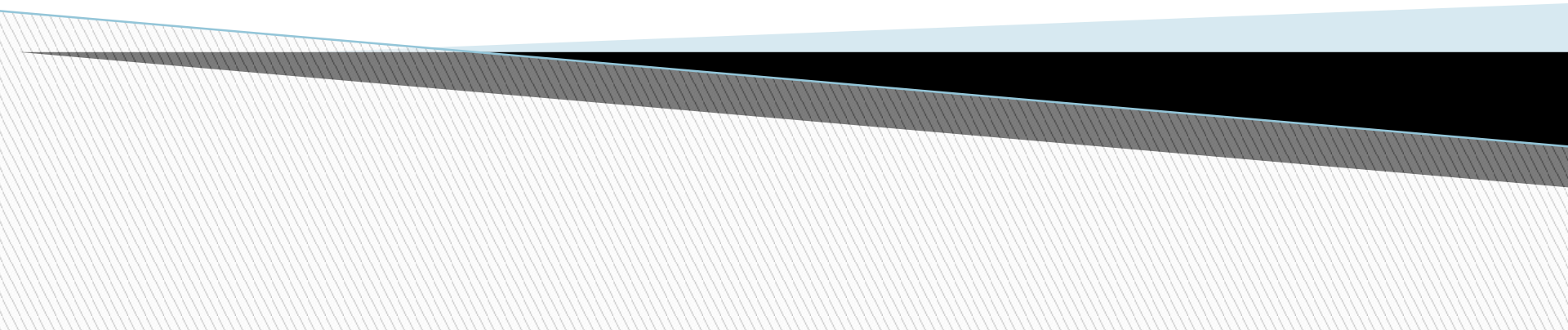# Assessment Integration for Serious Games

Dr. Thomas Hainey

Prof. Thomas Connolly
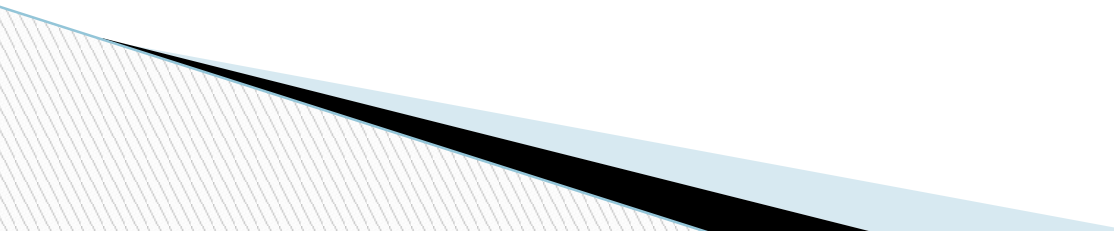
Structure of Presentation

- What is assessment?
  - General definition
  - Academic definition
  - Formative and Summative Assessment
  - Embedded and External Assessment
- Challenges of assessment integration
- Traditional forms of assessment
- Assessment in Commercial Games
- Assessment in Serious Games

What is assessment?

- There are various forms of assessment
    - Health assessment
    - Vulnerability assessment
    - Risk assessment
    - Psychological assessment
    - Psychiatric assessment
- We of course are interested in educational assessment or performance assessment in the context of a serious game for learning
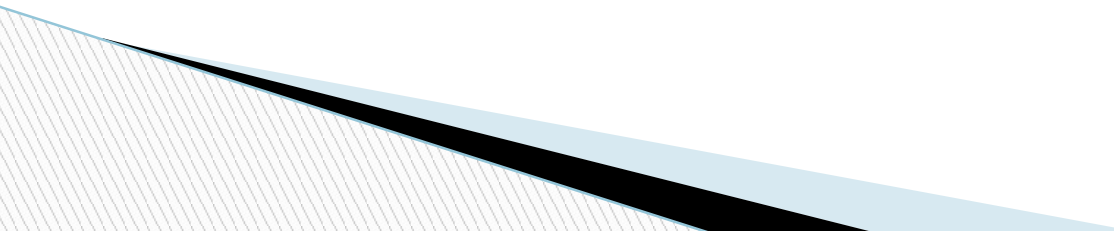
What is assessment? – General Definition

▶ The evaluation or estimation of the nature, quality, or ability of someone or something: "the assessment of educational needs".

▶ The act of assessing the evaluation of a student's achievement on a course.

▶ The term 'assessment' refers to all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged.

