



# NEES

Núcleo de Excelência em Tecnologias Sociais

## Gamification and Intelligent Learning Environments From Theories to Evidences

Ig Ibert Bittencourt

`ig.ibert@ic.ufal.br`

[www.nees.com.br](http://www.nees.com.br)

# Let's Visit Brazil... and Maceió!

AIED

Gamification

Gamification and ILE

Grand Challenges



# Let's Visit Brazil... and Maceió!

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Gamification and ILE  
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- Gamification
- Gamification and ILE
- Grand Challenges



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# Agenda

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- 1 AIED
- 2 Gamification
- 3 Gamification and ILE
- 4 Grand Challenges



# Instructional Complexity

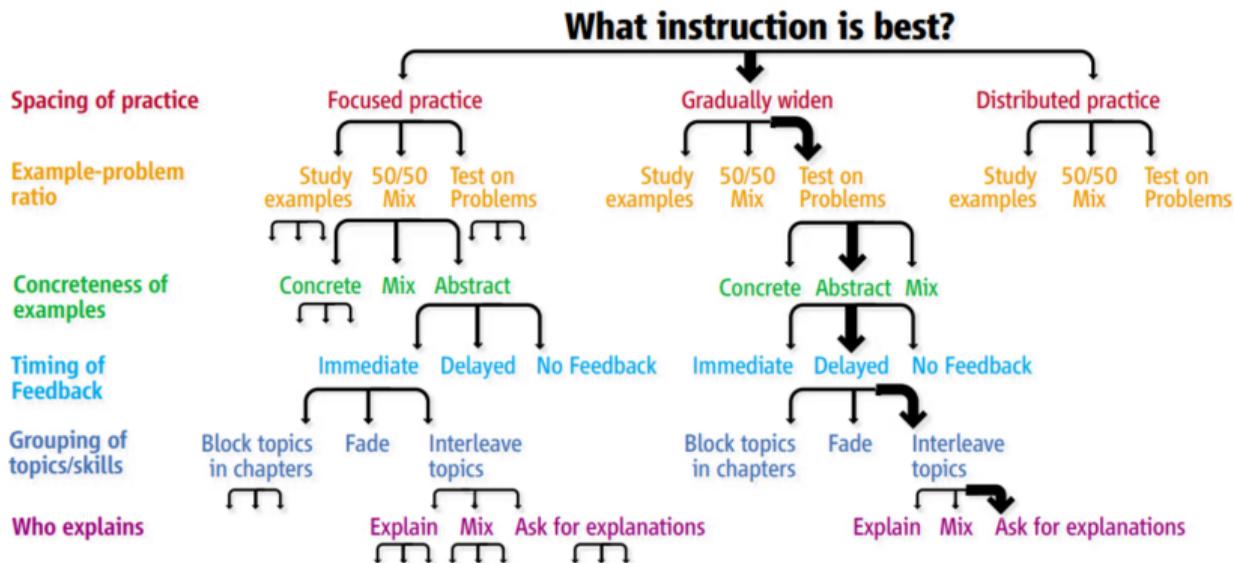
Different choices along different instructional dimensions can be combined to produce a vast set of instructional options

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■ Koedinger, K. R., et. al (2013). *Instructional complexity and the science to constrain it. Science, 342(6161), 935-937*

# Instructional Complexity

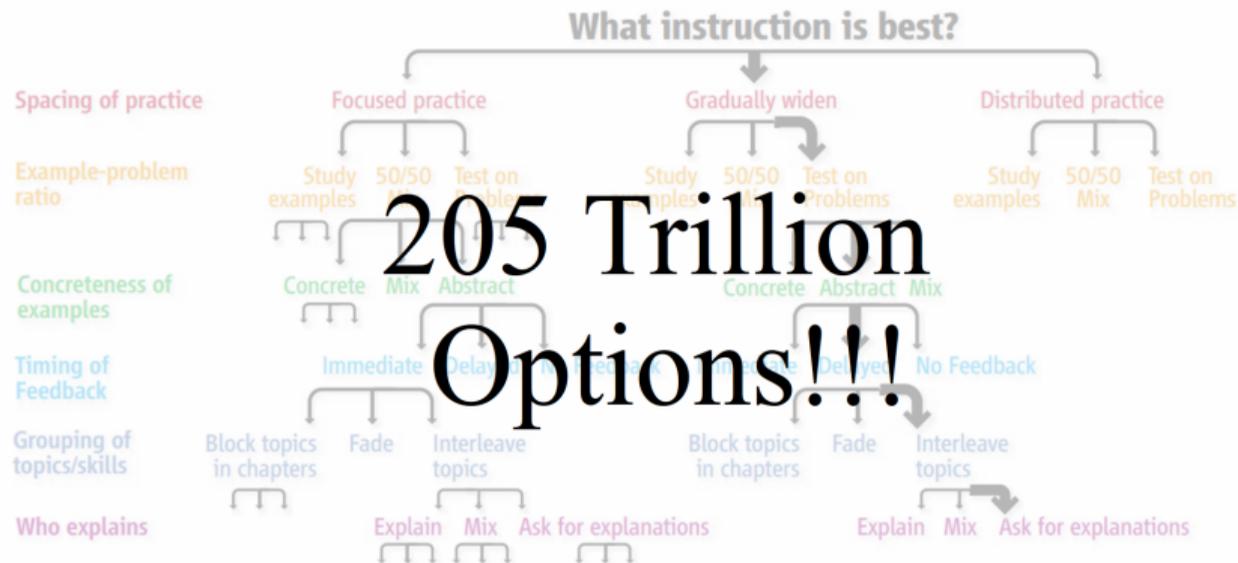
The path with thicker arrows illustrates one set of choices within a space of trillions of such options

