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Guidelines for Educational Games targeting Children

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DESIGN-GUIDELINES FOR EDUCATIONAL GAMES FOR CHILDREN

EXPERIENCE
1) Consider the intended learning goals of the game early in the development process.
2) Designers should be aware of individual differences and preferences to address self-expression and engagement.
3) Provide the feeling of control to empower and engage the player.
4) Implementing fantasy and roleplay creates enjoyment and the feeling of escapism which in turn can support engagement and learning.
5) The cultural context of the end users should be considered.

DYNAMICS
6) Provide clear goals and tasks within the game.
7) Provide Choice to address and to make it more tailored within the game.

Cognitive aspects
8) Provide scaffolding & guidance with positive feedback and feedback by giving hints, tips and tricks. Provide immediate feedback to avoid impatience.
9) Show current state for when the system is processing (buffering) or when the system is waiting for input to avoid impatience.
10) Provide customization to enhance intrinsic motivation and self-expression.

DESIGN
11) Use rewards to motivate and engage but be careful with too frequent rewards not to overweight the intrinsic motivation. Do also make sure to balance the number of rewards along the gameplay and the level of challenge or when the learning curve is steeper.

Motor aspects
12) Touchscreen is a good choice for younger users rather than a computer and mouse interaction.

Gestures
13) Use consistent gestures throughout the app.
14) Avoid too small targets, especially on the edge of the screen. Do also provide enough of distance between targets and increase the active area around them.

Avoid gestures as:
a. drag & drop (use "sticky-drag-and-drop" instead.
b. rotate, pinch and spread for younger users <4.
c. double tap gesture or allow longer delay between the taps.

Accept gestures as:
d. partial gesture completion, single and multi-touch.

Cognitive aspects
15) Design buttons and clickable items in a 3D- or a clickable-looking way to differentiate these from the background by using different colors and outlines.
16) Avoid visually complex backgrounds as it can create confusion and use a neutral color palette to lower the cognitive load.
17) Limit the behavior of interactive elements to their sole purposes not to draw attention from their core functions.
18) Use content specific metaphors and meaningful icons and minimize abstract concepts (e.g. "left" and "right") or symbols.
19) Avoid menus and submenus as it can be challenging for children in the pre-reading age and difficult to understanding this kind of navigation.
20) Entertainment "click-ons" and hotspots can keep the child engaged and entertained between tasks but use these carefully as they may distract from learning.
21) Use good quality audio and visual cues instead of text to support understanding. Audio supported by animations can help to uphold the attention.
22) Expand the complexity and the level of challenge along the users learning curve in order to optimize learning. Provide levels to increase challenge in a natural way.
23) Preschoolers tend to appreciate challenge with short term awards (e.g. collecting items rather than longer problems/quests with long term rewards).
24) Three-dimensional images and virtual worlds can teach and let children explore new environments and objects.

Authors

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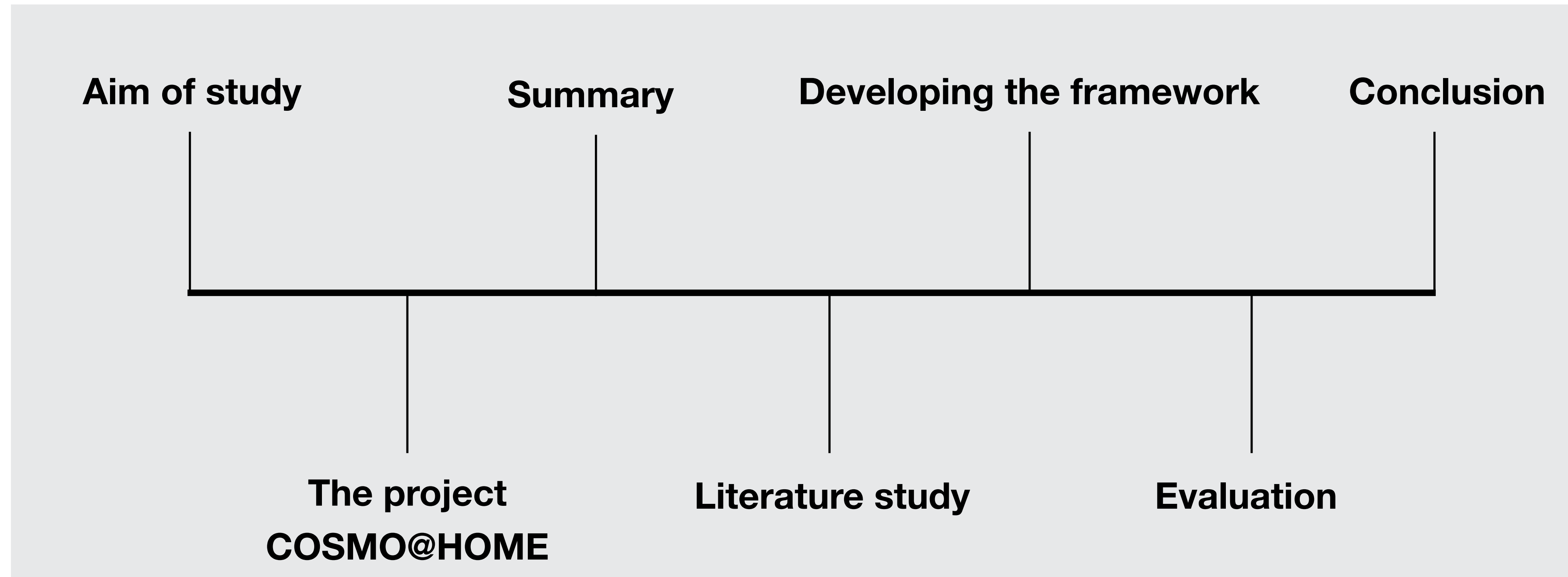**Senior researcher**

