Computer Science Student-Centered Instructional Continuum

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ABSTRACT

See conference copy for DOI and to reference.

The Computer-Science Student-Centered Instructional Continuum (CS-SCIC) is a new framework to support PreK-12 instructors in their lesson design. Educators are faced with choices when building lessons; there is a tension between direct instruction, constructivism and constructionism and difficulty in providing differentiated instruction. Theoretically aligned to Vygotsky's zone of proximal development, CS-SCIC places research-based instructional strategies on a simple learning continuum. Teachers use the continuum to discuss, review and design learning events. Used internationally, initial qualitative feedback from teachers who attended pilot CS-SIC workshops was emphatically positive. Future work includes more feedback from academia and formal research, including pre and post-professional development workshop surveys.

CCS CONCEPTS

• **Social and professional topics → K-12 education**.

KEYWORDS

computer science education, differentiation, scaffolding, K-12

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1 INTRODUCTION/PROBLEM

There is a lack of research on how to teach computer science in schools but there is increasing suggestion from academic studies that a blended approach should be used [6]. Current trends in CS PreK-12 instruction tend to focus on either structured copy code software offering immediate feedback (i.e. Code.org, programming language apps, and IDE's), or more unstructured tinkering, open projects and inquiry-based learning. Tinkering (e.g. learning by doing), or pure constructionist experimentation, is prized by some [3], and evidenced as "natural" for precocious or savant students who enjoy this approach outside of class [1]. More structured activities, such as code reading tasks or Parson's Problems, provide greater scaffolding and are being increasingly portrayed as important in computer science education [6].

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2 CS-SCIC: A CONTINUUM OF INSTRUCTIONAL STRATEGIES

Computer-Science Student-Centered Instructional Continuum (CS-SCIC) provides a simple overview of instructional strategies along a continuum of scaffolding, from most tightly controlled to most loose; in doing this, it highlights opportunities on how to differentiate instruction. CS-SCIC has six instructional approach categories of: 1) Copy code: students are given step by step instructions to follow e.g.copy an example program; 2) Targeted tasks: students are given a short task e.g. fix buggy code, Parsons Problems; 3) Shared coding: the teacher thinks aloud as they design and write code, sometimes called demonstrating or live coding e.g. teacher models how to write a program; 4) Project based: students are provided with a project goal and create a solution e.g.create a quiz in Scratch; 5) Inquiry based: students consider a scenario or question and create a solution e.g. explore a set of code commands and discover ways to use them; 6) Tinkering: completely unstructured student-led exploration e.g. explore a software. CS-SCIC's more scaffolded activities are likely to bridge a learner's zone of proximal [5] through the task itself; whereas, at the other end of the continuum, in less scaffolded tasks, any gap must be bridged independently by learners accessing support from more knowledgeable others. See conference copy.

3 PREVIOUS WORK, PILOT RESULTS AND FUTURE WORK

The continuum was created for professional development (PD) as translational work from a literature review and since has reached around 250 K-12 teachers in the United Kingdom, Ireland and Germany [7, 8]. Educators have also used the continuum as a framework to review teaching tools [2]. More recently, a 2 hour pilot study of the impact of CS-SCIC on PD has commenced in the United States. The majority (75%) of pilot teachers (n=8) reported they "absolutely" improved their CS teacher knowledge and skills. In next steps, we will obtain feedback from academic colleagues on the continuum, pursue research to assess the impact of CS-SCIC, and are interested to explore "localisation" across countries and educational phases.

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