Accessible CSP for Students with Learning and Attention Deficit-Based Disorders

A 2 year researcher-practitioner partnership to support more equitable learning in CS.

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Our Question: How Do We Make CS More Accessible for Students with Learning Differences?

Tackling practical challenges requires collaboration across areas of expertise

• **Team:** Education researchers & curriculum specialists; Special education & learning strategies specialists; School psychologist; CS teachers; HS Students with diagnosed learning differences

• **Current Work:** Creating & piloting adjustments to existing instructional materials with students with diagnosed learning & attention deficit disorders

• **Next Steps:** Sharing more comprehensive findings about what may work in other settings, and why with CSP curriculum developers & teachers
Students Who Learn Differently...

- **Specific learning disabilities** (e.g., disorders in reading, written expression, math, and language)

- **Attention deficit disorders** (e.g., attention deficit hyperactivity disorder, or ADHD, attention deficit disorder, or ADD & related Executive Functioning challenges)

- Our work also considers the **Underlying Psychological Processes** often associated with learning and attention disorders

2.4 million public school students in the U.S. identified with a specific learning disability*

6.4 million students in the U.S. diagnosed with an attention deficit disorder*

“Learning disability” - largest group of students receiving special education services under IDEA^ System for diagnosis is not perfect (under & over-diagnosis of kids)

Today’s Goals

1. Describe our approach to make CSP more accessible for certain learners and our process to identify lesson adjustments

2. Share lesson adjustment examples & specify our rationale for adjustment in relation to learning differences
1. Work Approach

In Yr 1 pilot, worked with small sample of both BJC and Code.org lessons; in current Yr2/actual AP class, working with Code.org version only.

**Our job:** Applying what is known from research in other subject areas about practices that support students who learn differently; **NOT** changing the rigor, nor simplifying the material.
Creating Adjustments: Considering Adjustments to Navigate Potential Barriers

Applying what is known from research in other subject areas about practices that support students who learn differently – **2 types of lesson adjustments/ways to try and improve lesson accessibility:**

- **Adaptations:** Whole-class adjustments to a lesson to benefit students with learning disabilities and attention deficit disorders & possibly the whole ranger of learners in class; similar to elements of Universal Design for Learning (UDL)

- **Accommodations:** Explicit approaches offered to individual students/groups of students because of an identified learning difference beyond what a whole-class adaptation can provide

> These adjustment recommendations **don’t** change the content or rigor, nor simplify the material
Study Data Collection Methods

- **Student data** (*experiences with lessons*)
  - Student focus groups (yr 1)
  - Written feedback (for each lesson; yr 2)
  - Every-other-week student individual interviews (yr 2)
  - Pre & post student attitude questionnaire (yr 2)
  - AP exam data (yr 2)

- **Teacher data** (*teacher usage, and student experience with lesson adjustments*)
  - Written feedback (for each lesson)
  - Every-other-week interview (yr 2)

- **Observational data** (*some adjusted lessons*)

  + **Full team meetings** (every-other-week) to discuss data, generate new ideas, & refine lesson adjustment recommendations
2. Common Curricular Challenges (& Adjustment Examples)

Sample of Teacher and student feedback about curricular challenges:

a. New Terminology / Vocabulary, often presented with Lengthy Verbal Remarks
b. Project-Based Summative Tasks/Assessments
c. Collaborative Work
d. Aspects of Programming

Primarily related to Attention, Language and Executive Functioning*

*a weakness in some mental skills re: planning, organizing, prioritizing, often found in students with learning and attention issues
Example a: **New Terminology**, often presented within **Lengthy Verbal Remarks**

- Teachers are asked to present a great deal of technical information verbally with no visual support for the students;
- Use of lengthy videos that introduce a lot of new terminology

**Quick Vocabulary**

We need to get some terminology down so that we can speak about our problems and solutions more efficiently.

- **Protocol** - For our purposes today a “protocol” is simply a set of rules about sending, receiving and interpreting binary messages.
- **Bit** - We will call each element of a binary message a *bit*. “Bit” is short for *binary digit*. So for example if you have a binary message `A 3 B A`, we would say that is a 4-bit message.