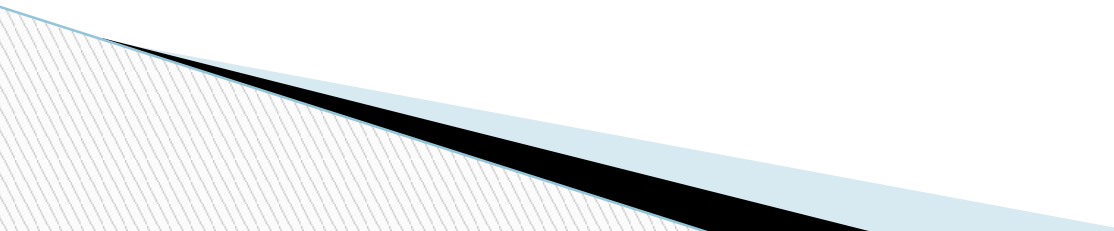# What is assessment? – Academic Definition

► Assessment according to Mislevy *et al.* (2003) is a *"machine for reasoning about what students know, can do, or have accomplished, based on a handful of things they say, do, or make in a particular setting* (p. 1)."

What is assessment?

The UK Assessment Reform Group (1999) identifies 'The big 5 principles of assessment for learning

- ► 1. The provision of effective feedback to students.
- ► 2. The active involvement of students in their own learning.
- ► 3. Adjusting teaching to take account of the results of assessment.
- ► 4. Recognition of the profound influence assessment has on the motivation and self esteem of pupils, both of which are critical influences on learning.
- ► 5. The need for students to be able to assess themselves and understand how to improve.'

What is assessment – Formative and Summative Assessment

▶ Formative assessment is intended to inform and guide adjustments to learning on an on-going basis.

▶ Summative assessment is intended to monitor progress and evaluate the overall success of both students and instructional programmes on a long-term basis.
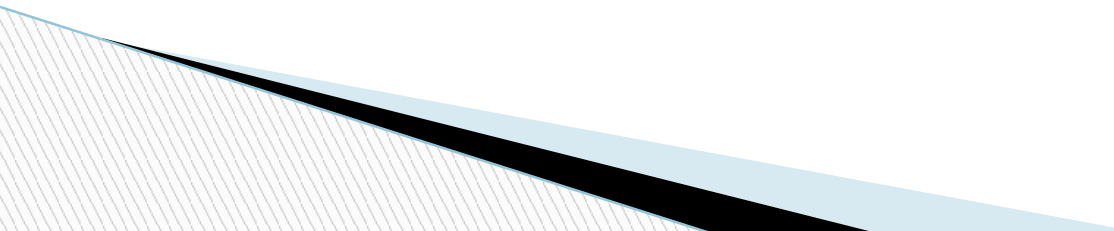
What is assessment? – Embedded and External Assessment

