

# Assessment in Educational Games without using Quizzes

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(Readable version)

Fausto Fonseca (Game developer) - [faustofonseca@gmail.com](mailto:faustofonseca@gmail.com)  
[www.faustofonseca.com](http://www.faustofonseca.com)



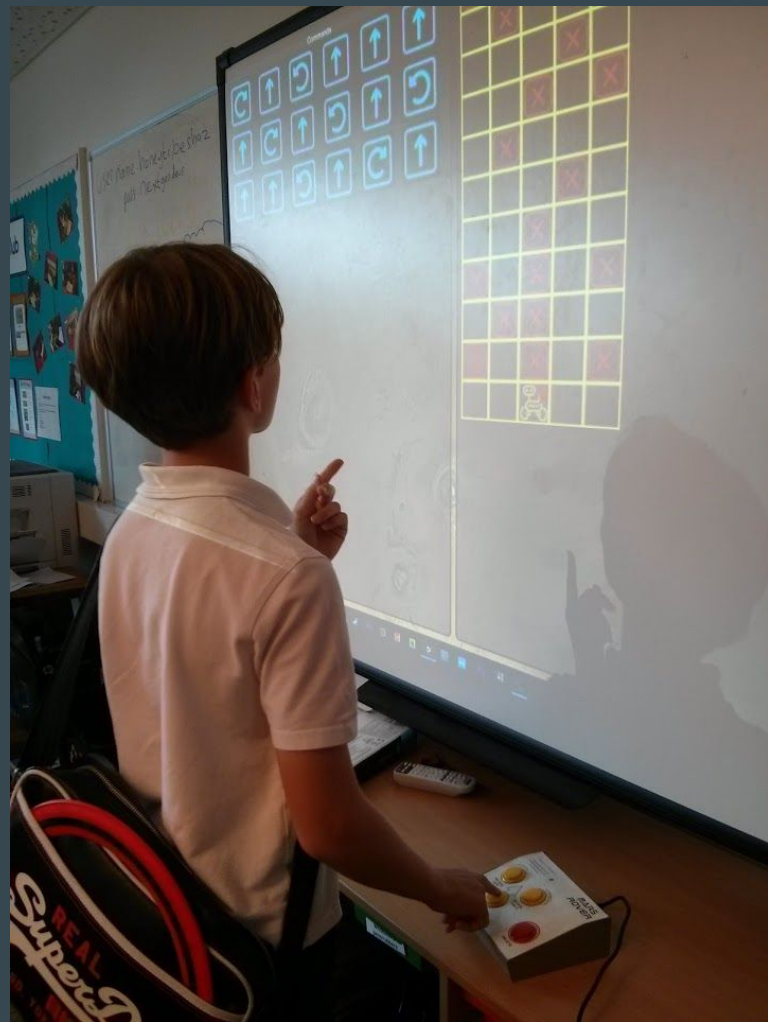
Solar energy activity. All the children are provided with mirrors and need to work together to harvest the sun (strong lamp) into the solar panel to try and get the best score.

“But, in order to continue learning, and also for fun, I continuously create games prototypes in my spare time. One day my partner, who works with children providing them with After School Clubs of Science and Science Birthday Parties ([www.kidswithbrains.co.uk](http://www.kidswithbrains.co.uk)), asked me to help her by creating 2 activities for an event. One was about solar energy (left). The other one was about space, and I decided to make a game.”

