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ENGINEERING FOR INNOVATION  
**University of Salento**

*Augmented and Virtual Reality Laboratory  
(AVR Lab)*



# Touchless navigation in a multimedia application: the effects perceived in an educational context

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# Outline

- Edutainment
- Natural user interaction: gestures and object manipulation
- Gesture-based learning
- Target scenario: ipermedia application on Leonardo's inventions
- Evaluation of the user experience
  - Usability
  - The effects on education

# Edutainment

## Game-oriented environments for education

- Engaging multi-channel and multi-sensory platforms
  - ➔ Higher level of attention
- Informal learning
  - Not highly structured
  - Related to practical experience
- Natural interaction based on user movements
  - ➔ kinesthetic pedagogical practices

# Natural User Interaction

## Gestures

- Positions/movements <-> meaningful commands
- Guessability: ability to guess symbolic input without any prior knowledge

## Object selection

- Virtual hand
- Virtual pointing

## Object manipulation

- Direct manipulation
- Based on an augmented tangible interface

# Gesture-based learning

- Kinaesthetic interactions + auditory and visual information
  - Embodied cognition theory: manipulation can improve the way of thinking
  - Constructivism: active process of knowledge construction
  - Multiple intelligences
  - Different learning styles (Kolb's theory)
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- Some limitations:
    1. Finding an optimal position for the device in a classroom setting can require many attempts
    2. The accuracy of Kinect tracking is influenced by environment conditions and surrounding materials
    3. The preliminary calibration may disrupt the class
    4. Difficulty to convey the attention back to traditional lessons after the Kinect-based activities

# Target scenario

Ipermedia application on Leonardo Da Vinci's inventions

Touchless control interface based on Kinect

- Object selection and manipulation
  - Gestures
- GUI elements



# Kinect One

## Time-of-Flight camera

- 512 x 424 resolution
- 30 Hz frequency
- 70° x 60° field of view

## Color camera

- 1080p video
- 30 Hz frequency



# The application interface

The user can select an item by holding his/her hand over it





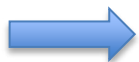
# The application interface



- **Swipe gesture:** go to the next/previous page
- After **holding the hand** on the loupe icon to enable zooming by gestures, **push** the hand forward to zoom in and **pull** it back to zoom out
- **Grab gesture:** move the image

# Questionnaires for user experience

- Test with 16 students of a secondary school
- Three questionnaires
- 5-point likert scale ranging from “Strongly Disagree” to “Strongly Agree”
- **System Usability Scale (SUS)**
  1. Learnability: ability to quickly learn how to use the system
  2. Usability
- **Usefulness, Satisfaction and Ease of Use (USE)**
  1. Usefulness
  2. Ease of use
  3. Ease of learning
  4. Satisfaction
- **Custom application questionnaire**



users' impressions and opinions on the ipermedia application

# SUS

- **Learnability: ability to quickly learn how to use the system**
- **Usability**
  1. I think that I would like to use this system frequently.
  2. I found the system unnecessarily complex.
  3. I thought the system was easy to use.
  4. **I think that I would need the support of a technical person to be able to use this system.**
  5. I found the various functions in this system were well integrated.
  6. I thought there was too much inconsistency in this system.
  7. I would imagine that most people would learn to use this system very quickly.
  8. I found the system very cumbersome to use.
  9. I felt very confident using the system.
  10. **I needed to learn a lot of things before I could get going with this system.**

# Custom application questionnaire

- **Kinect effectiveness**

1. Do you think the Kinect device can facilitate the interaction with the application?
2. What is the naturalness and intuitiveness of Kinect gestures associated with commands?

- **Content presentation and understandability**

1. Do you think the application content is shown in an effective way?
2. Do you think the application can help in understanding the concepts?
3. How do you evaluate the level of detail of the study achievable through this application?
4. Do you think the information presentation is effective and engaging?
5. How do you evaluate the connections among pieces of information concerning the subject?
6. How do you evaluate the multimedia content organization in order to support the understanding of the subject?

# Custom application questionnaire

- **Cooperative learning improvement**

1. Do you think the application could improve the collaboration with the teacher?
2. How do you evaluate the ability to work in group during the use of the application?
3. How do you evaluate the use of ICT to support processes aimed at sharing, collaboration and involvement in a learning content?
4. Do you think the use of such applications could improve the educational processes in a laboratory?

- **Increase of interest**

1. Do you think the application has enhanced your interest in the subject?
2. Do you think the application has enhanced your interest in the laboratory school activities in general?