Today you and your partner will be developing a protocol for exchanging 2-bit messages using an Internet Simulator.
Why a Potential Challenge

Activities that present new terminology, often with lengthy verbal remarks may pose challenges for students with learning differences because of the requirements to:

- maintain focus while watching a video or listening to a teacher’s verbal introduction
- learn and retain new vocabulary and content when presented primarily verbally without visual support

**Associated Learning Disorders:**
- Language Disorders
- Attention Disorders

**Associated Underlying Processes:**
- Verbal Reasoning
- Vocabulary/Semantics
- Listening Comprehension
- Language Processing
- Sustained Focus and Alertness
Alternate Strategies for New Terminology; Lengthy Verbal Remarks

• Maintain a glossary, preferably a shared electronic document to which terms can be added

• Present written terms, definitions, and key information on a board or presentation slide during verbal introductions

• Watch videos twice or repeat information regularly

• Provide guided notes for students to complete while watching videos or listening to verbal instructions

• Check for understanding regularly
Example b: **Project-Based Summative Assessments**

**Project: Big Data and Cybersecurity Dilemmas**
You will independently select and investigate an issue related to Big Data or Cryptography that poses a societal or personal dilemma. Specifically, you will:

1. **Choose your Dilemma**
2. **Conduct your Research** on a specific issue or event related to the topic that poses a dilemma
   - Understand the different sides of the issue.
   - Explore the “innovation” that caused or spurred this dilemma.
   - Find a visual or audio artifact that highlights, demonstrates, or helps explain some element of the issue.
3. **Write your responses** to prompts that ask you to:
   - Explain both sides of the dilemma
   - Connect your research to things you’ve learned in class
   - Explain what your visual or audio artifact is communicating about your issue.
4. **Submit** your written responses and artifact

Little explanation about what students are expected to do
Why a Potential Challenge

Activities that are exploratory, or project-based may pose challenges for students with learning differences because of the requirements to:

- **choose** a topic, a point of focus, or program to write
- **find** appropriate sources at an appropriate reading and background level
- **develop a plan** by breaking task into smaller components
- **build knowledge** while exploring content in a ‘systematic’ manner

**Associated Learning Disorders:**
Attention Disorders
Reading Disorders

**Associated Underlying Processes:**
Visual-Perceptual Reasoning
Higher-Order Reasoning
Cognitive Flexibility
Visual-Pattern Recognition
Visual Discrimination
Sustained Focus and Alertness

Sequential Memory
Procedural Memory
Self-Monitoring
Planning
Alternate Strategies for **Project Based Tasks or Assessments**

- **Model** strategies and approaches
  - Provide exemplar
  - Demonstrate examples
  - Provide steps for how one could explore options

- **Present students with potential options** if they are having difficulty choosing a topic, a point of focus, or program to write

- **Circulate** and **assist** in breaking down plans into smaller steps

- **Provide information sources** for students

- **Provide** consistent and explicit feedback about their approach
Example c: Collaborative Work

Includes:

- **Think-Pair-Share** Activities
- **Paired** Programming and Activities
  - Partnered **Thinking** and **Problem Solving**
Why a Potential Challenge

Activities that involve collaborative work may pose challenges for students with learning differences because of the requirements to:

- use **socially appropriate language** to communicate collaboratively and amicably
- read **social cues**
- **sustain attention** while classmates explain their thoughts
- comprehend the language used by their peers
- find the correct words and phrases to articulate thoughts
- reflect and identify the reasoning behind approaches to problem solving

Associated Learning Disorders:
- Language Disorders
- Attention Disorders

Associated Underlying Processes:
- Oral Formulation
- Listening Comprehension
- Vocabulary/Semantics
- Listening Comprehension
- Sustained Focus and Alertness

- Retrieval Fluency
- Language Processing
- Self-Monitoring
- Social Skills

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Alternate Strategies for Collaborative Work

• Place students in partnerships or groups that will be **supportive of learning differences**.
  • These may remain for an extended period of time, or may need to be changed periodically.

• **Circulate and model phrasing** for students who may have difficulty phrasing their thoughts to language and who have difficulty retrieving the words they would like to use.

• **Explicitly state** that students will work together/problem-solve together (not just work in parallel).