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■ Koedinger, K. R., et. al (2013). *Instructional complexity and the science to constrain it. Science, 342(6161), 935-937*



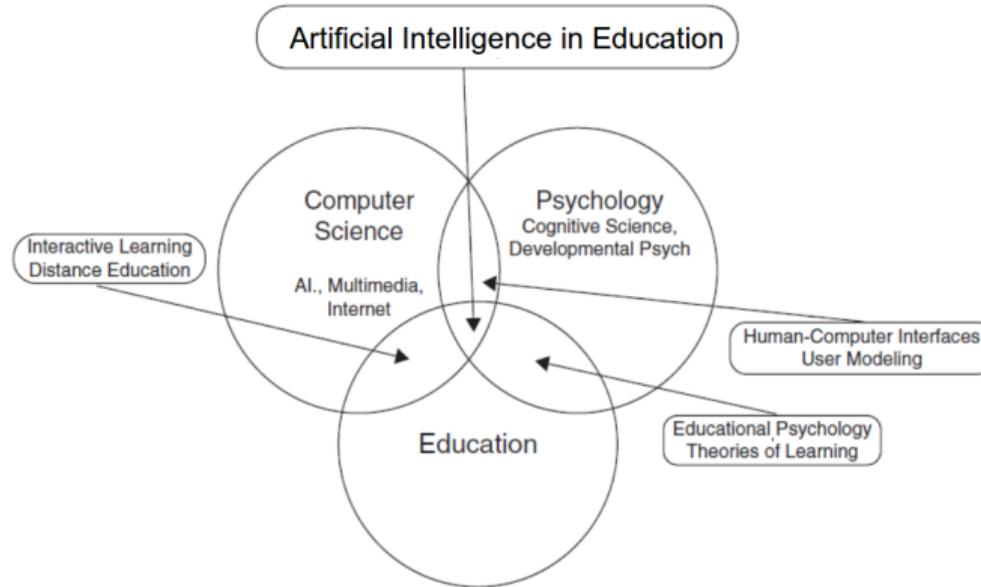
# Artificial Intelligence in Education

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■ *Wolf, B. P. (2010). Building intelligent interactive tutors: Student-centered strategies for revolutionizing e-learning. Morgan Kaufmann.*

# Artificial Intelligence in Education

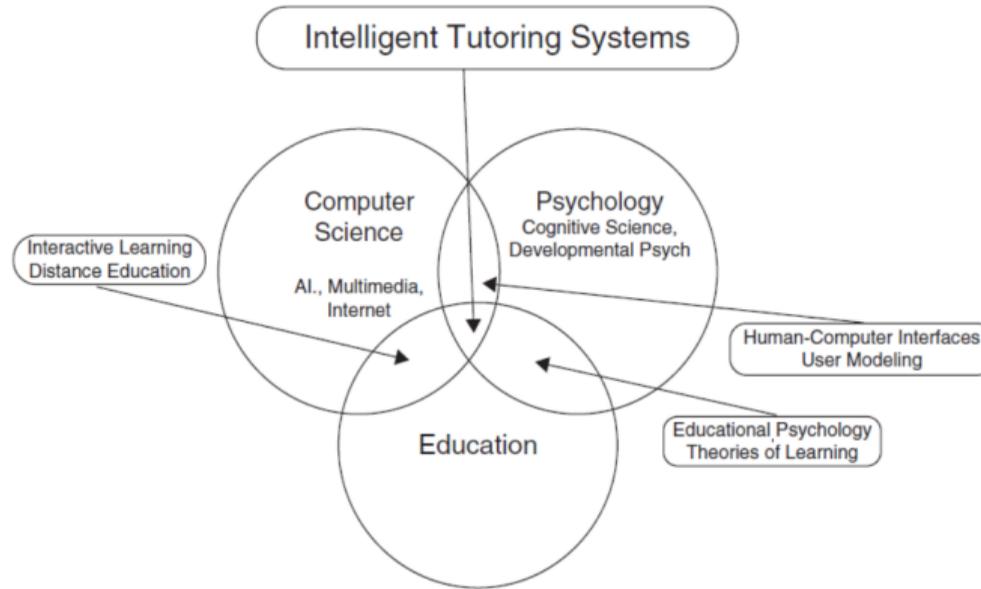
## Intelligent Tutoring Systems

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■ *Wolf, B. P. (2010). Building intelligent interactive tutors: Student-centered strategies for revolutionizing e-learning. Morgan Kaufmann.*

# Intelligent Tutoring Systems

What you mean by inner loop and outer loop ?