- **Digital competence improvement**

1. Do you think the application has improved your competence in using digital technologies?

# Main results

## Application

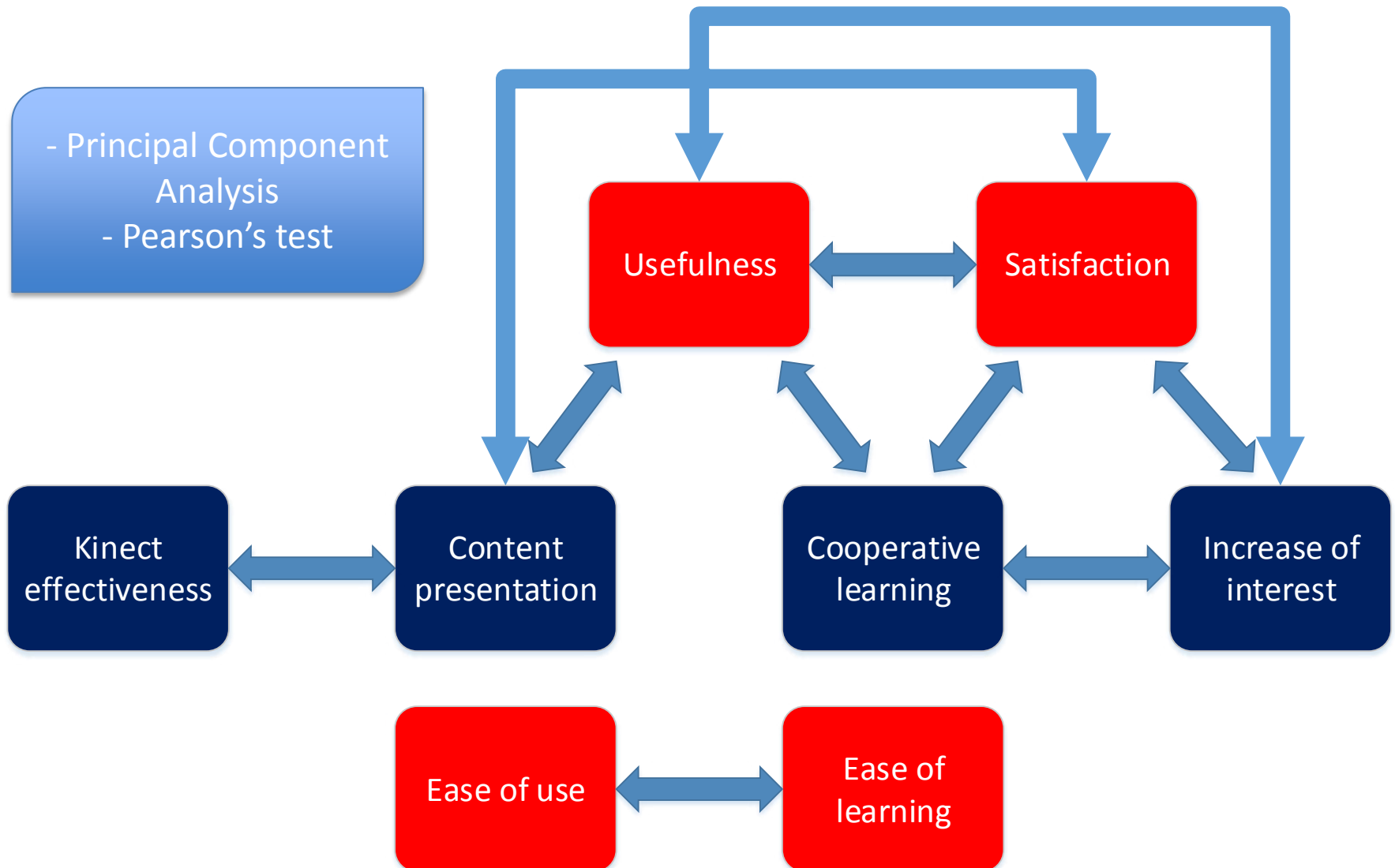
- positive opinions on multimedia content organization
- different opinions about the ability of the Kinect-based approach to enhance the users' interest (it can be inferred from the high standard deviation)

## Usability

- usability has a higher mean score than learnability (67% vs 62%)
- different opinions about the possibility to learn quickly how to use the system

Application	SUS	USE
69%	66%	70%

# Correlations among components



# Conclusions and future work

- We studied the effects of touchless navigation in an educational scenario
- We considered a gesture-based ipermedia application on Leonardo Da Vinci's inventions
- Perceived usefulness and level of satisfaction influence students' opinions about content presentation, cooperative learning and the interest towards the topics

## Future work

- Tests with other devices (Leap Motion, Azure Kinect)
- Comparison with data recorded by Brain Computer Interfaces