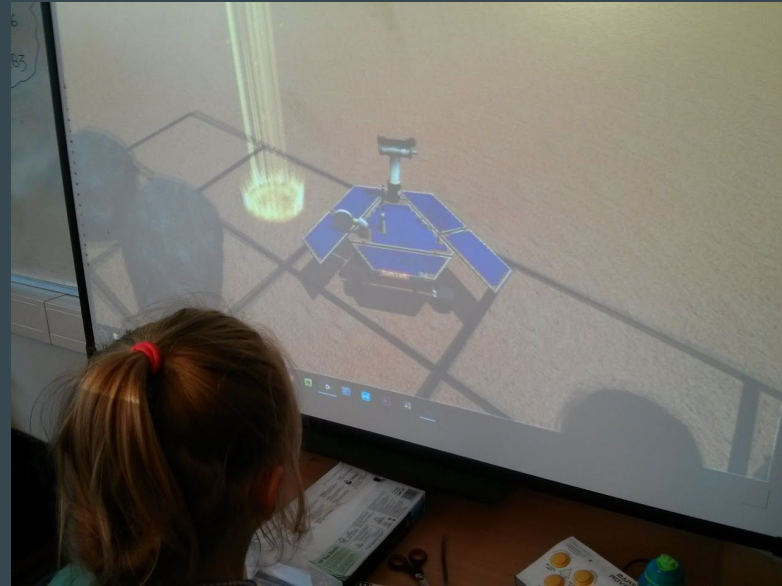
# Mars Rover

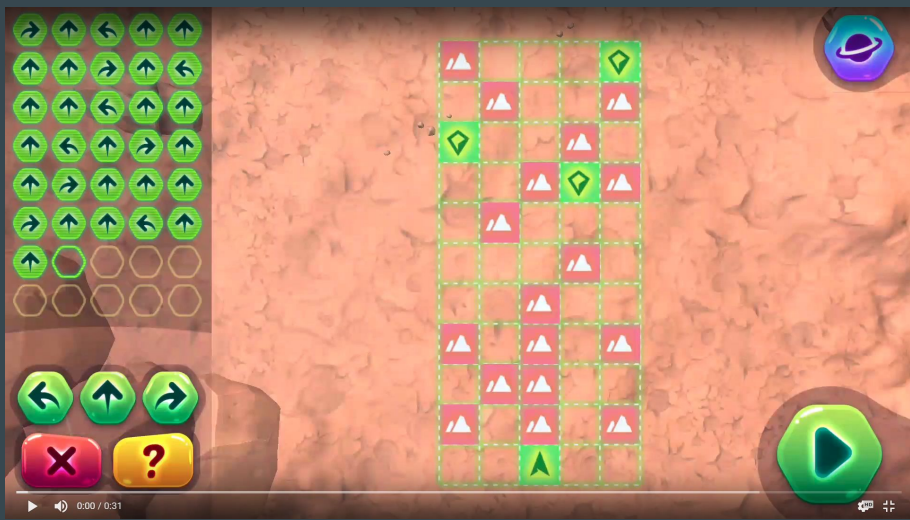
“That’s when I thought about creating a game to teach kids how to program. The game mechanic was already known but I wanted to give it a try. Created my own controller and created a simple version. Kids loved it and I understood I would like to create something educational.”



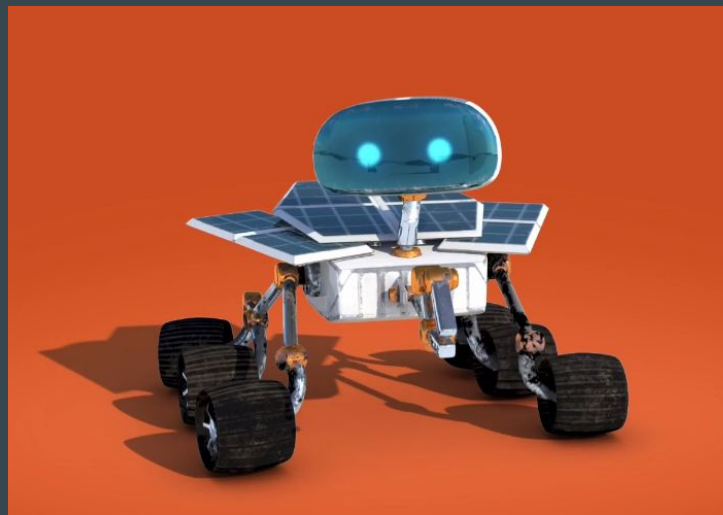


**“After a while I was invited to show it in another event. Made a few adjustments and still the engagement was all there. I also understood how different children learned things when they are 6 and 8. I ended up reading a bit about designing games for children and also about educational games in general.”**





“The team making the game grew and we’ve been improving it in our spare time. My job was being a developer but also trying to understand how to make the game work well for children and how to maximize the learning.”



“Reading about it is not enough. I started going to events and talks and try to learn it from the best. Went to a lot of meetups of LEGup (London educational games meetup) and to BETT (annual fair of educational tech in London). Truly exciting events!”



**#LEGup**





“At BETT there were a lot of good examples of beautiful educational games. But soon I started seeing a trend about them. Something they had in common that made me see a missed opportunity in all of them.”



# NO INTEGRATED ASSESSMENT OR SIMPLE QUIZ OR QUESTIONS

“All the games I saw either didn’t incorporate any type of knowledge assessment or they simply used quizzes to do it. I need to start by saying I have nothing against quizzes. I think quizzes can be highly effective. But at the same time you have a game and someone playing it and you’re missing an opportunity to test the person while playing the game. It’s not an easy thing but there are some techniques!”