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Agenda

Aim of study   Summary   Developing the framework   Conclusion

The project
COSMO@HOME   Literature study   Evaluation

Aim of study

To define a framework with guidelines for educational games for children.
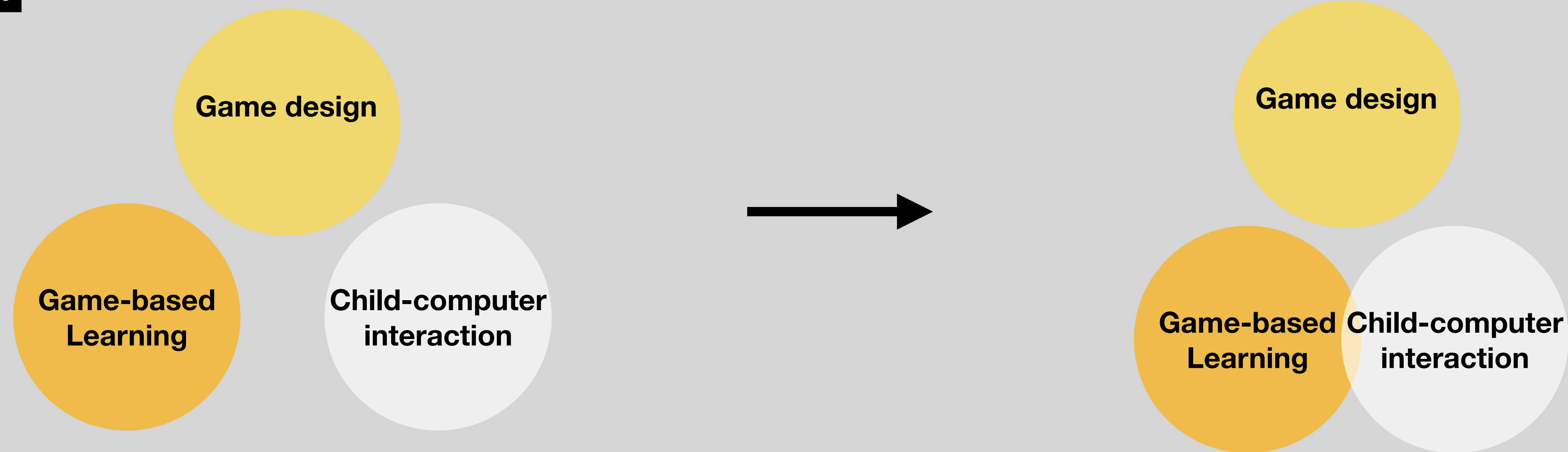
This work is a first explorative step towards developing a tool that easily can be used by designers for educational games. There exists a wide range of guidelines within the fields of game design, game-based learning/educational games and child computer interaction. All of these are useful when designing for these specific areas but from the literature study we could see a lack of guidelines which combines these areas, especially game-based learning and child-computer interaction.

