

Hybrid Environments: A Bridge from Blocks to Text

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MOTIVATION

Text and blocks programming have pros & cons:

- Text languages are used in industry, but can be intimidating presents syntax barriers
- Blocks provide scaffolding & are tailored for learners, but are perceived as unauthentic can be difficult to move to text from later on

Hybrid programming environments provide a transition and connection between blocks and text representations by offering multiple representations of the program. This dissertation will expand research of impact on learning & attitudes of hybrid environments as a bridge from blocks to text.

RESEARCH QUESTIONS

When used as a bridge between blocks and text, how do hybrid environments impact student competency and perception as compared to unbridged transitions and learning purely in text?

1.0 How do bi-directional hybrid environments impact student learning of CS?

- 1.1 How do programming environments (blocks, text, hybrid) impact learning in CS competencies?
- 1.2 What challenges do students encounter when programming in blocks and text and when transitioning?

2.0 How do bi-directional hybrid environments impact student perceptions of CS & their abilities?

- 2.1 How do hybrid environments impact student confidence?
- 2.2 How do hybrid environments impact interest in CS?

CURRENT WORK

Current Work

Our initial study was with 150 8th graders. It used Pencil Code in Python to investigate how hybrid environments impact students transitioning to text.

Condition	Week 1	Week 2	Week 3	Week 4
Blocks	Blocks	Blocks	Text	Text
Hybrid	Blocks	Hybrid	Text	Text
Control	Text	Text	Text	Text

The curriculum included fundamentals and projects:

Week	Day 1	Day 2	Day 3	Day 4
1	Intro	Commands	Variables	For
2	While	If-Else	Functions	Functions
3	Basic IO	Proj. 1	UI	-
4	Device IO	Proj 2	Proj 2	-

Initial results suggest hybrid environments provide a less frustrating transition from blocks to text and promote positive perceptions of programming.

Future Work

- Assessment validation /w think-aloud interviews
- Item analysis

EXPECTED CONTRIBUTION

Identifying Programming Environment Impacts

- Self-confidence, interest in CS
- Perception of programming in blocks, text
- CS concept competency learning
- Hindrances of blocks, text, and hybrid modes

REFERENCES

- [1] R. J. Enbody, W. F. Punch, and M. McCullen, "Python CS1 as preparation for C++ CS2," ACM SIGCSE Bulletin, vol. 41, no. 1, pp. 116–120, 2009.
- [2] D. Weintrop and W. Wilensky, "To block or not to block? That is the question," in *Proc. IDC2015*, pp. 199–208, 2015.
- [3] M. C. Parker and M. Guzdial, "Replication, Validation, and Use of a Language Independent CS1 Knowledge Assessment," in *Proc. ITICSE2016*, pp. 93–101, 2016.
- [4] College Board, "AP Computer Science Principles," <http://www.collegeboard.org>, 2016. [Accessed 10-Oct-2016].
- [5] CITATION FOR ERICSON & MACKLIN

RESEARCH METHODOLOGY

Selection of Language—Python

- Common instructional language with widespread use^[1]
- Skills can transfer to other environments
- Low syntax hurdle

Integrated Development Environments (IDEs)

- Plugins now available for Visual Studio and IntelliJ
- Extends reach of hybrid representation beyond Pencil Code
- May help address perceptions of lack of authenticity^[2]

