Designing a Course on Serious Games Programming

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- Who is interested in Serious Games?
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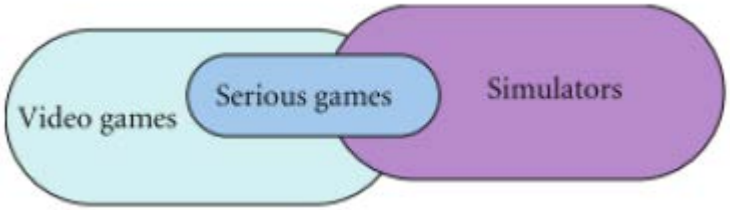
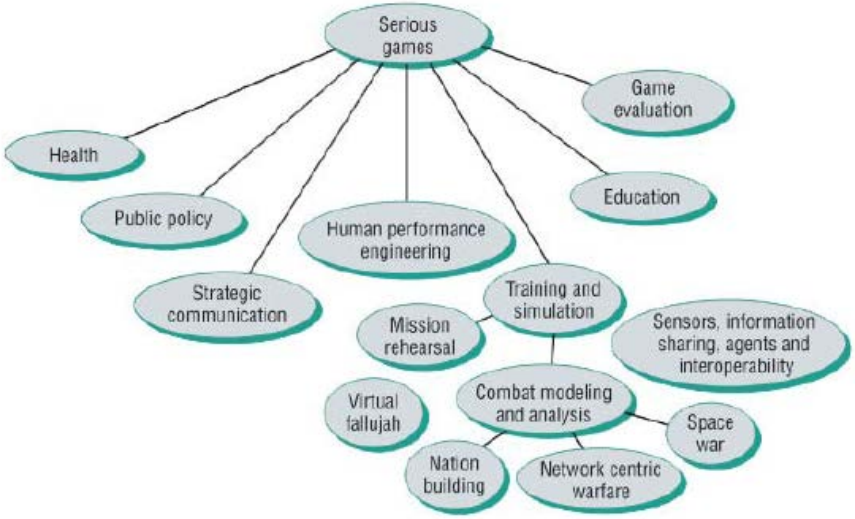


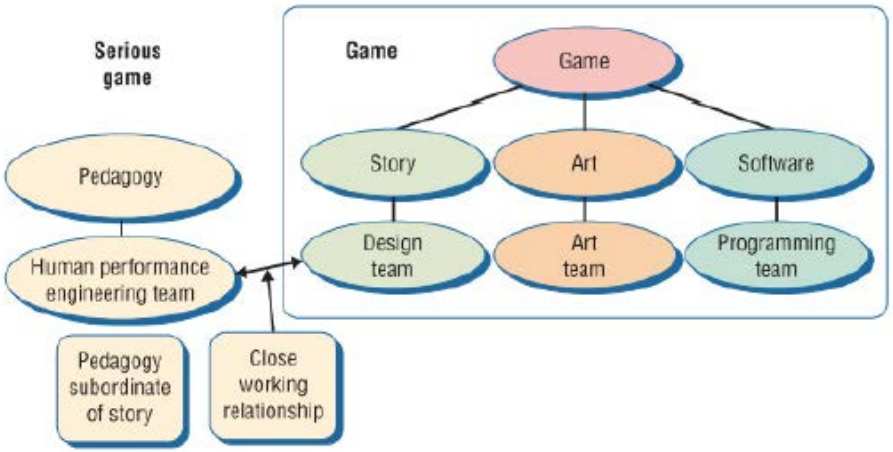
Murratet et al. 2009

Winn 2009

Serious Games



Zyda 2005



What are Serious Games?

- **Serious Games** are not just for entertainment, but they are specifically designed to change behaviors and **impart knowledge** and are widely used in training situations, such as emergency preparedness, training for leadership and even citizenship.
- *These games have wide acceptance due to their **challenging design** and the **social interactions** that they generate.*
- *Research showed that games also **develop mental abilities** and skills such as strategy and decision making. They also promote digital competence and other key transversal competences for life and employability.*

SEGAN: http://seriousgamesnet.eu/

What are Serious Games?

- **Serious games** are simulations of real-world events or processes designed for the purpose of solving a problem.
- Although serious games can be entertaining, their main purpose is to train or **educate** users, though it may have other purposes, such as marketing or advertisement.
- Serious games are not a game genre but a category of games with different purposes. This category includes some **educational games** and advergames, political games, and so on.
- Serious games are primarily focused on an audience outside of primary or secondary education.

http://en.wikipedia.org/wiki/Serious_game

What are Serious Games?

Mike Zyda's definition:

- **Game**: a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participant.
- **Video Game**: a mental contest, ***played with a computer*** according to certain rules for amusement, recreation, or winning a stake.
- **Serious Game**: a mental contest, played with a computer in accordance with specific rules that ***uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives***.

Zyda, M. (September 2005). "From visual simulation to virtual reality to games". IEEE Computer.