• **Review and/or model guidelines** for students on how to work together and provide feedback
  • Example **guidelines for how to provide feedback:**
    • Only one person talking at a time
    • Everyone accepts feedback
    • People listen *actively*
    • People share differences of opinion
    • All are respectful of each others’ opinions
Example d: Aspects of Programming

Debugging Event-Driven Programs: IDs

Try another one! -- This one is trickier, but very common.

1. Run the program and inspect the messages in the Debug Console for clues.
2. Investigate - track down what the root of the problem might be.
3. Fix it the program and correct the errors so that it works as intended.
4. Run the program and verify that both buttons have the intended functionality.
5. Repeat as necessary until the program works as intended

Students are expected to identify that the program will treat an upper case and lower case letter as different and as a result program will not function properly
Why a Potential Challenge

Activities that involve aspects of programming may pose challenges for students with learning differences because of the requirements to:

- use the same element ID with consistent spelling and capitalizations
- identify “errors” in the way variable have been written when debugging
  - noticing difference between “Apple1” vs “aple1”
- recall the use of each of the commands and the type of variable that should be entered in the command

**Associated Learning Disorders:**
Written Language Disorders (spelling)
Reading Disorders
Attention Disorders

**Associated Underlying Processes:**
Phonological Awareness
Visual Memory
Visual Pattern Recognition
Sustained Focus and Alertness

Self-Monitoring
Visual Discrimination
Alternate Strategies for Programming Activities

- Create a **reference sheet** listing code introduced
  - Provide a short descriptor of the command and the type of variable that should be entered in the command.

- Instruct students to create an **electronic document** (Google Doc, Word Doc) to record the variables used in the programs.
  - They can refer to this document to copy and paste the variables in order to ensure that they are always writing the variables in the same manner.
Student Interview Themes: Other Learning Challenges

- Conflict with group/partner or simply working with partners*
- Lack of attention to details or too much attention to details ("I think I was thinking too much into it and it just needed to be more simple than it was.")
- Lack of prior experience with CS ("I’m starting farther back than everyone else is, so that’s kind of a struggle.")
- Large class size, or other students who are loud/disruptive
- Math work
- Mixed grade or experience level in class/Not enough challenge ("I wish it posed more of a challenge...It's all stuff I've learned before. I feel like it's designed to be for novices, but it's also labeled as an AP course. So I don't know what the goal is.")
- No immediate feedback (from teacher; Code Studio)
- Not enough time ("We're spending 5-10 minutes on something and then we're done. By the end of it, I'm finally understanding how to understand it and I didn't really get it.")
- Not understanding instructions or written material ("I didn't know what it was and it was hard to know where to start. When I found information, I didn't understand it so I'd ask a lot of questions.")
- Understanding/processing new content
- Unsure where to start/what strategy to use
- Writing ("It was challenging trying to figure out what it [instructions] said and then putting that in my own words")
Student Interview Themes: Learning Supports

- Additional time for work, particularly project-based work
- Extended teacher explanation
- Glossary or other repetition of vocabulary (“She has entire charts and spreadsheets of all the definitions...If I missed something in a video, I can go back and find it. It's good.”)
- Group note taking
- Working with partners*
- Help from peers/peer explanation
- Modeling/guided practice/examples (“What I think helps me learn is examples and using those examples, to do [that]. Like letting us try to do it and then if we can't, then we learn more about it then try to do that.”)
- Multiple ways to provide responses
- Quiet/separate work space
- Small class size
- Visual representation of information (including videos) (“I'm a visual person. Once I had it [a manipulative] and was messing with it, it was super easy.”)
- Whole class video viewing/discussion

Code.org Unit 1 & 2 Lessons
#1 Takeaway: Students CAN Learn

- Adjustments are tools (*don’t change content or rigor*).

- Use them in a *diagnostic teaching approach*; adjust and intensify as needed (*what all good teachers already do – What do my students need/what scaffolding is needed? Do I need to scaffold more?*)

Computer Science is accessible to students with learning disabilities and attention deficit disorders.

See our study website for more information: [outlier.uchicago.edu/accessCSP](outlier.uchicago.edu/accessCSP)