▶ Underwood, Kruse and Jakl (2010) give the following description of embedded assessment: *"the process of measuring knowledge and ability as part of a learning activity rather than after the fact, when it is only an approximation of learner behaviour. Student actions can be evaluated within context while carrying out tasks, or otherwise interacting in a gaming environment."*
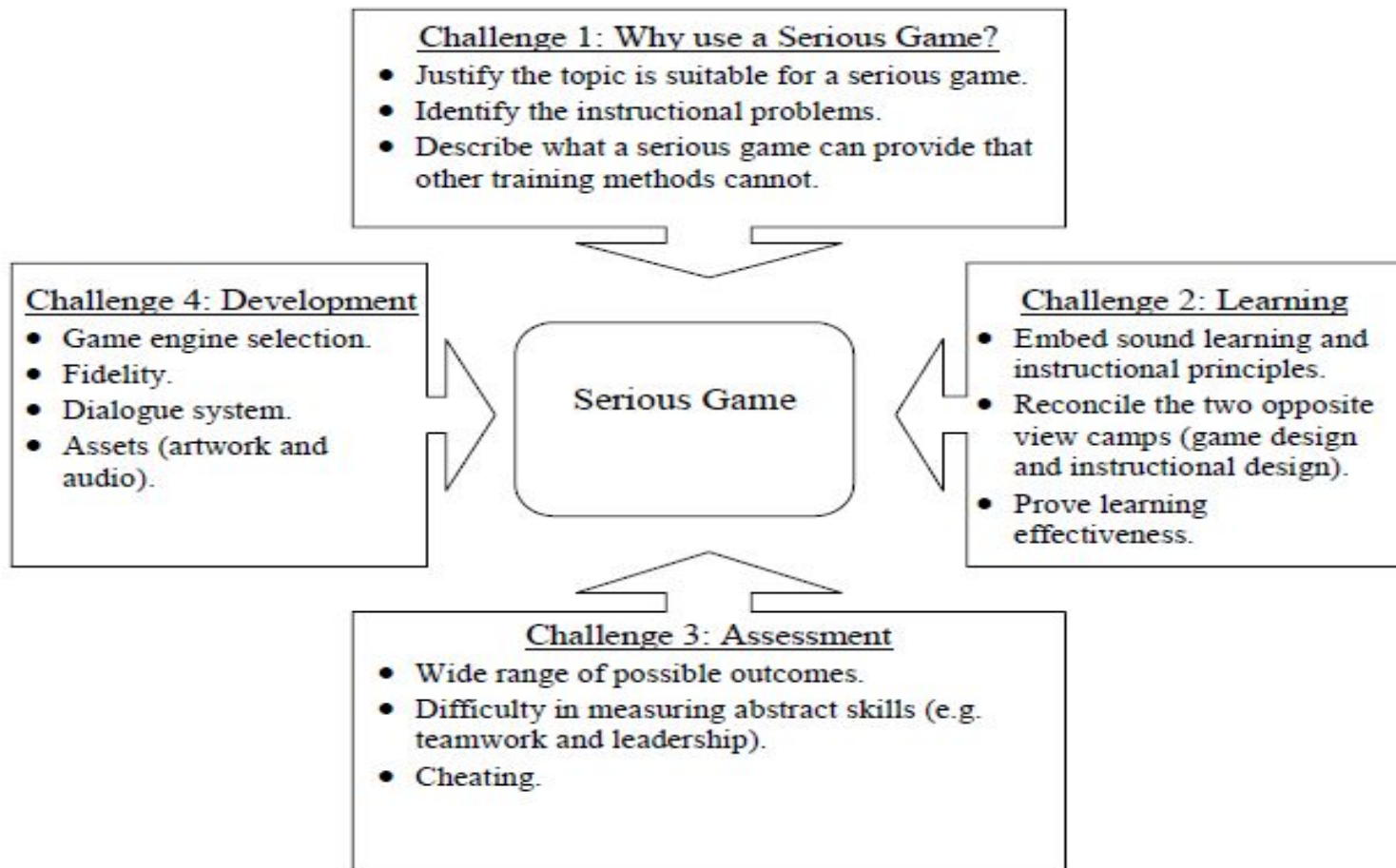
What is assessment? – Embedded and External Assessment

▶ Embedded Formative Assessment

▶ *If we think of our children as plants… summative assessment of the plants is the process of simply measuring them. The measurements might be interesting to compare and analyse, but, in themselves, they do not affect the growth of the plants. On the other hand, formative assessment is the garden equivalent of feeding and watering the plants – directly affecting their growth."* Clarke (2001, p. 2).

Challenges of assessment integration for Serious Games

► What exactly is to be assessed?
  ◦ Inextricably interconnected to the Learning Outcomes.
► How is this assessment carried out?
  ◦ Is it during the game play (embedded assessment)?
  ◦ Is it before and after the game play (external assessment)?
► What particular kind of assessment should be used?
  ◦ Multiple choice?
  ◦ Decision making?
  ◦ Puzzles?
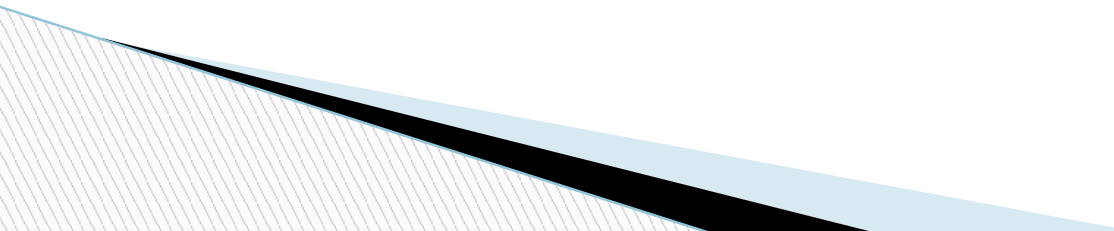► How do you teach interpersonal skills, team work, soft skills?

Challenges of assessment integration for Serious Games

Challenge 1: Why use a Serious Game?
- Justify the topic is suitable for a serious game.
- Identify the instructional problems.
- Describe what a serious game can provide that other training methods cannot.

Challenge 4: Development
- Game engine selection.
- Fidelity.
- Dialogue system.
- Assets (artwork and audio).

Serious Game

Challenge 2: Learning
- Embed sound learning and instructional principles.
- Reconcile the two opposite view camps (game design and instructional design).
- Prove learning effectiveness.