What are Serious Games used for?

SGs are used for various **purposes**, such as:

E-learning	Training	Simulation
Team-building	Collaboration	Social Networking
Advertising	Business Modeling	Investigating …

They are used in many **industries and sectors**, such as:

Education	Business	Healthcare
Scientific exploration	Engineering	Emergency Management
Military Defense	City Planning	Tourism and cultural Heritage …

Who is interested in SGs?

The Serious Games Industry …

"Research Debuted at Serious Play Conference Shows Growing Acceptance, LOS ANGELES – Aug. 23, 2012:

- The serious games market is already a **multi-billion dollar industry**, growing at a slow, but steady pace as games and simulations designed for education and training purposes gain acceptance, according to research studies.
- Latin America sales are growing at the highest rate at 29.1%, followed by **Eastern Europe** and Africa at **25.7%** and 20.7%, respectively."

http://www.hypergridbusiness.com/2012/08/serious-games-now-a-multi-billion-dollar-industry/

Who is interested in SGs?

HORIZON 2020 – WORK PROGRAMME 2014-15 - ICT…

- **ICT 20 – 2015**: Technologies for better human learning and teaching

  Specific Challenge: The development and integration of robust and fit-for-purpose digital technologies for learning are crucial to boost the market for and innovation in educational technologies.

  … apply e.g. adaptive learning, augmented cognition technologies, affective learning, microlearning, **game-based learning and/or virtual environments/virtual worlds** to real-life learning situations.

- **ICT 21 – 2014:** Advanced digital gaming/gamification technologies

  Specific Challenge: ***Digital games and gamification mechanics applied in non-leisure contexts*** *is an important but scattered industry that can bring high pay-offs and lead to the emergence of a prospering market.*

  … development of new methodologies and tools to produce, apply and use digital games and gamification techniques in non-leisure contexts, as well as building scientific evidence on their benefits - for governments, enterprises and individuals.

Who is interested in SGs?

EU Research Networks …

- Games and Learning Alliance – **GALA**: http://www.galanoe.eu/
- Making Games in Collaboration for Learning - **MAGICAL**: http://www.magical-project.net/
- **SEGAN**: http://seriousgamesnet.eu/
- **Serious Games Institute - SGI:** http://www.seriousgamesinstitute.co.uk/
- **LUDUS**: http://www.ludus-project.eu/
- … and many more

Who is interested in SGs?

Researchers, Instructors (Game-based Learning) …

- European Conference on Games Based Learning (ECGBL)

  (8th ECGBL Conf., 9-10 October, Berlin, Germany)
- International Conference on Serious Games Development and Applications (SGDA) *(5th SGDA Conf., 9-10 October, Berlin, Germany)*
- European Alliance for Innovation (EAI) Endorsed Transaction on Serious Games
- International Journal of Game-Based Learning
- Several special issues in International Journals
- Special sessions in International Conferences (ACM ITiCSE, IEEE ICALT, IEEE EDUCON)
- …

Who is interested in SGs?

Master programs …

- **Msc Serious Games Development**, University of Glasgow, UK: http://www.gsa.ac.uk/study/graduate-degrees/serious-games-development/
- **Msc Serious Games**, University of Skövde, Sweeden: http://www.his.se/en/Prospective-student/education/master-studies/Serious-Games/
- **Games and Meaningful Play Msc**, Michigan State University: http://seriousgames.msu.edu/ma/
- and many more…

Designing a MSc Course on Serious Games Programming

A new course on SGs Programming …

MSc in "Applied Informatics" with 4 specializations

(new program of studies from the academic year 2014-15):

- Computer Systems and Network Technologies
  - Course: **Serious Games Programming**
- Computational Methods and Applications
- Business Computing
- E-Business and Innovation Technology

http://mai.uom.gr/frontend/index.php?chlang=EN

A new course on SGs Programming …

Semester 1 (30 ECTS)	Semester 2 (30 ECTS)	Semester 3 (30 ECTS)
• Cryptography • Advanced Computer Architecture • Advanced Software Engineering • Advanced Computer Networks • Concurrent and Distributed Systems	• Web and Mobile Application Development • Information Security in the Internet Age • Ubiquitous Communications and Data • Topics in Database Technology • **Serious Games Programming**	• Master thesis

In each one of the first 2 semesters students choose 4 courses (1 course per semester might be selected from one of the other streams of specialization).

What are the objectives of the course?

The aim of the course is for students to acquire:

(a) knowledge of the role, the types and the features of serious games, as well as the whole process of devising a serious game,

(b) capabilities of **designing and implementing** serious games using contemporary tools, interfaces and programming languages,

(c) knowledge and capabilities of **using/devising evaluation metrics** for serious games based on the aims defined during its design.

What skills will students acquire?

