Examining Participation and Outcomes Among Middle School Students in a Virtual Camp on Coding with Music

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June. 2024

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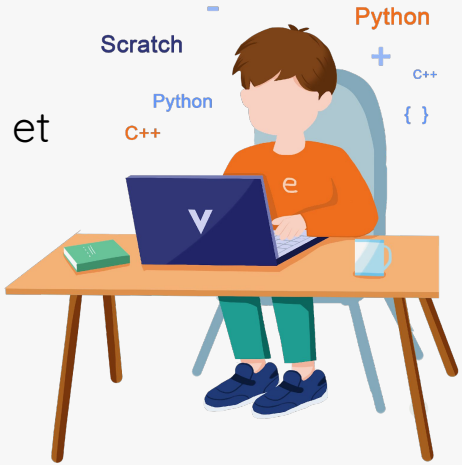
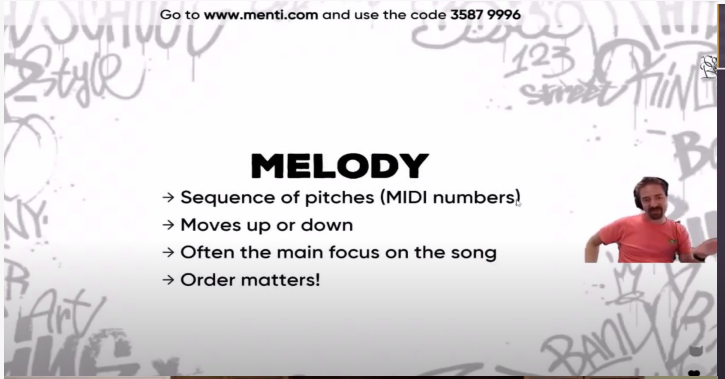
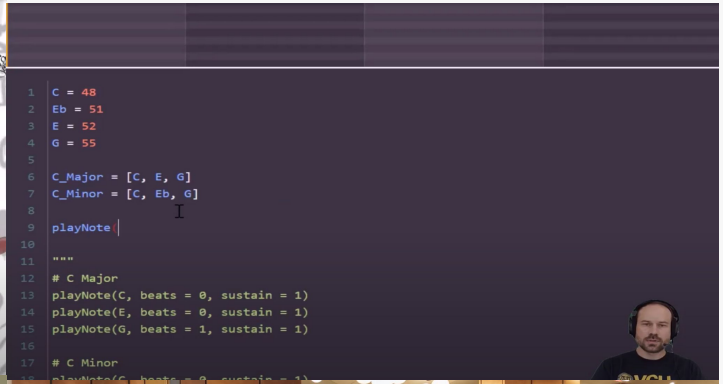
Computing Coupled with Music

- ✔ Attracting and exposing children at an early age to computing is crucial to forming opinions and ideas; Can also lead to to future decisions to pursue computing (Petrie, 2022)
- ✔ Teaching programming through artistic endeavors is a promising approach to broadening participation in computing (Freeman et al., 2014; Lusa Krug et al., 2021)
- ✔ Music shares similarities with programming, including notation and CS concepts, such as repetition (Bell & Bell, 2018)



Code Beats – Scenarios

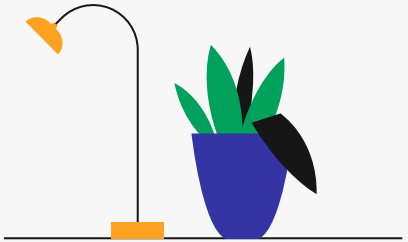




1: Live streaming	3: Live coding
2: Live performing	4: Beats contest

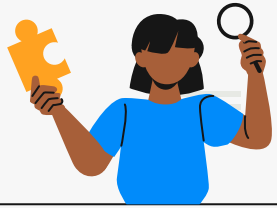
Research Questions

- How did the participants' prior experiences with coding and music motivate participation in the camp?
- In what ways did participants engage with summer camp activities?
- How has participation in Code Beats influenced participants' attitudes towards programming?



Participants

Camps	Number	Age	Gender	Race
A (morning)	N = 82	11.7 (min: 9 - max: 14)	43.8% female 50.7% male 5.5% prefer not to say	35.6% White 28.8% African-American 19.2% Asian 6.8% Multi, not Hispanic 2.7% Hispanic 2.7% Other 4.1% Prefer not to say
B (afternoon)	N = 50	11.9 (min:7 – max:15)	34% female 64% male 2% prefer not to say	32.0% White 24.0% African-American 14.0% Asian 6.0% Multi, not Hispanic 8.0% Hispanic 10.0% Other 6.0% Prefer not to say