Multimodal Assessment

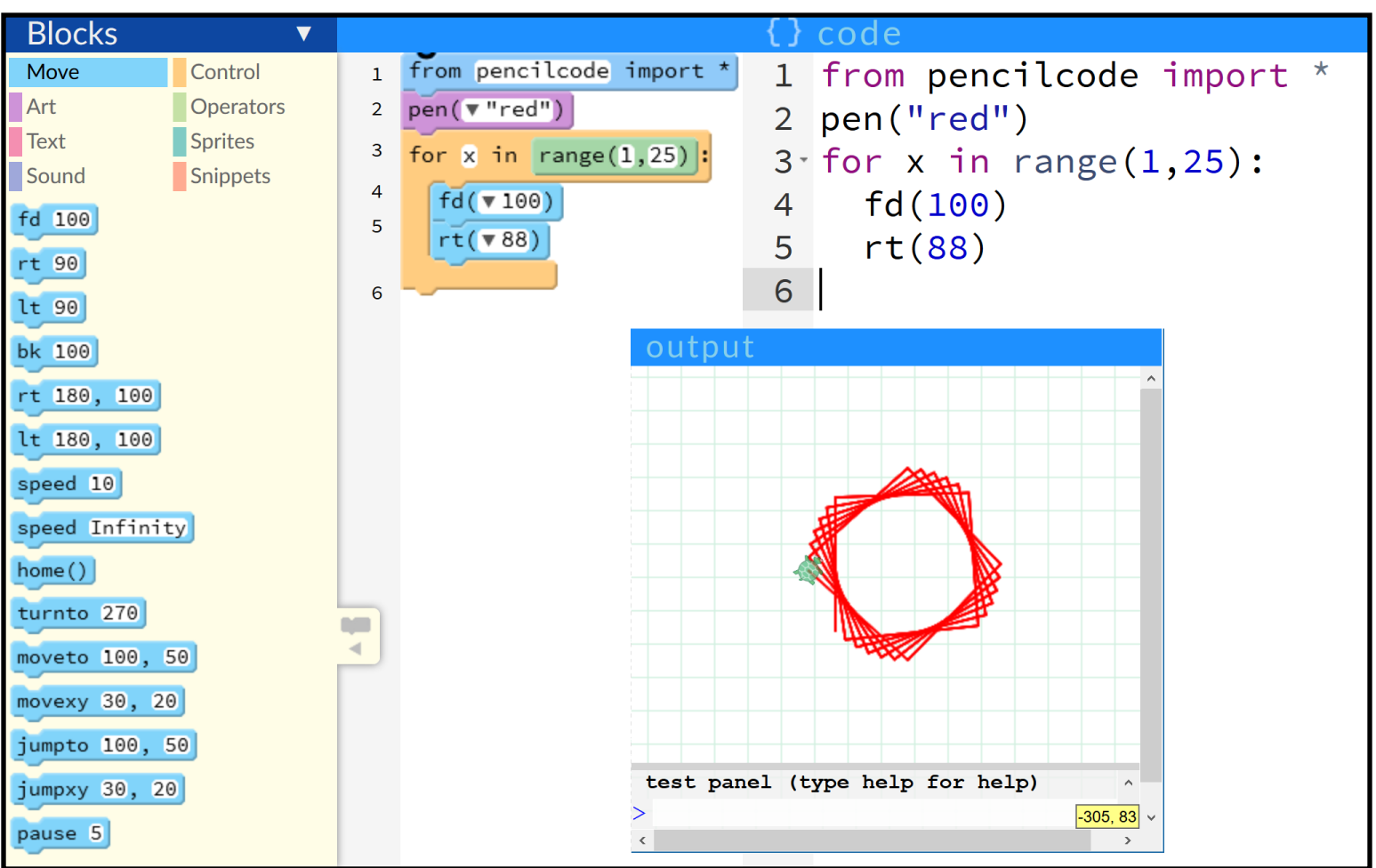
- Computing & programming concepts (variables, loops, etc.)
- Blocks & text variants for each question; isomorphic variants
- Multiple difficulty levels—easy, medium, and hard
- Based on SCS1, AP CSP concepts^[3,4]