Upon successful completion of this course students will be able to:

- **evaluate the design quality** of serious games and the degree they fulfill the initial goals
- **design serious games** taking into account various factors/design principles
- **implement simple serious games** using the object-oriented programming technique and game libraries\engines

What should the content of the course be?

In order to fulfill its goals the course must combine material taught in different courses in a MSc on (Serious) Games:

MSc	Courses
Msc Serious Games Development, University of Glasgow, UK	▪ Serious Game Design and Research, ▪ Serious Games Development, ▪ Game Programming
Msc Serious Games, University of Skövde, Sweeden	▪ Serious Games Research and Development
Games and Meaningful Play Msc, Michigan State University	▪ Foundations of Serious Games, ▪ Game Design and Development I
Master of Entertainment Technology, Carnegie Mellon University	▪ Game Design
Game Design and Development MSc, Rochester Institute of Technology, NY	▪ Game Design, ▪ Game Development Processes

Topics	Contents
Foundations of SGs	▪ The **role** of serious games as tools for educating, skills acquisition and simulation in various sectors, such as education, health and business processes. ▪ **Game genres** (i.e. puzzle, strategy, role-playing games). ▪ **Types** and **features** of **SGs**. ▪ Review of representative **examples** of serious games.
Designing SGs	▪ **Scenario:** the world, the characters (players and bots) and their actions, the levels of the game. ▪ **Content and pedagogy**: learning objectives, learning outcomes, activities. ▪ **Design principles**, **methodologies** and **frameworks**.
Evaluating SGs	▪ Evaluating the quality of existing serious games using **frameworks** and quality **metrics**.
Programming SGs	▪ The game loop, game architecture and game state, interaction and event handling, rendering text, 2D graphics and animation, game math, arrays and object collections. ▪ **Tools, engines** and **programming interfaces** for serious games. ▪ Designing a SG using contemporary game engines and platform independent graphics libraries (such as OpenGL) and implementing it in C#, C++ or Java.

What programming language should be used?

Programming Language	Advantages and drawbacks for Game Programming
Java	(+) uses a Virtual Machine: one version of the game runs on various CPUs (+) client or server side, interpreted, OS independent. (-) non-deterministic memory management (-) lack of 3rd party libraries (-) smaller community for game development
C++	(+) low level memory management (+) multi-platform language (+) client executable, no interpreter/vm required (+) there are plenty of SDKs/APIs/Libraries for game programming (-) separate compiled versions are required
C#	(+) uses a Virtual Machine: one version of the game runs on various CPUs (+) is a higher level language and is much easier to learn to begin with (+) client executable, interpreted, best for windows (+) there are plenty of SDKs/APIs/Libraries for game programming (-) XNA on Microsoft platforms like Windows and Xbox 360

It depends on the requirements of the game

- ✓ Single Player/ multiplayer?
- ✓ 2D/3D?
- ✓ Memory management?
- ✓ OS independent/ browser games

Ok! ***But which language should be better used in the course?***

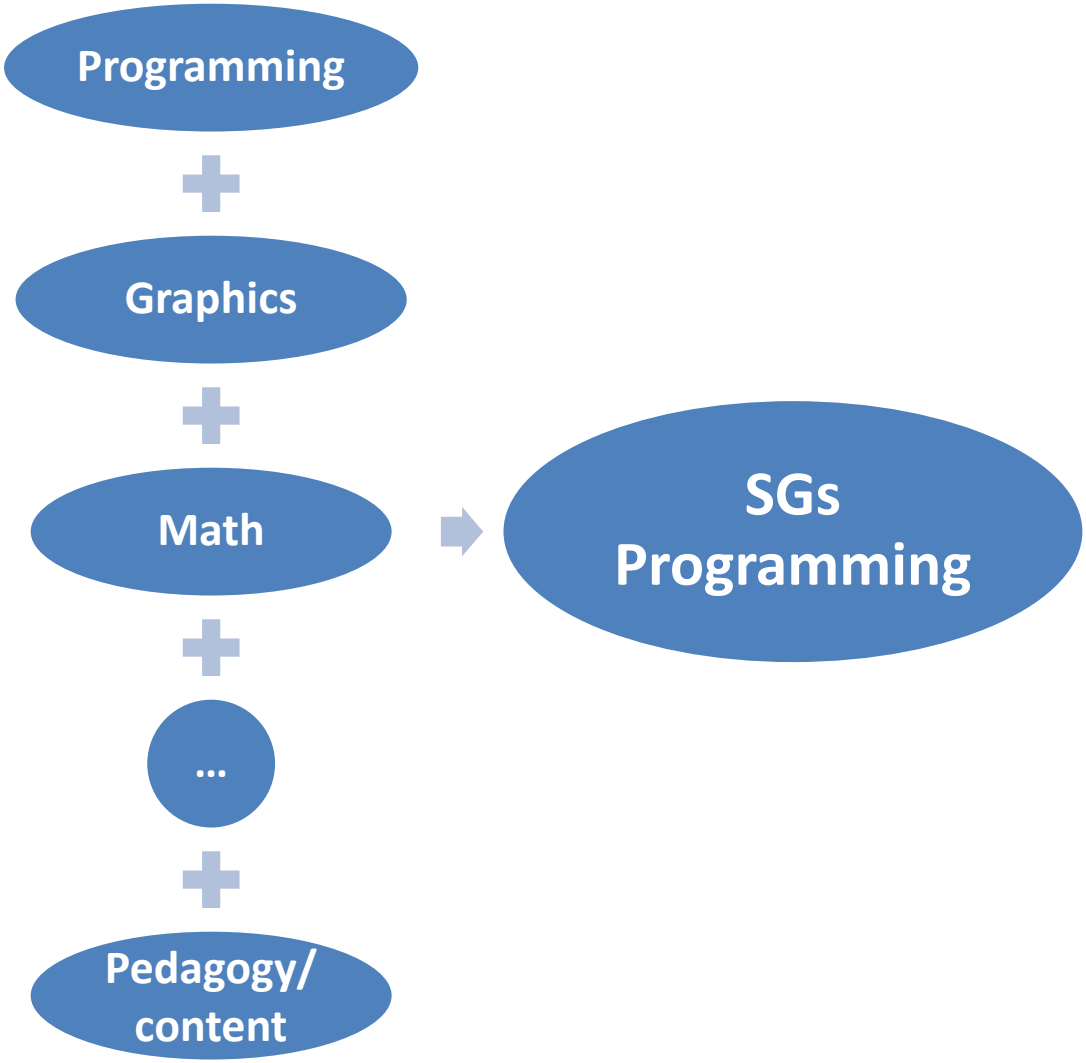
Facts:

