the time.



Resource Links

<https://www.common sense.org/education/top-picks/best-typing-games-for-students>

Commonsense provides a list of possible typing games with reviews. Some other options are given below:

www.typing.com

www.edotyping.com

<https://www.goodtyping.com/>

<https://powertyping.com/>

<http://www.typing-lessons.org/>



CSS.EL.3-5.1.5

Identify the features of current technologies and use that knowledge to understand emerging technologies.

6. Compare and contrast prior knowledge on current technologies with that of new or emerging technologies.

The fifth element in this domain is understanding emerging technologies. The intent is for the students to understand current technology that they are using and be able to look ahead and see what an emerging technology is.

There are several categories of technologies that students can compare between current and emerging technologies.

Given below are a few examples.

Social Media

Students are familiar with the latest app that they use to connect. At the time of this writing Facebook, Snapchat, Instagram are among the popular ones. But it is quite possible that the time this topic is covered in the classroom something new has already come up. Students can compare the new ones to what they used maybe a year ago.

Smart Phones

Students can compare the various kinds of phones in the classroom with their friends and come up with features that are common and useful. There are various manufacturers and the two pieces of the smart phones that students need to distinguish is hardware and the software. Students can compare the differences between Android and Apple phones as well as the utilities that come with the phone such as App Store and iTunes.

Computers

Students can compare the latest laptops, desktops and tablets and decide which ones are trending and why. Processing power, hard disk capability, memory resources all make for a good computer. Students understand this and can compare what is available in the market and compare it with upcoming trends such as quantum computing. Students should be familiar with Moore's Law that governed much of the computer development. Explain to students that hardware gets smaller with technology but more powerful. Software gets powerful as well but sometime hardware and software do not work together in an attempt to keep up with the growing need and the exploding technology.



Resource Links

<https://techcrunch.com/>

<http://kidsnews.com>

<http://kidskonnnect.com>

<http://www.khanacademy.com>

<http://www.kids.britannica.com>

<http://www.healthychildren.org>

<http://www.sciencekids.co.nz/sciencefacts/technology.html>



CSS.EL.3-5.1.6

Identify the features of current technologies and use that knowledge to understand emerging technologies.

7. Develop, reflect on, and revise personal learning goals in collaboration with their peers.

The sixth element is one of more reflective. Students need to reflect and be deliberate about the use of technology in their lives. Using current technologies there are many collaborative tools that students use to work on projects and other assignments in the classroom with their peers. Students should know the key things they have to keep in mind while collaborating with their peers. Students should realize that they are working in a team. And teamwork principles require the following behaviors:

Goal Setting: The first step towards creating teams should include setting goals, identifying tasks, gathering facts, providing information, clarifying and summarizing ideas, and building consensus

Working together: Students should realize that everyone comes with a certain skillset. And when teams put all skills together, they get a much better outcome than individuals working in isolation. Working together requires a lot of other skills to be practiced. Such as encouraging participation, expressing feelings, reconciling disagreements, keeping communication open, setting and applying standards for group performance, and building on each other's ideas.

Communication – Conveying expectations and goals as well as understanding the role of each member in the team is important. Team members should put the needs of the individual ahead of the needs of the team. They include dominating the discussion, interrupting, wasting time, not listening, withdrawing from the conversation, and holding side conversations. Team members should be willing to share ideas - particularly if there is a new member in the team.

Below in the resources section are several tools that are good to training students to collaborate and work in teams. Provide students with several opportunities to collaborate. Once you decide on a task identify exactly what you want students to learn and make sure it's suited to group collaboration. Next decide how to break down work and then delegating those responsibilities among members. Then help your students out and break down the work for them. Eventually this responsibility is that of the students. But it's important to model it for them first. Make sure everyone knows what is expected out of them.

e.g. Assign Group work in Google Classroom.



Resource Links

<https://www.common sense.org/education/top-picks/best-student-collaboration-tools>

<https://d1e2bohyu2u2w9.cloudfront.net/education/sites/default/files/tlr-asset/document-group-work-roles-4.pdf> (Printable work cards for students to identify their roles and responsibilities.)

<https://inspired.fb.com/>

<https://www.centervention.com/social-skills-game/>



Related Vocabulary

K-2:

See chart in [CSS.DA.K-2.9:3](#) for K-2 vocabulary term

3-5:

Hardware- The part of the computer that are visible (e.g. monitor)

Software – The part that makes the computer work.

Emerging Technology – The technology that is pretty current and new and not completely realized. As such they are still emerging.

Troubleshooting- Systematically identifying the problem and trying to find the solution.

Problem Solving- Identifying the solution to a problem using a methodology.

Teamwork- Working collaboratively and constructively to solve a problem.