The project - COSMO@HOME

Project partners:

This paper and work was conducted alongside the development of an healthcare educational game for children, called COSMO@HOME, through which, child patients can learn and prepare for MRI-scanning procedures. The application COSMO@HOME consists of games and interactive exercises to prepare the children, and to convey important learning goals.

For example, increase the understanding of the size of the MRI-scanner and its sounds, the need for lying still for a long period of time, and information about not being allowed to bring metal objects into the MRI-scanner.

Summary

Literature study

First draft - 42 guidelines

Evaluation of the framework

Final version - 24 guidelines
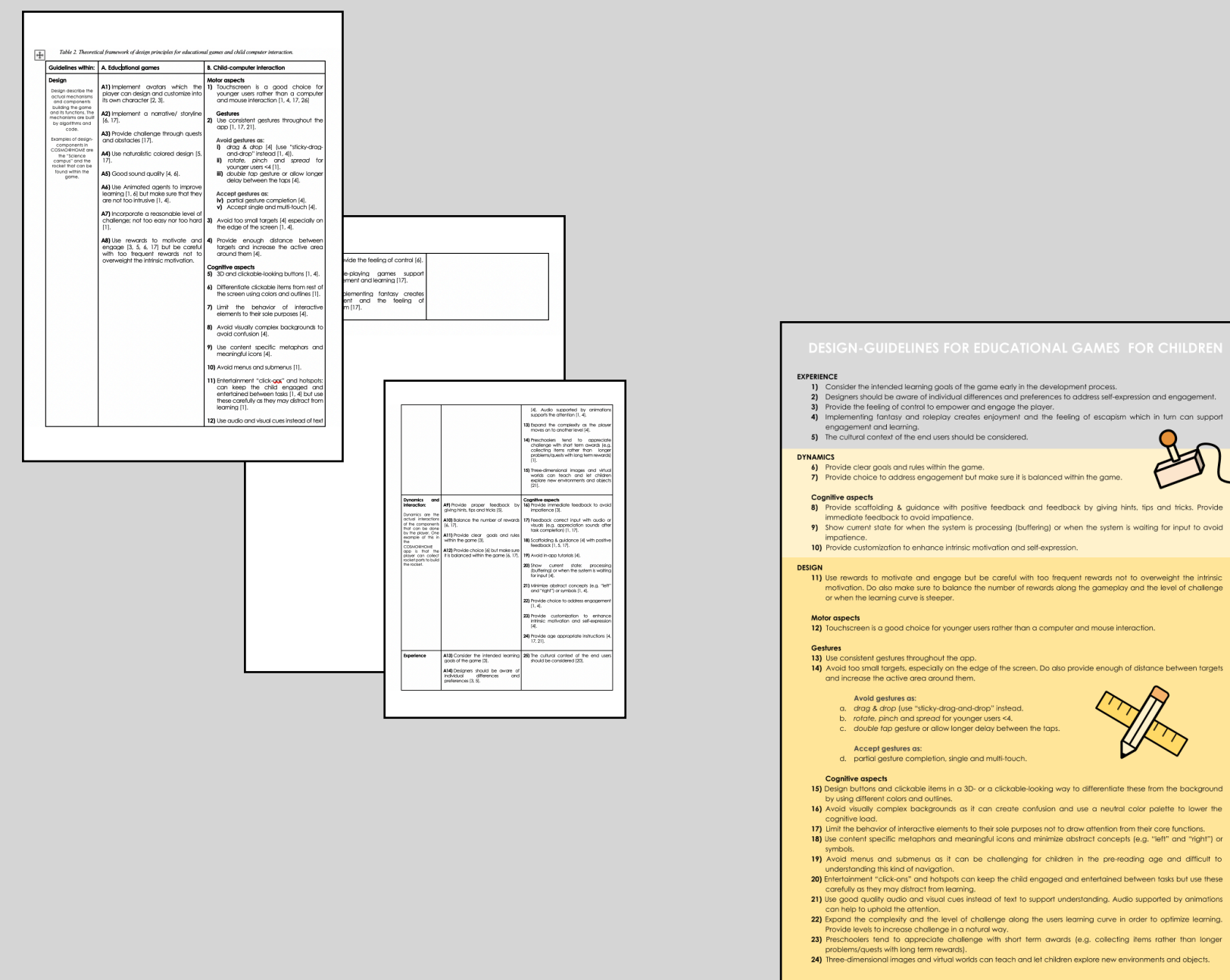
A literature study was conducted within the areas of games, educational games, and child-computer interaction. From the publications, 42 guidelines within educational games and child-computer interaction were elicited. The guidelines were applied and tested on the healthcare application COSMO@HOME. Based on the outcome of the evaluation, formulations of the guidelines were updated and resulted in a new, more easily applicable compact version of the framework, named the Educational Games for Children (EGC) framework.