- ✓ Knowledge of Object-Oriented Programming in any language is a prerequisite for attending the course
- ✓ Students that have no background can attend the OOP course offered in the undergraduate curriculum

Concerns/criteria:

- ✓ Which language better supports the teaching/learning of game programming?
- ✓ Free and user-friendly programming environment?
- ✓ Available resources (good textbook, open source projects, community, libraries, SDKs)?
- ✓ Acceptance in games industry and skills for employability?

What teaching approach will be applied?



Designing and implementing a serious game is complex.

Teaching *SGs programming* is challenging!

How will be students supported?

Hands-on activities for applying theory

- Evaluating the design and quality (in terms of fulfilling its goals) of a SG using one of the available design frameworks.
- Revising a SGs design framework for applying it in a specific type of SGs (i.e. health SGs).
- Designing a SG for a specific purpose and writing a report for the choices made using one of the available design frameworks.

Usage of educational software

- Creating the prototype of a game using educational software, such as GameMaker, GreenFoot, or even Scratch.

Learning through open-source SG projects

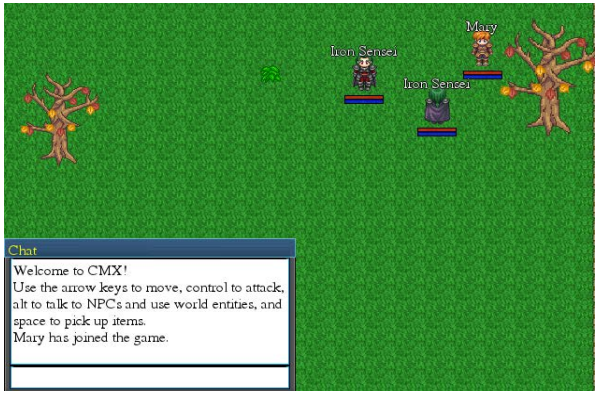
- Study and document the source code of SGs

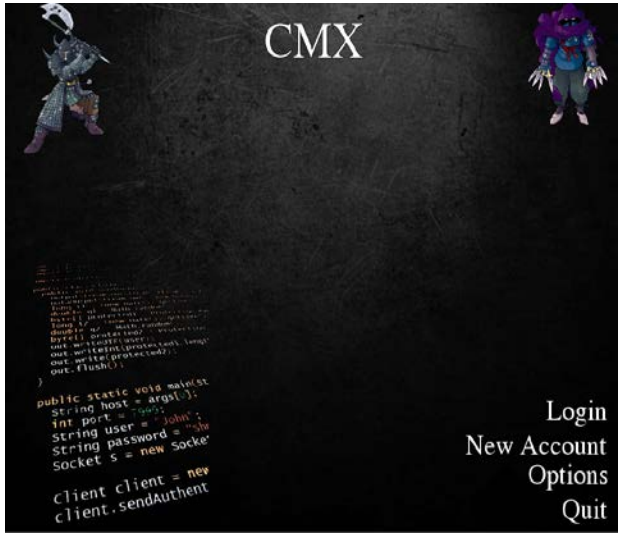
Case study: the CMX MMORPG for programming

CMX is an educational game that aims to introduce students to computer programming, to help them get acquainted with the way computer programs are structured and also allow them to engage in algorithmic logic.

