Factors contributing to student experience in the Cave Automatic Virtual Environment (CAVE) for Computational Thinking (CT) development.

Presentation
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Outline

- Background / Literature overview
- Problem Statement
- Gap in Literature
- Statement of Purpose
- Research Question
- Significance and Contribution
- Conceptual Framework
- Research design and Research Methodology
- Results and Discussion
- Conclusion

Background- VR

The CAVE (Cave automatic virtual environment)

CAVE input devices

Head Mounted Display devices (HMDs).

Problem Statement

The problem is national crisis in Science, Technology, Engineering, Mathematics (STEM) due to limited technological training to meet industry demands.

National crisis in STEM

- Digital literacy.
- Change in core skills and abilities required to do existing jobs due to technological advancement.
- Diversity and inclusivity in STEM fields.

(Pellas et al., 2020; Radianti et al., 2020; T et al. 2020)

Literature Overview – Virtual Reality (VR)

Benefits

1

- Foster student engagement, motivation, skills acquisition, academic performance.
- Foster cognitive abilities, digital skills, and soft skills in a safe environment .
- Visualization, immersion, interactivity.

Learning Paradigm

3

- Behaviorism - Classroom management, student-centered.
- Cognitivism – Active learning.
- Constructivism - Experiential and interactive pedagogy.

Framework

2

- Virtual Environment.
- User interface.
- Tracking system.

Instructional Design Framework.

- Interactive.
- Collaborative.
- Gamification elements.

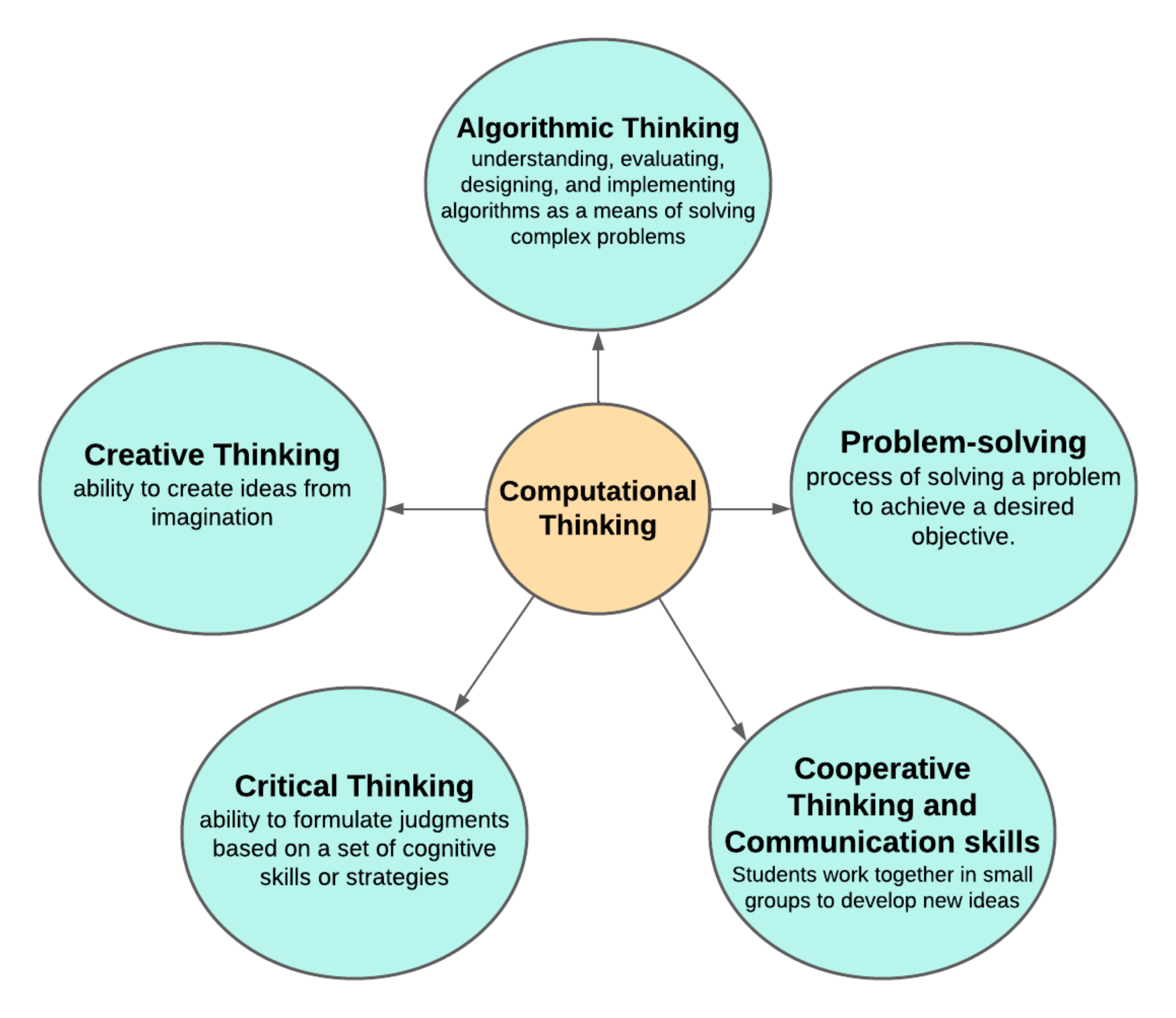
Learning Theory

4

- Cognitive Theory of Multimedia Learning.
- Experiential learning.