**Why use In-game assessment?**

# Why use In-game assessment?

1- Quizzes and questionnaires interrupt and can in some cases affect the learning process

“Most of the engagement with games comes from how immersive they can be. How they create that sense of flow that keeps you highly focused and motivated. If you stop that flow to show something unrelated with gameplay as a quiz, you break the immersion and engagement and probably a good opportunity to use it to assess real knowledge!”



# Why use In-game assessment?

- 1- Quizzes and questionnaires interrupt and can in some cases affect the learning process
- 2 - Some knowledge doesn't express through explanation or answers, but through actions

“Sometimes people are better at showing knowledge by acting upon it in a practical way. Not all knowledge comes from knowing how to explain what you're about to do. It might come by just doing it! So, let your game be the context where they can do it!”



# Why use In-game assessment?

- 1- Quizzes and questionnaires interrupt and can in some cases affect the learning process
- 2 - Some knowledge doesn't express through explanation or answers, but through actions
- 3 - Games create engagement and immersion which give space to less stress and easier access to knowledge

“I don't know about you, but when I sit down for a test I get nervous. And I feel that it makes me have a hard time accessing the knowledge I have in my head. The best way to test knowledge is for you not even knowing you're being tested!”



# ASSESSMENT OBJECTIVES

“There must be an objective to why you’re going to assess someone. Let’s talk about a few of the motivations.”

# ASSESSMENT OBJECTIVES

## Self Evaluation

“Self assessment is a great tool for your personal path in learning! Do I need to know more about a subject? Am I missing something? Am I prepared for a certain challenge? Games might help you test yourself in different scenarios.”

# ASSESSMENT OBJECTIVES

Self Evaluation

External Evaluation

“Games can be a great way to test the knowledge of someone trying to get certified. Or maybe someone who’s trying to get a job. There’s interesting things you can do in a game for assessing not only core knowledge, but also other soft skills that might be useful to know for your company (like if someone is a good team player).”

# ASSESSMENT OBJECTIVES

Self Evaluation

External Evaluation

Game/Tool Evaluation

“Knowledge assessment can also help you validate the usefulness of your game (if you need to improve certain areas), or even to help you get funding for it. It’s always easier to invest in something that shows results!”



# Assessment Games Vs Educational Games With Assessment

“I want to make a distinction here. Assessment game’s sole purpose is to assess your knowledge. Educational games with assessment exist to give you both the knowledge and assess if you really learned it. There’s some differences. For instance, assessment games are not meant to be played more than once, and also won’t have scaffolding in place (see further).”

# some TYPES OF ASSESSMENT

“Let’s look at some ways you can assess knowledge inside your game.”

Completion

Scaffolding

Adaptive difficulty

Big data

Emergent

# COMPLETION

“Completion is the easiest way to assess knowledge, which doesn’t mean is less valid. One way of doing it is to connect the several learning objectives to different levels of your game. If a certain level is completed you will know that learning objective was achieved. Of course you can make other types of more subtle uses of this technique like quests and side quests and even inventory puzzles. Anything that you know, once completed, shows knowledge mastery.”



# SCAFFOLDING

“Scaffolding in educational games is the structured support the game gives you to help you progress your knowledge along the game. It might be tightly connected to the learning objectives and is there to make sure you don’t get lost along the way, having the support you need at the right time. You can design it in a way where you can measure how much of that support was actually needed and use it to assess the knowledge the player had before reaching it or after. The less support needed, the more knowledge you know the player has.”



“One way to do scaffolding is by using NPC’s in your game to give you information that you seem to need at that time. (left).”

“Or the simplest way which is to have a hint button (right) that players can use whenever they need. Make it cost something so players only use it when they really need it. That way you can assess they really needed that piece of knowledge and assess knowledge with that.”



# ADAPTIVE DIFFICULTY

“In a lot of today’s games the difficulty of game play adapts to the player. If you shown skill the game will throw harder things at you (harder enemies, more quantity of enemies, etc). The same thing can be done with educational games. The more you know how to do something the more difficult problems the game will throw at you. At the same time that’s a great metric to assess the knowledge of the player. You’re already doing it to know how hard the level should be! Use it!”



“Both LEGO games and Skyrim use adaptive difficulty engines.”