The following aspects of CMX will be studied:

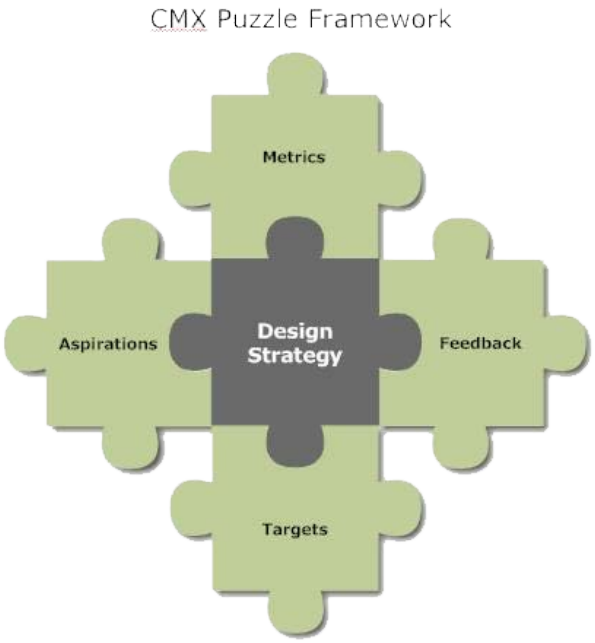
- Design framework
- Software architecture and technical/programming issues
- Learning Analytics
- Evaluation Framework