(Philippe et al., 2020; Hickman & Akdere, 2017; Dong, 2016; Chen, 2020; Guo, 2019; T et al., 2020; El-Mounayri et al., 2016; Radianti et al., 2020)

Literature Overview – Computational thinking (CT)



Definition

- Set of thinking and problem-solving skills derived from computer science.
- Frequently used words describing CT include creative thinking, critical thinking, problem-solving, cooperative thinking and algorithmic thinking.

Implementation

Fostering CT in STEM education using:

- Active learning.
- Project-based learning.
- Problem-based learning.
- Coding and robotics activities.

Assessment

Observation, performance tasks, and surveys.

(Gong et al., 2020; Tang et al., 2020, Brennan & Resnick, 2012, Daungcharone, 2017; de Jesus & Silveira, 2019; Orozco-Garcia et al., 2019; Korkmaz et al. 2017)

Gap in literature

01

Limited research on VR and CT conducted in historically black colleges and universities (HBCUs).

02

Little systematic research has been done on how immersive VR can benefit underrepresented engineering students.

Statement of purpose

To provide an in-depth understanding of the factors that influence engineering students' experiences while using VR to enhance their CT skills .

Research Questions

RQ1

How do HBCU engineering students perceive VR space's use in CT development?

RQ3

what are the factors that influence students' experiences while using VR space in engineering classes at HBCUs?

Significance and Contribution

A

Virtual Reality

Research evidence of the effectiveness of VR to improve CT capabilities.

B

CT development

Provide information for practitioners and educators on CT development.

C

Education technology policies

Improve practices and policies in VR in STEM education.

Participant and Research Setting

01

An HBCU

Participants

02

38 First year engineering students in an HBCU.

Research Design

Approach Qualitative method

AIM — To gain in-depth understanding of participants perception, attitude, and behavior towards the use of immersive VR in the curriculum to enhance learning.

Research design — Cohort observational study.

Participants — The study took place in an HBCU.
38 students enrolled in first year engineering class (freshman engineering 120).

Data Collection — Focus group interview, direct classroom observation.

Data Analysis — Thematic coding.

Data collection procedure

- Two direct classroom observations sessions using an observation protocol.
- Each observation lasted approximately 60 minutes.
- Five focus group interviews containing 5-8 participants after exposure to the VR space.
- Each focus group interview lasted approximately 10 minutes.

Interview questions

How do you think this VR space can impact your learning process or learning experience?

How do you think this VR space can improve your problem-solving skills?

How do you envision the VR space in the next five years or in the coming years at this HBCU?

Do you have any concerns about the use of the VR space?

Can you please share your experience with the VR space?

VR space setting

Classroom Setting

Flipped classroom setting.

The instructor collaborated with the VR space facilitator to present VR models to students.

Class Content

Introduction to the VR space and its benefits in AM and engineering design was presented at the start of the CAVE session.

Students were required to submit reflective assignments in the form of an essay, a presentation, a class forum, or a portfolio.

LEARNING OBJECTIVES

- Visualization tools.
- Computer Aided Design (CAD).
- 3D printing.
- Cyber-physical systems.
- Identify and defend against threats.

VR activity

Each group of 8 students spent approximately 15 minutes interacting with three-dimensional models.

The students viewed three VR models and manipulated 3D models by grabbing, rotating, zooming, and dropping it.

Data Analysis procedure

Thematic Coding

Become familiar with collected data → Code the collected data → Generate themes → Review themes → Define themes → Report findings

Results R1 – Perception and Attitude

Observation

- Highly engaged and interested in the CAVE environment.
- Constantly collaborating, asking questions and contributing creative ideas.

Perception and Attitude – Positive

- VR is unique and realistic experience.
- VR is a helpful tool for developing practical skills, safety habits, and real-world problem-solving abilities.
- Enhance experiential and active learning, which is conducive to CT development.

Concerns

- Dizziness.

Quotes

"It was pretty cool"

"I would say it was pretty unique. I have not been in virtual reality CAVE before. I have experienced virtual reality in game before, but I never did anything like that. I thought that was pretty cool"

"it can help us improve our practical skills and safety habits and all that."

"Well, like I said, it's just basically putting them in real world situations. Like I can say these. This right here, yeah, we can create a model and break it apart and make us learn it piece by piece and bring it back together and learn the functionalities of the parts."

"I mean it help in putting on real life situation without actually spending more. That's how it will help because you can learn, you can make mistakes without messing anything up or, you know, damaging anything that costs a lot of money. You can make those mistakes early, so when you finally do get into the field its going to be perfect."

Results R2 – Factors

- Active learning
- Realistic and Immersive
- Visualization
- Interactive
- Cost- effective

Quotes

“yeah, because it catches everybody's attention in my opinion. Like you can sit there and watch somebody teach and learn when you're actually in it you feel much better and pay more attention and also interactive."

"I feel like it's good for visuals or something.”

“I would say I am a hands-on learner. So, for me to learn, I need to see things and actually do it myself. So, I feel like if I learn how to, you know, put something together in virtual reality I can do it in real life.",

" Well, like I said, it's just basically putting them in real world situations. Like I can say these. This right here, yeah, we can create a model and break it apart and make us learn it piece by piece and bring it back together and learn the functionalities of the parts."

Conclusion

1

Participants demonstrated high engagement and interaction levels and a positive attitude towards the VR space.

2

Students were highly engaged, creative, cooperative, critical thinkers, and eager to learn new challenging things in the VR environment.

VR in the engineering curriculum was seen as a valuable tool in improving students' learning experience and CT skills

3

Participants' positive perception of the VR sapce was attributed to active learning, realistic and immersive experiences, visualization, interaction, and cost-effectiveness .

4

Future work – Quantitative method to investigate the relationship between VR space and CT development

THANK YOU