Challenge 3: Assessment
- Wide range of possible outcomes.
- Difficulty in measuring abstract skills (e.g. teamwork and leadership).
- Cheating.

Challenges of assessment integration for Serious Games

▶ Underwood, Kruse and Jakl (2010) identify the following challenges for embedded assessment:
  ◦ Adapting the environment for the learner
  ◦ Assess process and skills not just content
  ◦ Embed assessments into the fabric of the game
  ◦ Maintaining flow while collecting in-game data
  ◦ Analyse the data with appropriate techniques

Traditional Forms of Assessment

- Written Exams
- Presentations
- Demonstrations
- Multiple Choice tests
- Practical Coursework
  - Individual
  - Group-based
- Quizzes
- Aural Examinations
- Oral Examinations
- Dissertations

Assessment in Commercial Games

► All games despite being for learning purposes or not have a learning objective – teach the player to play the game.

► Tutorials in games teach the players the basics of how to play the game.

► Scoring and high score tables.

► The only way a designer can make an effective game that simulates a particular phenomenon or teaches particular information is if the designer already understands the phenomenon or information.

► Further, the creation of such a game has the potential to lead to new knowledge and new ways to do things through emergent behaviour.

Assessment in Commercial Games

- Gear – epic items acquired, epic items looted, vanity pets owned
- Reputation – Total factions encountered, most factions at exalted, revered or higher.
- Consumables – bandages used, health potions used
- Character – emblems of heroism, valour, conquest acquired

Assessment in Commercial Games

Assessment in Commercial Games

Assessment in Commercial Games

Assessment in Serious Games

▶ Michael and Chen (2005) stated there are three main types of assessment used in Serious Games:

- ◦ Completion Assessment – Did the player complete the lesson or pass the test?
- ◦ In–Process Assessment – How did the player choose his or her actions? Did he or she change their mind? If so, at what point? And so on.
- ◦ Teacher Evaluation – Based on observations of the student, does the teacher think the student now knows/understands the material?

Assessment in Serious Games

Assessment in Serious Games

▶ MacAlpine, van der Zanden and Harris (2010) used Gagne's nine events of instruction to produce a framework for assessment.

▶ Games were produced using Thinking Worlds for SCQF Level 5 for Retail and Level 4 for the Health Sector.

Assessment in Serious Games

Instructional Event	
Gain attention	The learner is introduced to the environment and given general directions about where they find themselves and what they will be doing
Inform of objective	At each stage the objective and performance criteria that would be assessed were clearly signalled to the learner
Stimulating recall	The environment itself is designed to be a recall trigger, as they move about into different areas, they should encounter situations which are familiar to them from their learning
Present stimulus	The candidate is guided to a virtual area where a scenario has been set up with a character ready to interact with the candidate
Provide guidance	Guidance on how to response to the character is provided on screen through Instructions

Assessment in Serious Games

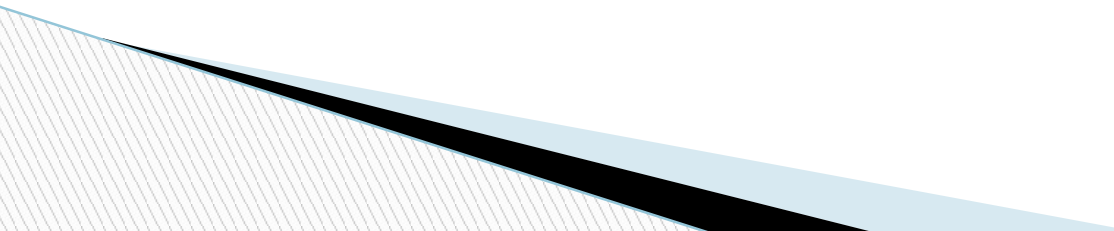| Instructional Event	
Elicit performance	Following the guidance provided
Provide feedback	This stage, although possible, is explicitly not done to replicate the conditions of a traditional assessment.
Assess performance	Performance is assessed by the tutor who receives a report of the candidates
Enhance retention	Again this stage was not considered to be suitable for a formal summative assessment