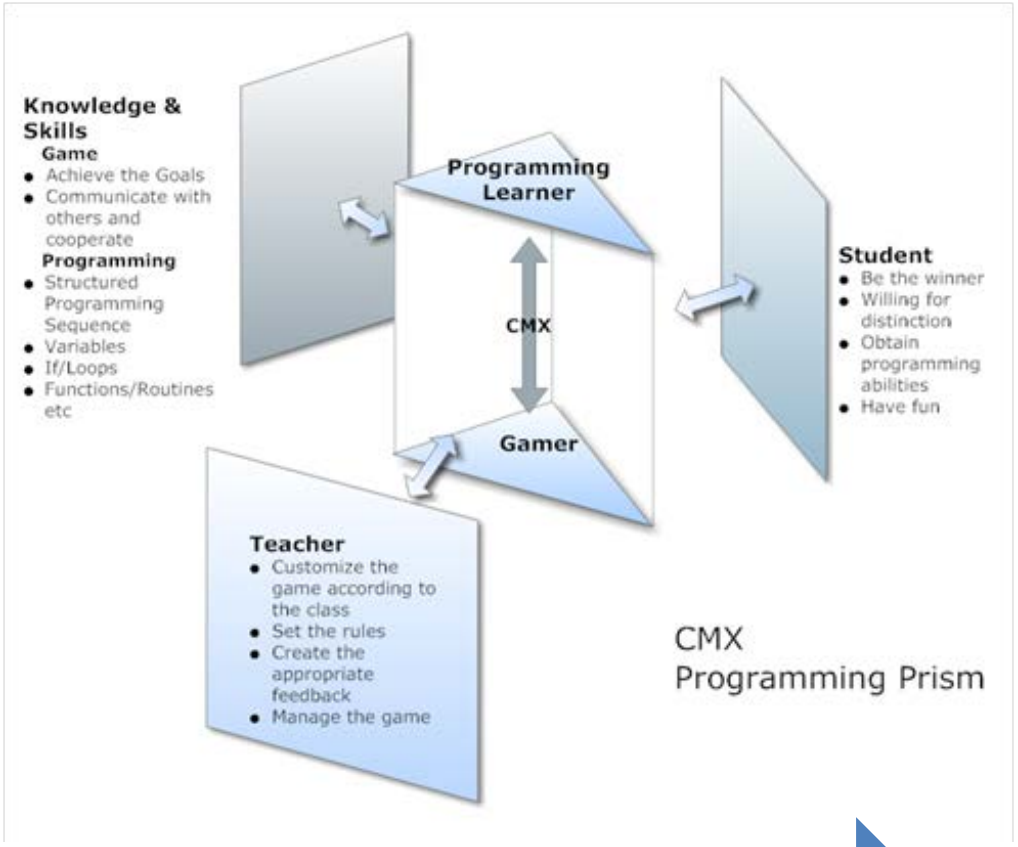




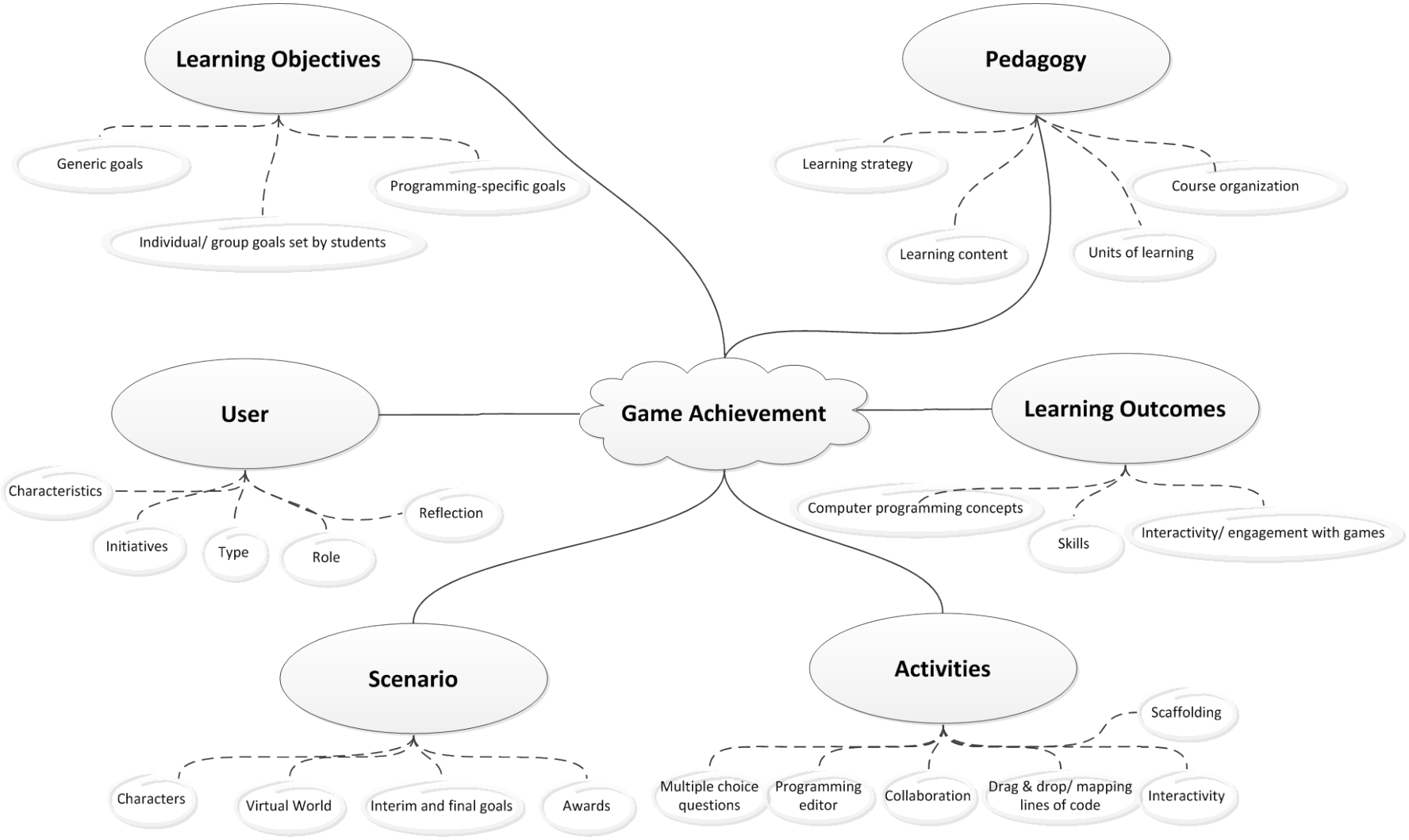
http://users.uom.gr/~malliarakis

Case study: CMX Design Framework



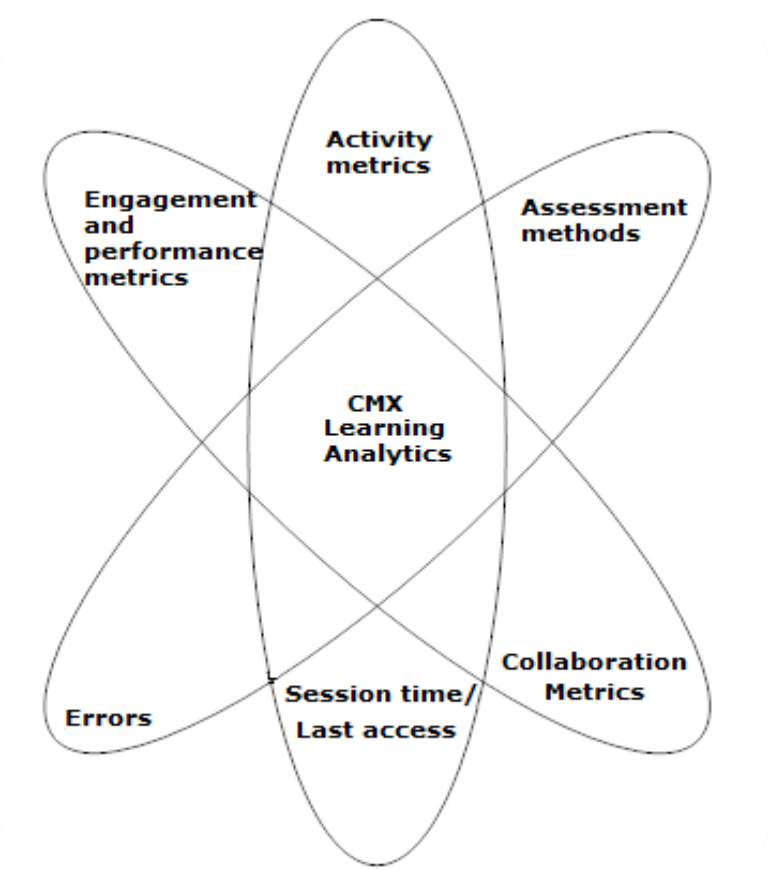


Design Strategy → Programming Prism → Design Framework



The CMX Design framework includes concepts that need to be represented within any educational game that aims to teach computer