Attitude Survey

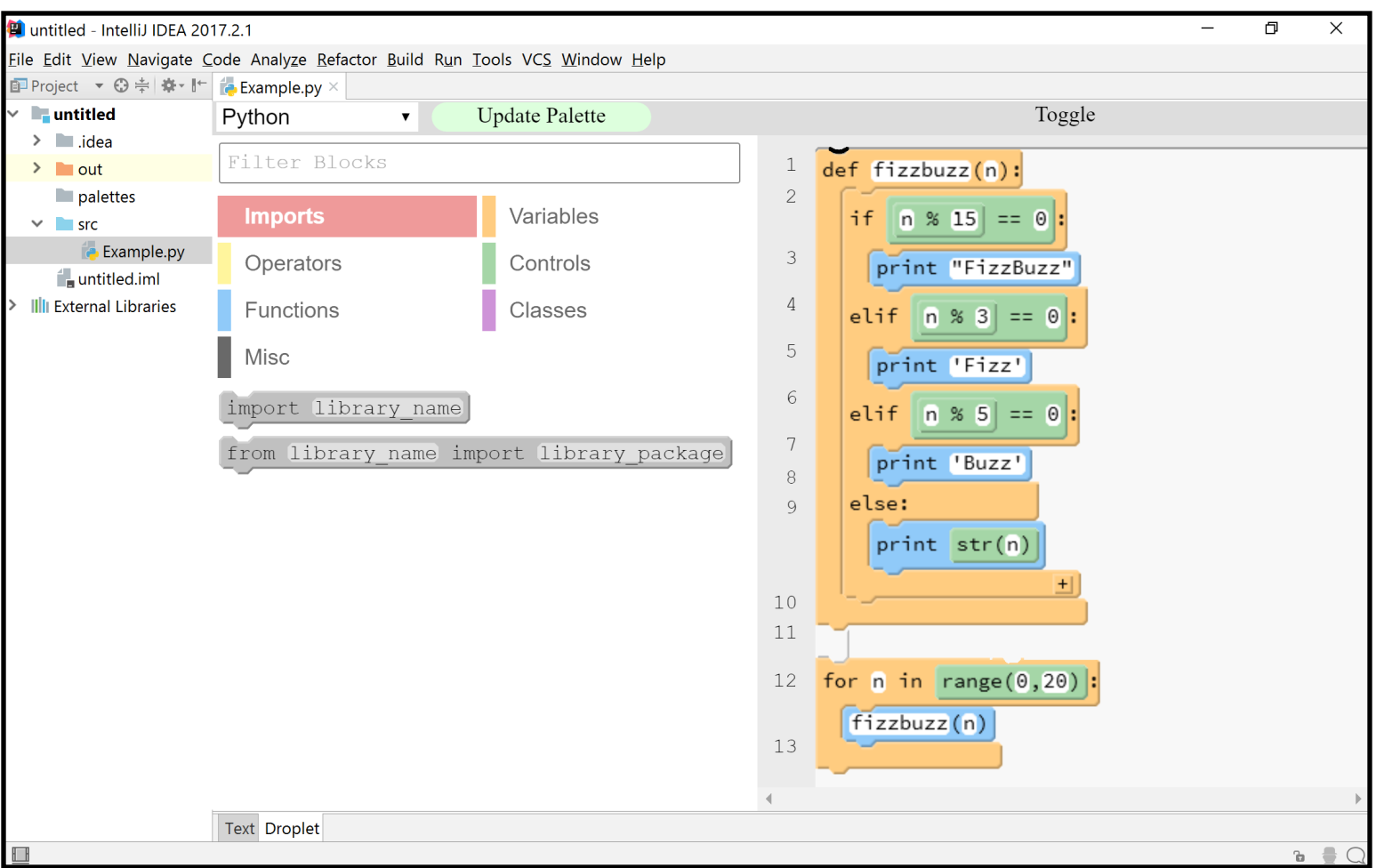
- Recognized attitude questions from work of Ericson & MacKlin^[5]
- Measures attitudes regarding ability, interest, and field of CS
- Questions comparing blocks and text ("Blocks / text are easier")