Collaboration: Working together. Communicating effectively and reaching a solution



Citations

<https://code.org/curriculum/docs/k-5/glossary>

<https://www.iste.org/standards/for-students>

<https://techterms.com/>

“Innovation is the outcome of a habit, not a random act.” – Sukant Ratnakar



Grade by grade progression

Kindergarten – Second grade

Description of Empowered Learner for kindergarten through second grade:

Much of the Empowered Learner skills will be attained while completing the other standards. To illustrate consider using touch screen. Young learners such as kindergartners can using drawing software to create pictures on the touch screen. Very much like finger painting touch screens can get students to draw and color on the screen. Software such as Microsoft Surface Lagoon, Corell Draw It! captures the images and saves it for the students. They can then use them as screen savers on their computers.

Another example is getting an early start on working on their keyboard skills. Students in kindergarten to second grade should be exposed to typing lessons everyday with increasing amounts of time depending on the attention span that is age appropriate. Kindergarteners are just being able to recognize their alphabets. Sitting in the right posture, placing fingers appropriately over the keys are some important skills to be mastered. Many of these are still being refined in first and second grade. By end of second grade students should be able to place their fingers over the keyboard appropriately. They should be able to type simple three-four letter words. Students can also learn to use the touch screen on the computer monitor.

Some of the artifacts that students can create are color pictures using software such as Microsoft Surface Lagoon. that they create using joining the dots, find the hidden figure. Doing these activities encourage students to learn their numbers and help with learning how to use the mouse and the touch pad.

Sample activity: Using Microsoft Surface Collage students can take the images that are on their touch screen monitor and enlarge or shrink them. Students should be instructed to search for images. The youngest learners can be asked to bring images from home. They can add or remove images to the software, resize them , make one come in front, change colors, making the final product a customized collage of images that they picked.



Third grade

Description of Empowered Learner for third grade:

In third grade students are starting to get more comfortable using technology independently. They are now willing to explore new features and try out different software and hardware. Using software such as power point, movie maker and even programming software to create artifacts will help students understand the different technologies. Students should be exposed to the Internet by teaching them the rules on the Internet. This includes social media, email, text/chat software.

Some artifacts that students can create a movies, Scratch programs, power points, etc.

Sample activity include – Using iMovie on the Mac or Windows Movie Maker students can be encouraged to create movies using this software. Student can use Scratch like software to create stories by programming. Encourage themes such as using “social media appropriately” , “Rules to follow while writing an email” to reinforce the “cyber-rules” to students.



Fourth grade

Description of Empowered Learner for fourth grade:

In fourth grade students start getting more confident on exploring technology. This is the perfect time to allocate bell-ringers which allow for students to explore various kinds of software. They should be able to systematically go through software (and hardware) and identify the features in the system that are useful. Students should be able to write about the technology software they explore and present facts as they come across them. An important learning activity would include asking students to compare two technologies that have the same purpose. (e.g. power point and Google Slides)

Some of the sample hardware they are can explore are tablets, smart phones. LCD – digital projector (especially the part they connect to computers), the network room in the school building, the smart boards, any of the maker kits (LEGO Mindstorms, MicroBits, etc.)

Some of the sample software they can explore are social media software such as Twitter, LinkedIn, Snapchat., Utility software such as word processors, spreadsheets, presentation software, etc

Sample activity: Students in this grade level should be provided with time to explore different types of hardware and software products. These can be bell-ringers or warm-ups. Once a week a show-tell where students can come up and show the product (especially if it is a software product) and demonstrate the features so that all others in the class can learn from it. Students should demonstrate the product with the help of a power point that lists out the features and possibly has some images. This allows for the activity to be graded and concrete feedback to be provided which the students can then improve upon.



Fifth grade

Description of Empowered Learner for fifth graders:

In fifth grade students start getting more confident on use technology. Students can be given projects to solve complex problems. Using photoshop to manipulate images, creating movies with transitions, to creating presentations with transitions and animations are all good projects. Students can create simple projects weekly and then work with teams to build a complex project. Students should be guided to pick appropriate software and by the end of the year they should be able to justify the choices they make. For this, students should examine and explore multiple software / hardware that are available for the same purpose and then pick one that has the most useful features.

Some of the artifacts that students can create are taking images and using photoshop to curate them. Or making movies- taking movies through their cell phones and editing them using movie making software. iMovie, Windows Movie maker, Corell Draw It! , Photoshop are good software tools.

A good activity: A good activity for students is to examine social media and the latest social media software available. Particularly one that is most used by students at this grade level and on the device that is most popular. E.g. smart phone. Make a movie illustrating the good behaviors on social media. Using examples illustrate behaviors that are not to be encouraged. Also highlight how students could misuse this media and the harmful consequences. Students can then show this movie to their classmates.