programming. It is abstract enough to be employed by future designers and developers and detailed enough to act as a solid guide without allowing many arbitraries.

Case study: Learning Analytics Framework

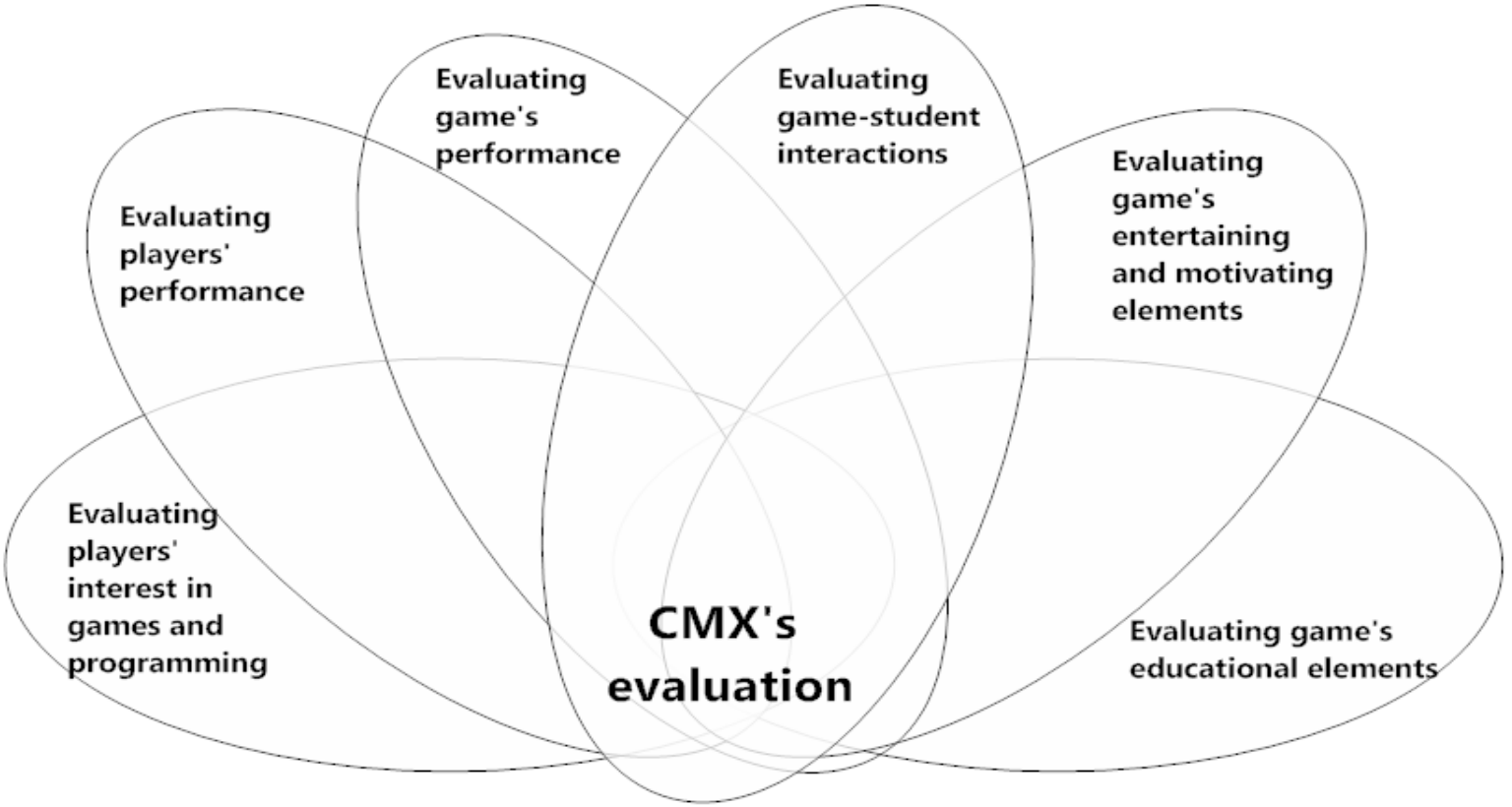


$$\overrightarrow{G_{CS}(t)} = \left\langle S^{CS}(t) \middle| E^{CS}(t) \middle| A^{CS}(t) \middle| F^{CS}(t) \middle| C^{CS}(t) \right\rangle$$