# BIG DATA

“Some educational games have a big amount of data being measured. If every player action can have a lot of linear effect along time, it might be difficult to measure everything you need about the player’s ability in real time in the game. So you can simply measure everything you need and send it to a server and then apply statistics and other techniques to assess how well the player did during the gameplay.”



“An example is a space simulator where the player might be doing a lot of corrections to the ship’s navigation which might have non discrete complex effects on the simulation. You might just gather all the information into a server and analyse the player’s skill in correcting the ship’s trajectory taking into account all the variables in that universe.”

# Emergent behaviour

“Emergent behaviour is a very interesting knowledge assessment technique and also a hard one to measure. It’s hard because the idea itself is to measure something unexpected. That means you need to have metrics prepared for that. It all comes down to looking into the player’s action sequences, seeing the patterns and connecting them to successful outcomes. If Big Data measured what you did, Emergent Behaviour measures how you did it.”



“I see Emergent Behaviour assessments being applied to open world sandbox games, doing an over time assessment. Imagine something like Minecraft where you could have challenges that can be solved in different ways and you’re monitoring all the ways players solve them. Some might show simplicity, some might show complexity, other might show a certain level of creativity.”



“Another example is the game Besiege where you have an inventory of simple mechanical parts that you can attach together to create complex machines. The game doesn’t tell you how to do it. It tells you you have a certain objective. You choose the way you build your machine to achieve it.”



**“Let’s just say... things get very destructively creative!”**

# Game vs Metagame metrics

“When you’re measuring knowledge, you might also find metrics that are beyond the game mechanics.”

# Metagame metrics

- Time taken to complete a task

“This is one of the oldests metrics when testing knowledge. How much time did you take to finish the task. You can incorporate that easily into your game. You might even hide it from the player, or show it if you want to test the player’s ability to complete tasks under pressure.”



# Metagame metrics

- Time taken to complete a task
- How many sessions did it take

“You can also test how many sessions it took. Maybe you’re measuring engagement. Maybe you’re measuring how much knowledge the player had to go and get before completing the game. Design it in a way you can differentiate.”

# Metagame metrics

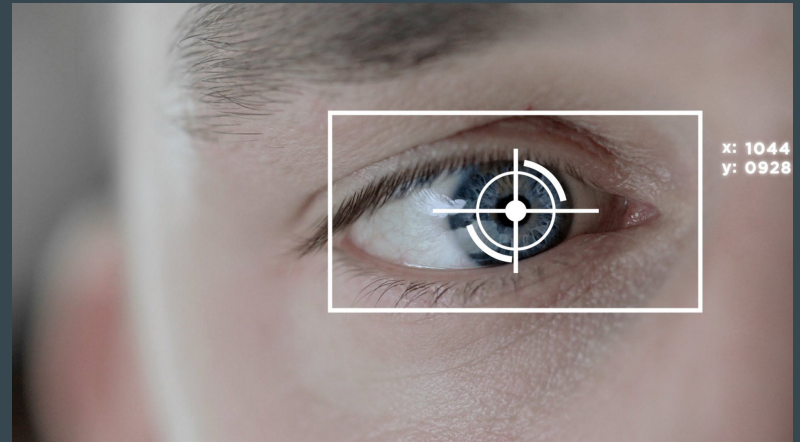
- Time taken to complete a task
- How many sessions did it take
- How many times a section was replayed

“Similar to the one before. It might show a will to master the subject. It might show engagement with the subject. Or it might show the speed of comprehension about certain subjects.”