Literature study

Child-computer Interaction

Game-based learning

Game design
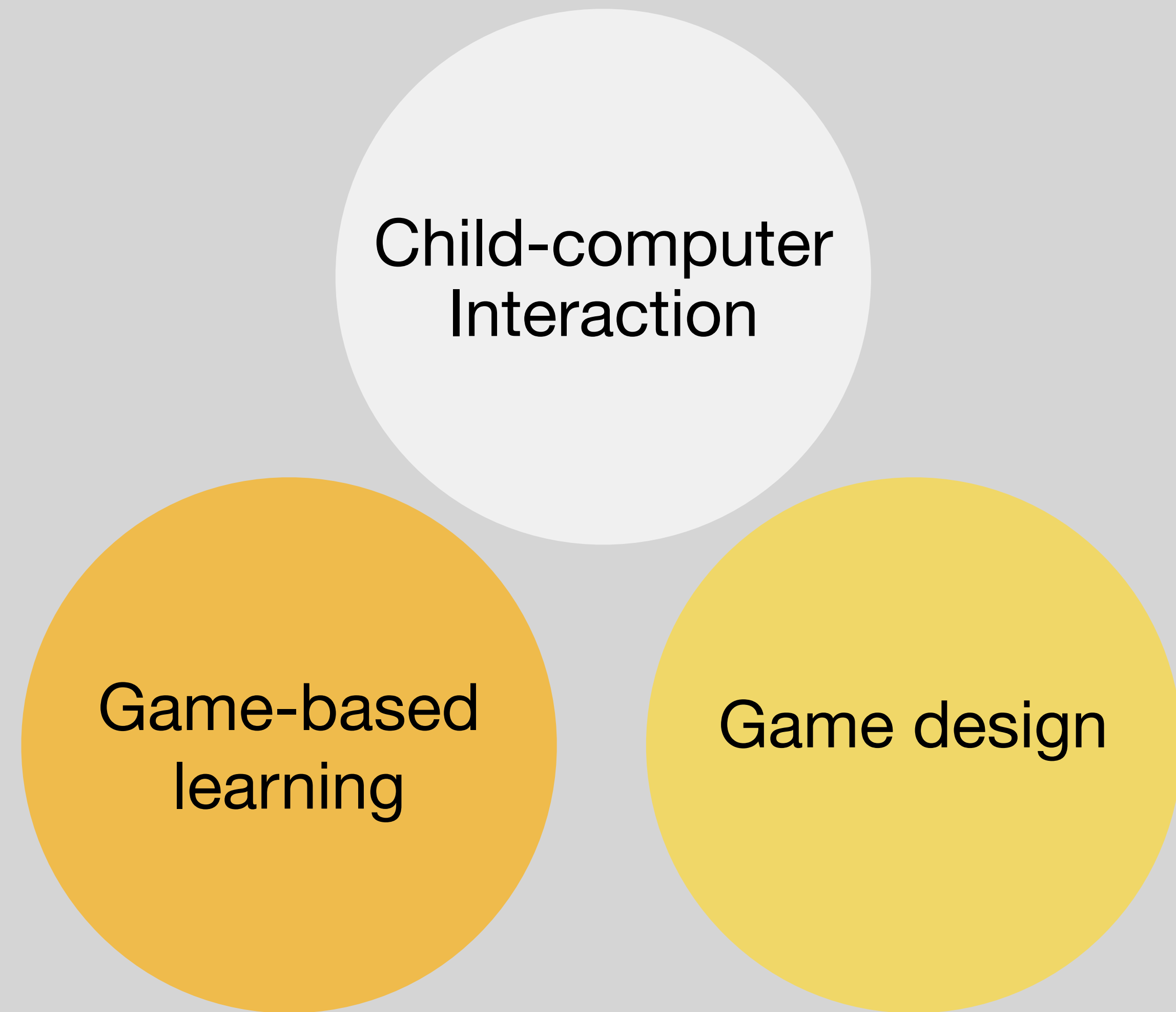
The paper starts by presenting the results from the literature study, describing the area of game-based learning and education (Section 2), followed by a section about child-computer interaction (Section 3). Section 4, in the paper, elaborates on existing frameworks and their advantages and disadvantages, in relationship to the suggested framework. Guidelines and recommendations that were found this study were continuously collected and structured into a table which will be shown later in this presentation.