The educational score the player gets in the game's progression is dependant on

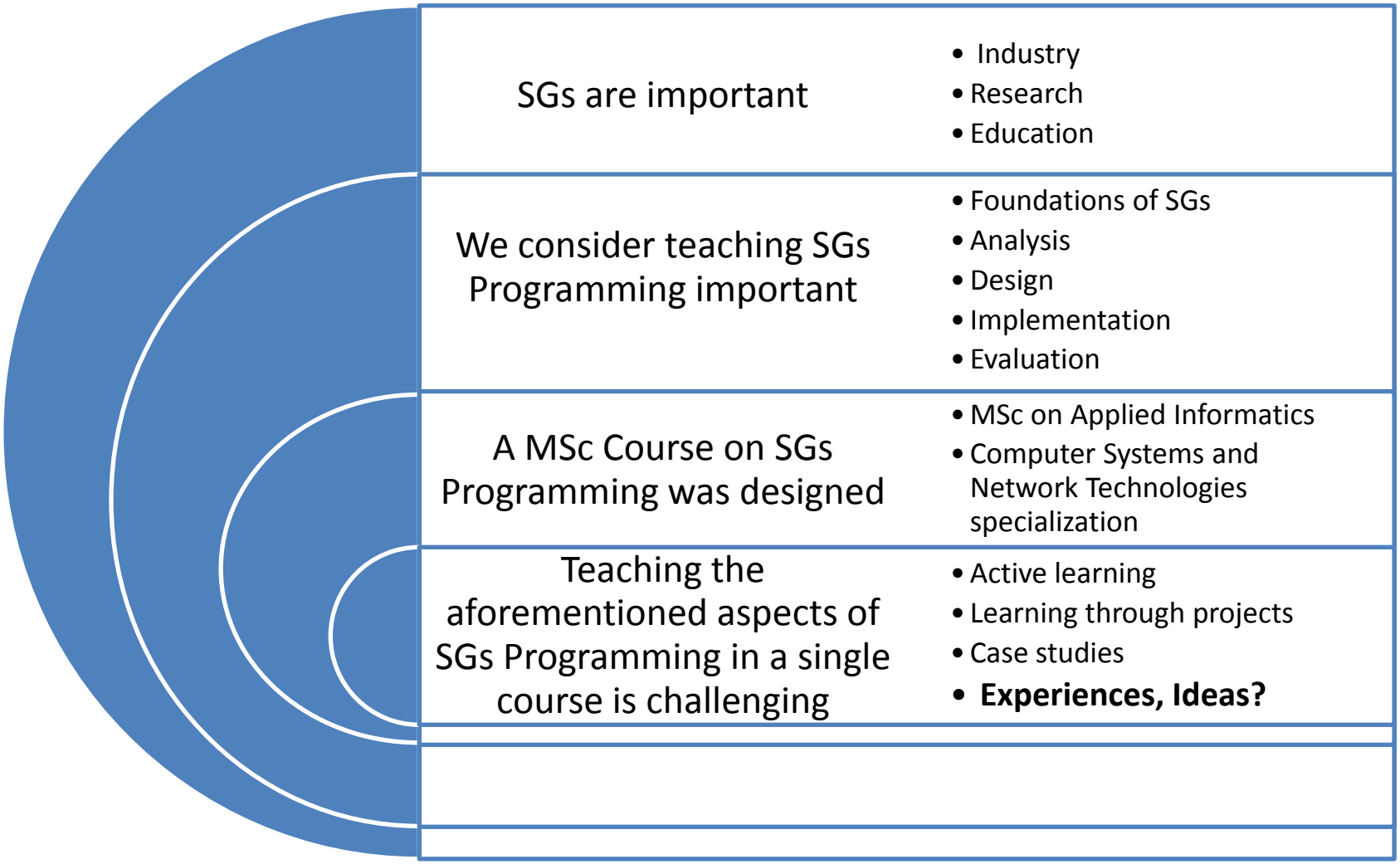
a) the player's success percentage during the assessments (S^{CS})
b) how many errors the player made (E^{CS}),
c) how active the player is (A^{CS}),
d) how frequently the player visits the game, (F^{CS})
e) how collaborative the player is, (C^{CS}).

Case study: Evaluation Framework



Each axis represents a specific aspect that needs to be assessed in order to determine the overall game's efficiency.

Conclusions



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THANK YOU!