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The Case for Non-linguistic Approach to Teaching Engineering Thinking

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"Rethinking Visual Programming"

Ivan Daniluk

"Video Games and the Future of Education"

Jonathan Blow

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Why learning to program software is hard

And teaching to program - twice as hard

- Verbal/textual transfer of knowledge doesn't suit complex topics well
- Programming languages lack uniformity, each requiring a different strategy to learn and master
- Students have not developed intuition that could be relied upon to boost the learning process

Problems with verbal transfer of knowledge

And using text for education in general

- Knowledge needs to be deconstructed by the teacher before it can be reconstructed by students, this process lacks feedback
- Cognitive load tends to increase dramatically, impairing students' ability to memorize content
- The intention that others understand one's intentions is inherently uncertain
- Text's primary function is to preserve knowledge, not educate

Problems with learning programming languages

They rely on mathematical notation too much

$$\text{Expression}_1 = \text{Expression}_2$$

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$$x = a * (b + c) + d$$

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$$x = a * (b + c) + d$$

```
mov      edx, DWORD PTR [rbp-24]
mov      eax, DWORD PTR [rbp-28]
add      eax, edx
imul     eax, DWORD PTR [rbp-20]
mov      edx, eax
mov      eax, DWORD PTR [rbp-32]
add      eax, edx
mov      DWORD PTR [rbp-4], eax
```

Problems with learning programming languages

Each of them is special in its own way

```
x = j if a > b else k
```

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```
x = j if a > b else k

x = a > b -> j, k
```

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```
x = j if a > b else k

x = a > b -> j, k

int x = (a > b) ? j : k;
```

What we could do to solve it

Hint: "non-linguistic" is the keyword

- Limit use of text in favor of multimedia instructions (cognitive theory of multimedia learning)
- Use special tools that provide instant feedback, improve inference, promote reflection
- Use language-agnostic forms of developing the right kind of intuition
- Develop engineering thinking early by introducing programming concepts before teaching a programming language

insert demonstration here

This talk was not about:

- Gamification of education
- Using video games in education
- Video games transforming education

This talk was about:

- Reconsidering the traditional approach to teaching
- Recognizing the power of non-linguistic communication
- Using advances in software development to improve how we teach

Links and references available at:

https://bit.ly/case-for-non-linguistic-teaching