Literature study

Game-based learning

Gamification

Feedback

Achievements

Motivation

Curiosity   Challenge   Fantasy
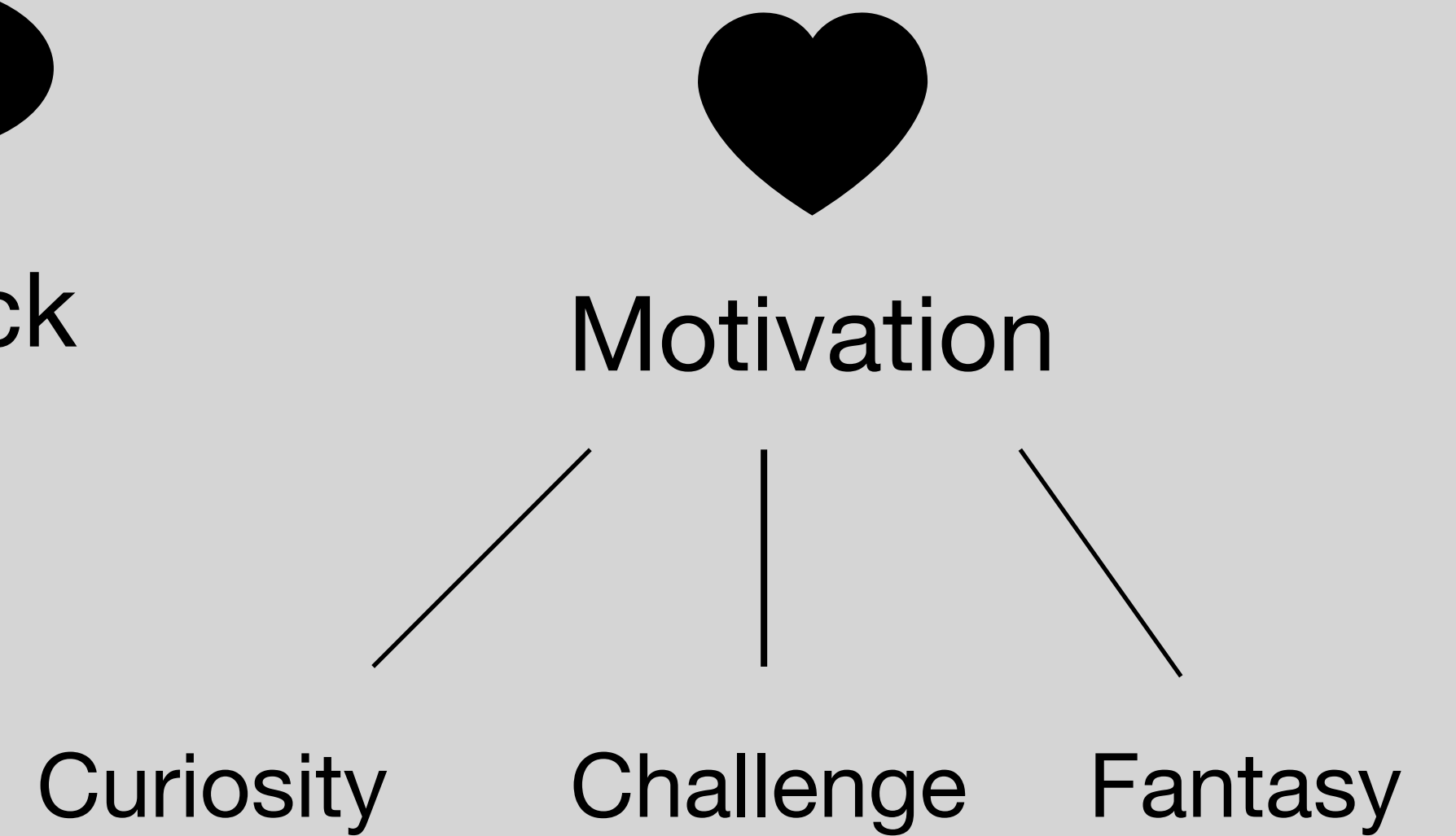
The area of game-based learning is often also referred to as pedagogical games and educational games. These kinds of games do generally have additional or other goals than pure entertainment. This field handles questions for how you with game elements as gamification, feedback and achievements can create motivation by curiosity, challenge and fantasy to educate a player through a game. Typical questions asked within this field is also *how* you can create curiosity and interest, *how* feedback can be given in a proper way but also *how, when* and *what* kind of achievements that can motivate and encourage the player at the same time as ensuring that the pedagogical goals are reached.