Additional Data Collection

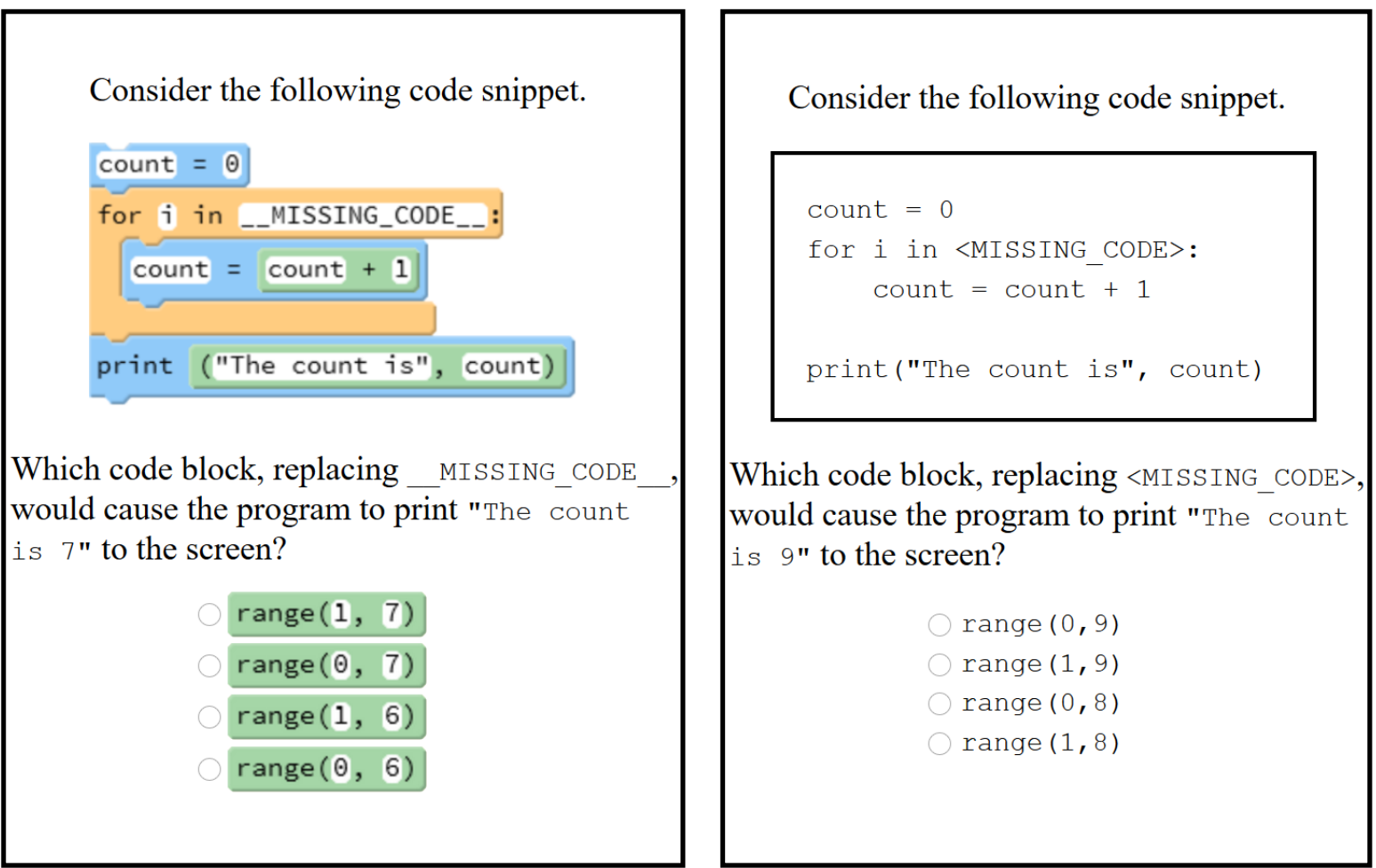
- Interviews with participants
- Artifacts created during study (programs / assignments)



(1) Python variant of Droplet in Pencil Code



(2) Droplet as plugin for IntelliJ IDEA



(3) Blocks and text assessment questions

BACKGROUND

Text and blocks present benefits but also challenges which hybrid environments can mitigate:

Mode	Provides Scaffolding	Coveys Authenticity	Bridges Blocks & Text
Blocks	✓	✗	✗
Text	✗	✓	✗
Hybrid	✓	✓	✓

Pencil Code's Droplet Editor

- A **bi-directional** hybrid environment
- Switches between blocks and text in real time
- Provides new language module architecture

Pencil Code allows us to add languages so that we can teach a single language across platforms.