# Metagame metrics

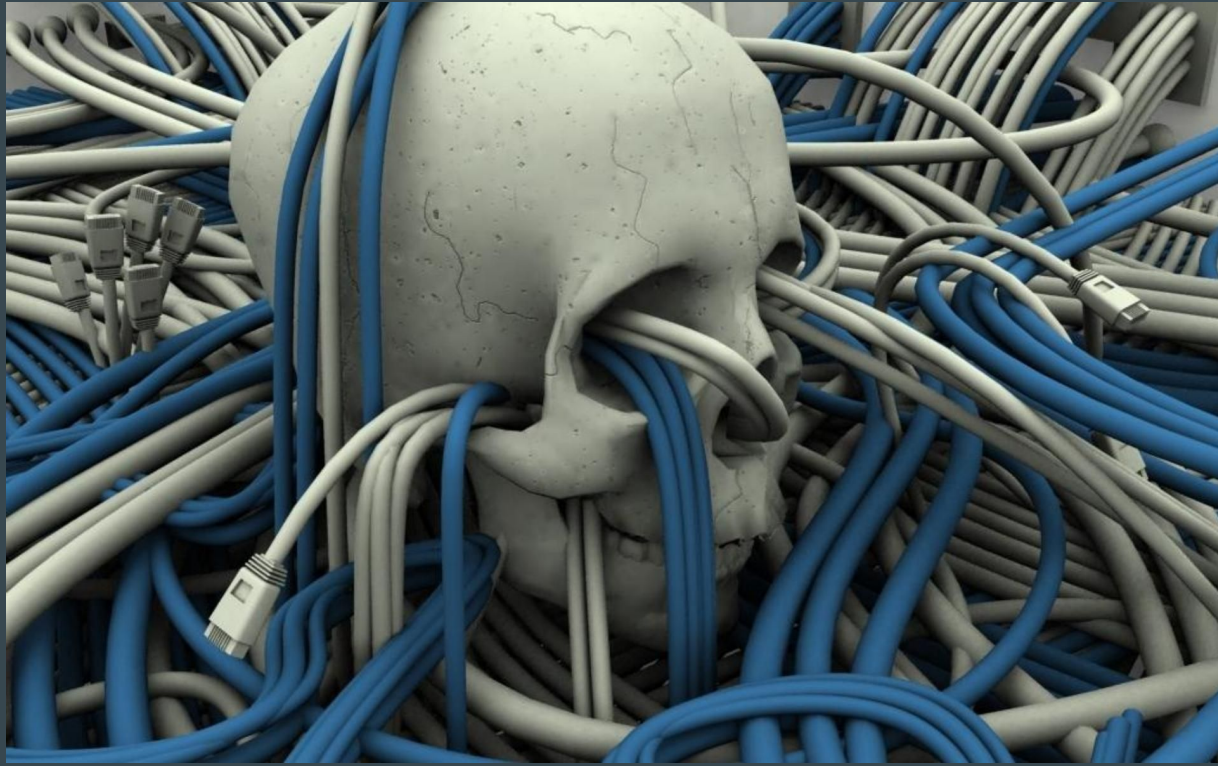
- Time taken to complete a task
- How many sessions did it take
- How many times a section was replayed
- Biometric data

“You can also read the player’s biometric data, in extreme cases. (more on the next slide)”



“Heart rate, breathing can give you hints on how stressful parts of the game are to people (top). Or you can track where the person is looking at the screen, maybe creating heat maps of some areas of the game (top right). Or you can measure how strongly people are gripping the gamepad somewhere in the game, or how much their hands are sweating! (Right).”





**“Just don’t go overboard!”**

# Tips

for designing good assessment in games

# Break it down to simple concepts

“The more granular are the concepts of your game and the mechanics, the easier they are to be measured.”

# Determine your learning objectives / outcomes

“If you didn’t do this from the beginning, you might as well not have a good educational game to begin with. But the knowledge assessment you are integrating in the game is very tied up to it. So take a moment while designing the game and determine really well not only what knowledge you’re teaching, but also what knowledge you’re going to measure!”



**Make your assessment goals and game mechanics work in unison.**

“I cannot stress enough. When you’re creating your game mechanics, design them in a way that shows the level of mastery of the subject. That might mean make it so you can adjust the level of difficulty easily, or that is hard for someone to complete it by luck.”

# Not All Activities are Good for Assessment

“Not every game mechanic will be good to assess knowledge (even if it might be good to teach). That is fine. Maybe you’ll just need another one that works as a complement. Just make sure it works. Don’t waste time on forcing metrics where they won’t work.”

# THANK YOU!

“These were just a few tips that I found in several articles and papers. I hope they are useful. On the next slide I have a list of some of the places I took it from. Any correction or suggestion about this presentation is very welcome. Just send me an email. Also add me in any social media you find me. I use the same email on all of them.”

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# Useful links

<https://www.filamentgames.com/blog/5-assessment-strategies-learning-games>

[https://www.gamasutra.com/view/feature/130843/proof of learning assessment in .php](https://www.gamasutra.com/view/feature/130843/proof_of_learning_assessment_in_.php)

<https://www.hindawi.com/journals/ahci/2013/136864/>

[https://www.ets.org/research/policy research reports/focus on rd/issue1](https://www.ets.org/research/policy_research_reports/focus_on_rd/issue1)

<https://ioapccosta.wordpress.com/2014/05/04/gamepad-pressure-recorder/>