Literature study

Child-computer Interaction

Children have other cognitive and physical abilities than adults

Feedback

Interactive objects (buttons etc)
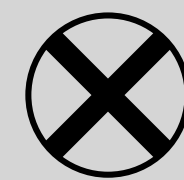
Abstract symbols
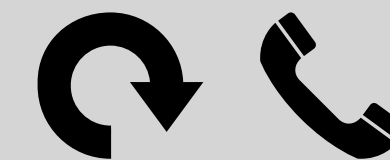
Gestures

Designing interfaces for children creates different challenges to designing for adults. Children, as they are in their developmental stage, have different cognitive, social, and physical needs and skills than adults. All of the areas presented on this slide are important to acknowledge and design appropriately for child users to make sure they understand and learn, understand the user interface and its components but also that the gestures needed for the game are appropriate for the children and their motor abilities.

Literature study

Game design

Mechanics   **D**ynamics   **A**esthetics
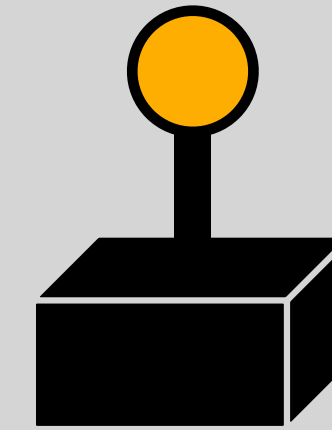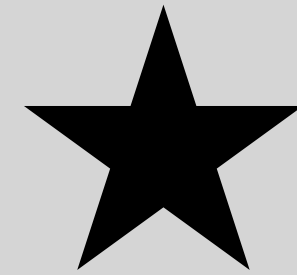
Design   **D**ynamics   **E**xperience

Design   **P**lay   **E**xperience

MDA, DDE and DPE are existing game design frameworks that functions to describe and understand how games are built and how they can be understood and evaluated. All of these frameworks divides games into three main parts which are slightly different from each other. Mechanics and Design can be described as all components and design choices implemented in a game (e.g. colours, characters, quests and obstacles). Dynamics or Play refers to the runtime behavior of the implemented design-components (e.g. selection of colors or clothes). Experience in this framework stands for the experience and reactions of the player (e.g. happiness or fear).

Developing the framework

Guidelines within:		A. Educational games	B. Child-computer interaction
Game Design	Design		
	Dynamics		
	Experience		

Table 1. Compressed version of the theoretical framework of design guidelines for educational games and child-computer interaction.

Guidelines from the literature were collected continually into a 3x4 table. The guidelines were structured into specific columns based on the area to which they belonged, either game-based learning or child-computer interaction. Further, these columns were separated by rows to sort the guidelines into specific aspects of game design. The left-most column categorizes the guidelines into game design within the areas of Design, Dynamics, and Experience. This column, describing educational games, suggests guidelines specifically elicited from game-based learning theory. The column named child-computer interaction suggests design recommendations specifically aimed for children as users.

Evaluation of the framework

Method

Walkthrough of COSMO@HOME

Review with guidelines

Comparison with user tests

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The framework was evaluated by testing it on the COSMO@HOME application to investigate how useful and usable the framework was. This was done by a walkthrough of the application were the design and functions were reviewed with respect to the guidelines. Findings from this walkthrough were compared to results and findings from user testing were children got to play the game. From this we were able to find similarities but also differences of the walkthrough result and the user testing.

Evaluation

Results

- A majority of the guidelines were applicable on the application.

- Concrete guidelines were easier to apply.

- Abstract guidelines can still help when reasoning about different aspects within a game.

- Need of reformulation and structuring of the guidelines.

The experience of evaluating the application via the walkthrough was that written guidelines can be applied and used to reason about design choices in educational games for children, and that concrete recommendations are easier to apply. Although more abstract or generic guidelines can work as good reminders or aspects to reason about, it is harder to answer whether such a recommendation is met or not. To create a framework of guidelines that can be used in an easy and accessible way by designers was also an important aim of this study. By applying the framework to the application, important indications were given about which updates should be made to make them easier to use.