Data Collection

Data	Size	Measurements
Pre-post survey	163 pre; 81 post; 73 pre-post	6 items on demographic 7 items on background and interests 26 items related to a) confidence, interests, and sense of belonging in computing b) attitudes towards gender equity in computing c) future intentions to engage in computing
Focus group	85 invitation; 48 attended	11 questions: a) reasons for attending the camp b) prior experiences with music and/or coding c) interactions with camp staff and peers d) experience in the camp and the music used within it e) what they liked most about Code Beats f) anything that surprised or they felt proud of g) suggestions for improvement

Data Analysis

Data	Method	Measurements
Pre-post survey	Quantitative	Descriptive statistics T-test (α of 0.05) Two-way analysis of variance (ANOVA) Post-hoc test Tukey's test
Focus group	Qualitative (Saldaña, 2021)	First, clean and organize data into a matrix Second, review and code themes Finally, quantify themes to determine percentage

Findings - Prior Experiences and Motivation

Prior experience	N (37)	% (100%)
Prior music experience by taking lessons, participating in orchestra, etc.	34	91.9%
Prior coding experience through structured classes, camps, or projects	29	78.4%

Reason for Attending	N (163)	% (100%)
My parent or guardian recommended it	114	69.9%
I am interested in computing	84	51.5%
I am interested in music	72	44.2%
The camp sounded fun	60	36.8%
I am interested in performing	30	18.4%
An adult at school recommended it	5	3.1%
My friends at school were doing it	3	1.8%
Other reasons	14	8.6%

Findings - Engagement

Attended classes	Live sessions		Help sessions	
	N	%	N	%
0-2	6	7.4	73	90.1
3-5	2	2.5	2	2.5
6-8	10	12.3	1	1.2
9-10	63	77.8	5	6.2

Live and help sessions attended

Amount of independent work time daily	N	%
Almost none	5	6.2
Less than 15 mins	16	19.8
15-30 mins	36	44.4
30-45 mins	10	12.3
45-60 mins	5	6.2
More than 60 mins	9	11.1

Self-reported after-class time spent daily

Findings - Attitudes

Category	Pre-test Mean	Post-test Mean	t	p
Computing confidence	3.48	3.80	-1.82	0.07
Computer enjoyment	4.41	4.41	-0.05	0.96
Perceived usefulness	4.51	4.46	0.43	0.66
Motivation to succeed	3.72	3.85	-0.88	0.37
Identity and belonging	3.61	3.80	-0.49	0.23
Intent to persist	3.43	3.52	-0.41	0.69
Gender equity	4.78	4.75	0.21	0.84

Findings do NOT indicate any significant changes in attitudes after the program. Only the computing confidence category shows a marginal effect with a moderately substantial difference with a p-value below 0.10 and close to 0.05.

Findings - Attitudes from Qualitative

- ✔ Meaningful from coding with beats

  “I thought it was really cool getting a problem and it would be hard to solve it. And then after a little bit of struggling, you finally accomplished it. You...feel really good..”

- ✔ Satisfied learning new skills

  “I definitely feel like I learned a lot about coding with TunePad, and I definitely think I’ll use it in the future cause it’s fun.”

- ✔ Enjoy sharing work with others

  “I like showing the beats that I just made for fun to my friends... I would let them listen, like the one I entered into the competition. They helped me name it.”

- ✔ Future plans in computing

  “I’m taking computer science for seventh grade.”

Discussion – Motivation

- Parents and guardians played an important role in motivating participation in the camp (Crowley & Jacobs, 2002)
- Prior experiences with either music or coding also played a role in student motivation to attend (Witherspoon et al., 2016)

Discussion – Engagement

- The majority of participants attended all live sessions and spent at least 15-45 minutes completing independent work
- However, most participants did NOT attend the individual help sessions
  - Students may have perceived these sessions as necessary only if they required support
  - Given the informal nature of the camp there was no accountability

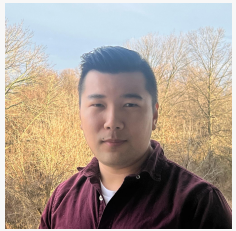
Discussion – Attitudes

- Mixed results in attitudes shifts towards computing
  - Equal development between genders except in identity and belonging where males scored higher
  - Students entered the camp with strong attitudes towards enjoyment and perceived usefulness, leaving little room for growth
  - Online delivery of the camp may have impacted outcomes

Future Work

- Teachers' involvement
  - Classroom integration
- Analyze coding process data to understand engagement
  - Logs, videos, etc.
- Understand how prior experiences influence engagement and changes on attitudes
  - Music preferences
  - Experience with coding/music

Author List and Acknowledgements



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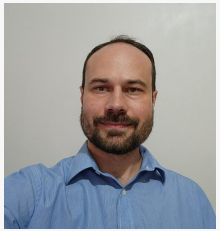

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NSF Grants #2048793 and #2048792