Assessment in Serious Games
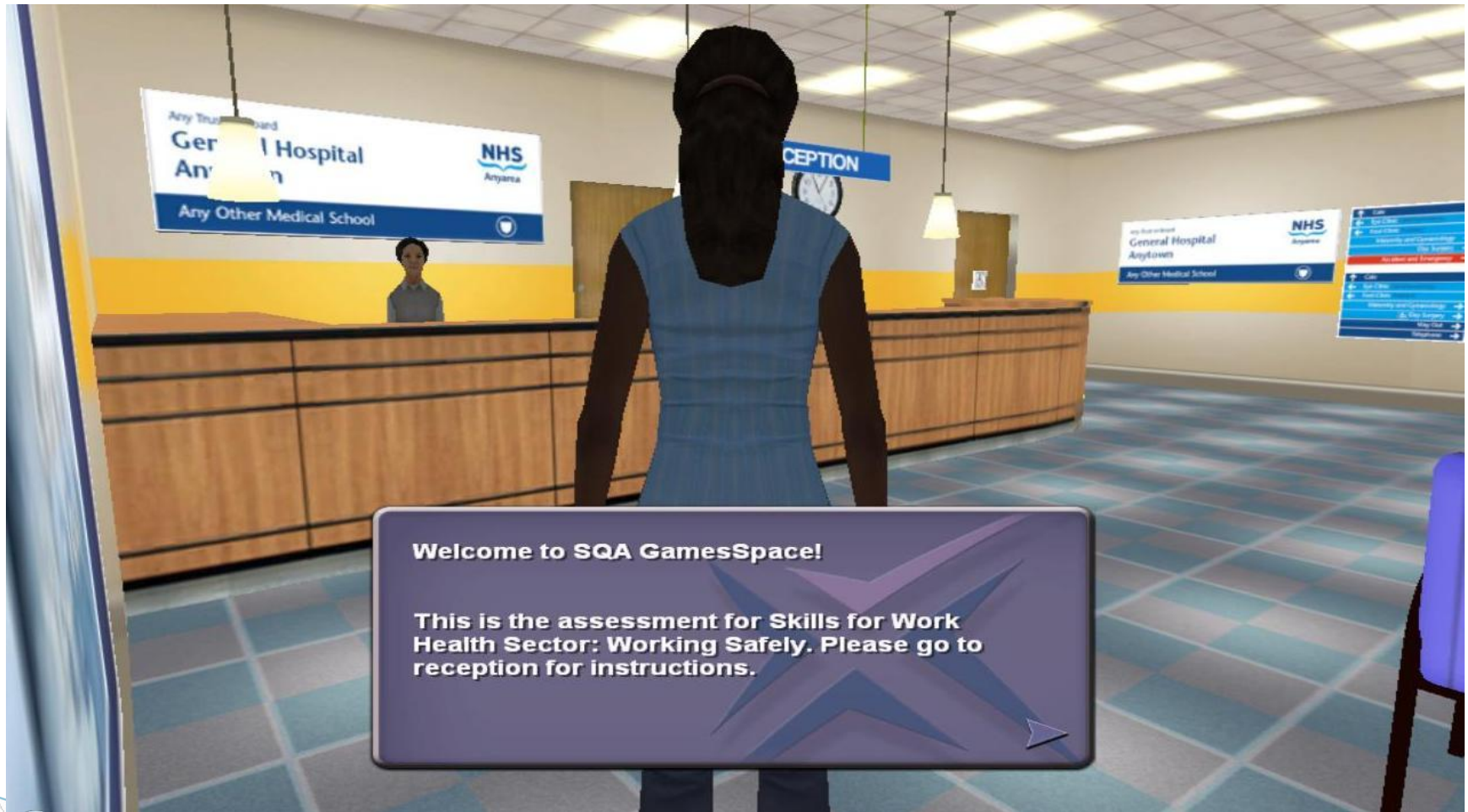
Assessment in Serious Games

Assessment in Serious Games

▶ The output of the game is a report of the answers provided and the courses of action taken .

▶ The SQA then marks the report generated by the games-based learning application.

Assessment Integration for Serious Games

► Primarily linked to the learning outcomes of the game
► Courses of action should be assessed

Assessment in Serious Games

▶ In a commercial game assessment occurs through scores and scales

▶ In a project management simulation game:
  ◦ Calculation of project completion percentage
  ● Comparison of staff allocation with task time and completion
  ◦ Correct choices made, incorrect choices made
  ◦ If the project runs over budget then the player should be penalised
  ◦ Staff satisfaction should also be monitored

▶ Can add in multiple choice PM knowledge questions at some stages. COCOMO II for ideas

References

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▶ Underwood, J.S., Kruse, S., and Jakl, P. (2010). *Moving to the Next Level: Designing Embedded Assessments into Educational Games*, In Design and Implementation of Educational Games: Theoretical and Practical Perspectives (Eds: P. Zemliansky and D. Wilcox)). doi:10.4018/978-1-61520-781-7