Evaluation

Updating the framework

- New order of game design components into experience, dynamics, and design.

- Merging the two columns and presenting the guidelines together.

- Grouping of similar guidelines near each other to improve the structure.

- Summary of recurrent guidelines to shorten the framework and not to repeat concepts.

- Reformulation of some of the guidelines to provide a better understanding.

- New layout of the framework to improve the overview.

42 guidelines

24 guidelines

The evaluation gave indications of how to further improve and update the framework. The number of guidelines and the distribution of these into two columns, which spanned over three pages, were not favourable for giving a good overview of the framework. To create a more usable and accessible framework, some guidelines were excluded, and some were pulled together to compress the first version. A new layout was also was also implemented to improve the overview of the guideline. The result reduced the number of guidelines from 48 to 24.

Conclusions

- Guidelines were applicable when reviewing the application.

- User tests and interviews confirmed the usability of the guidelines.

- The framework should not be seen as a check list.

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This work suggests that it could be beneficial to combine guidelines and theories from different areas. The walkthrough showed that it worked well to apply the framework of design guidelines in the development of an educational game for healthcare, and that it was also possible to evaluate how well the game met the recommendations. Another important conclusion is that the framework should not be seen as a checklist but rather as a way in which to reflect and acknowledge important aspects within game-based learning and child-computer interaction.

The EGC-framework

Zoom in to view the guidelines.

For questions, please contact:
emmalaura.nilsson@gmail.com

Thank you!

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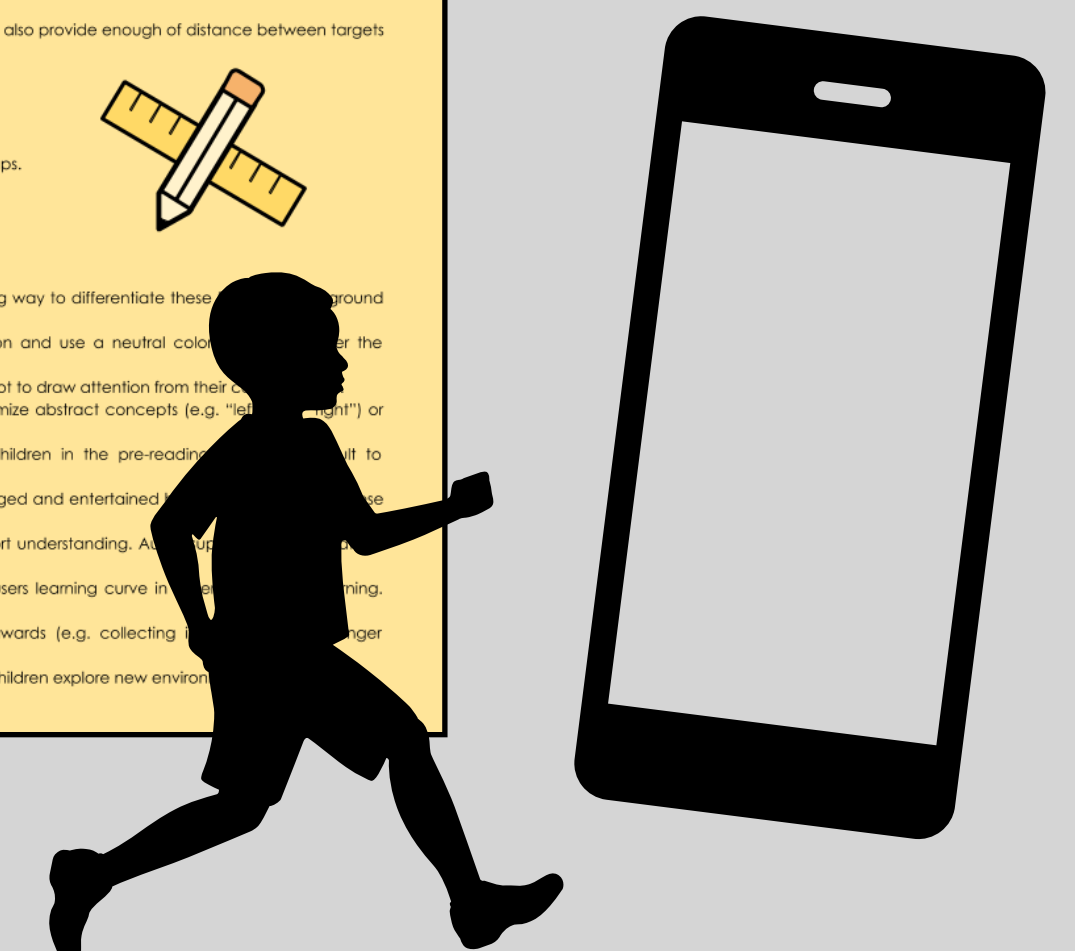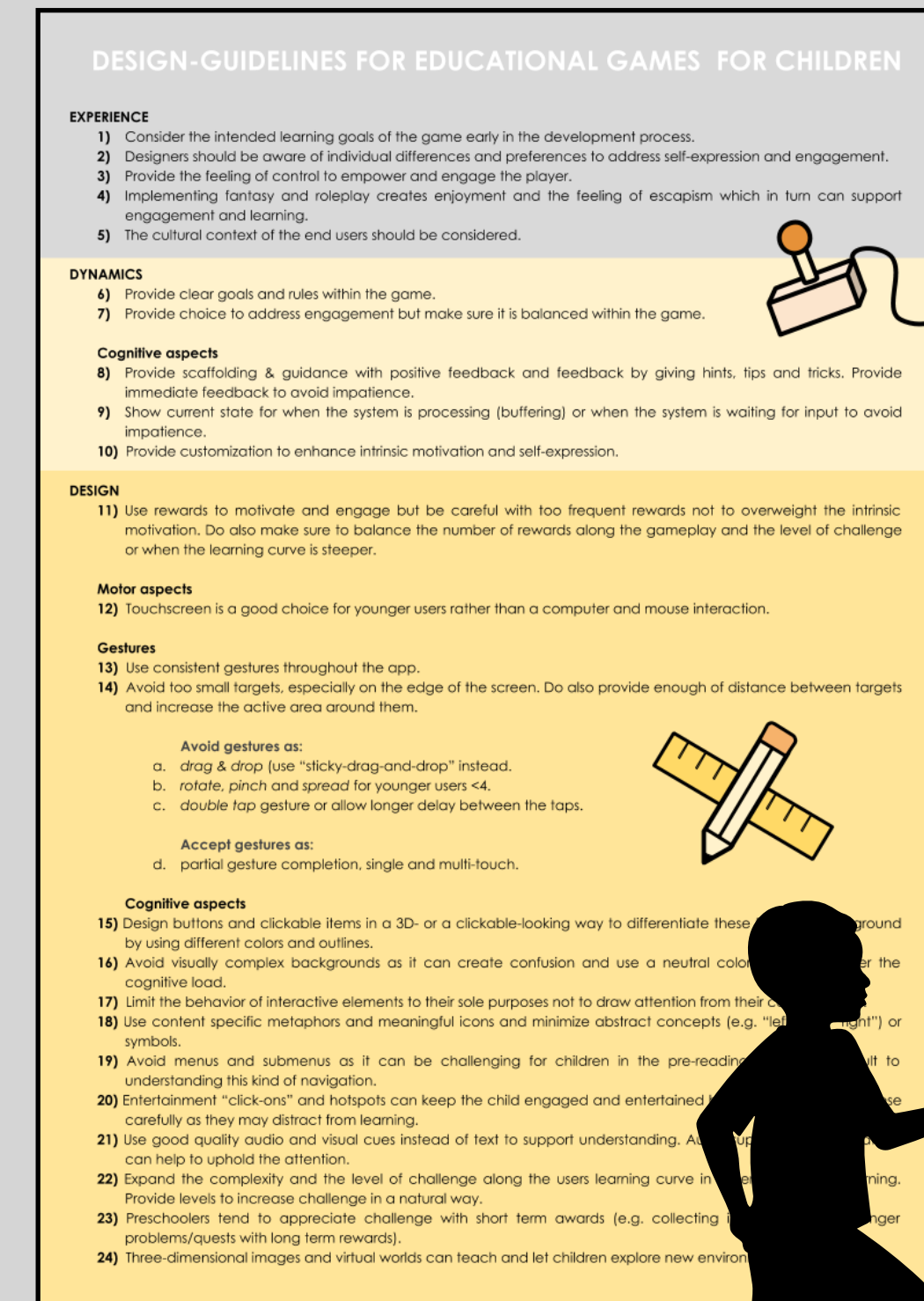24) Three-dimensional images and virtual worlds can teach and let children explore new environments and objects.