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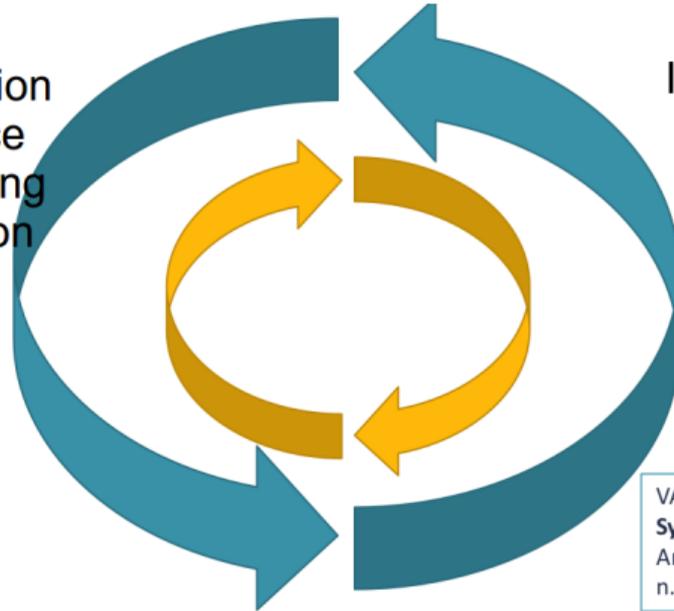
Gamification and ILE

Grand Challenges



## Outer Loop

- Student Selection
- Fixed Sequence
- Mastery Learning
- Macroadaptation



## Inner Loop

- Minimal Feedback
- Error Flaging
- Hint
- Student Diagnosis

VANLEHN, K. **The Behavior of Tutoring Systems**. *International Journal of Artificial Intelligence in Education*, v. 16, n. 3, p. 227–265, 2006.

# Intelligent Tutoring Systems

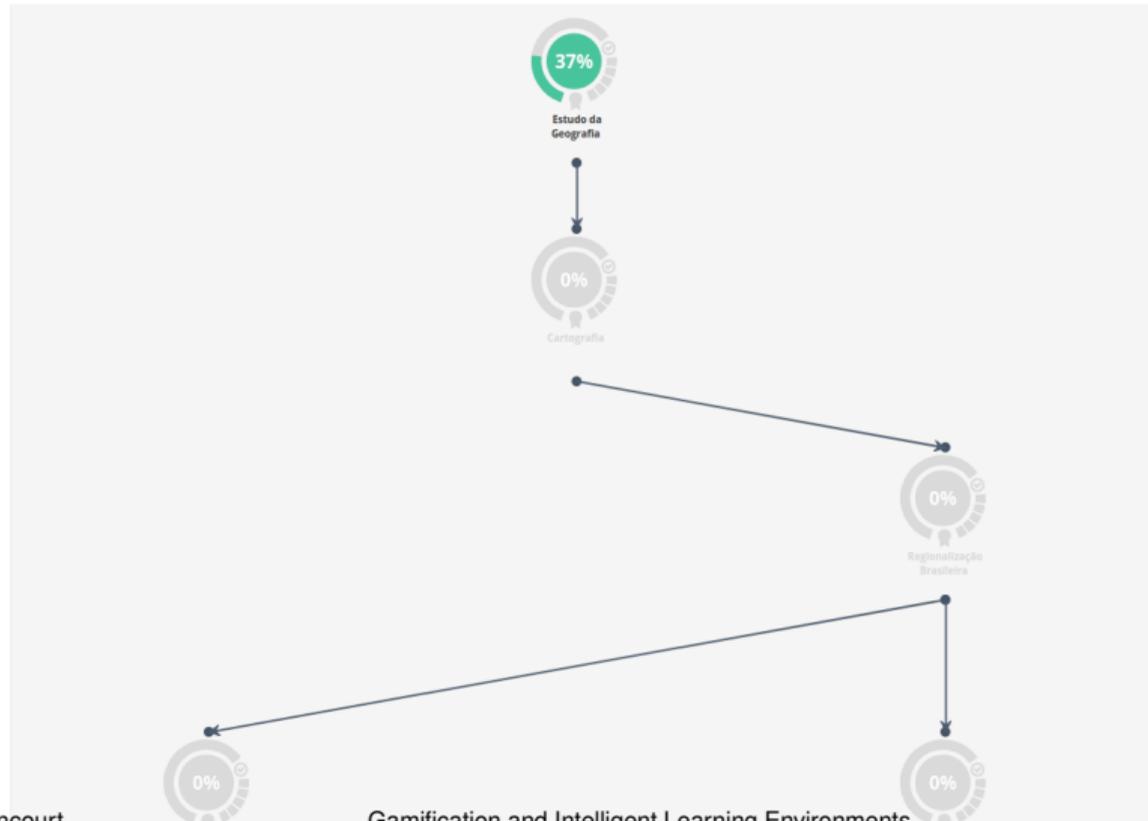
What you mean by inner loop and outer loop ?

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# Intelligent Tutoring Systems

What you mean by inner loop and outer loop ?

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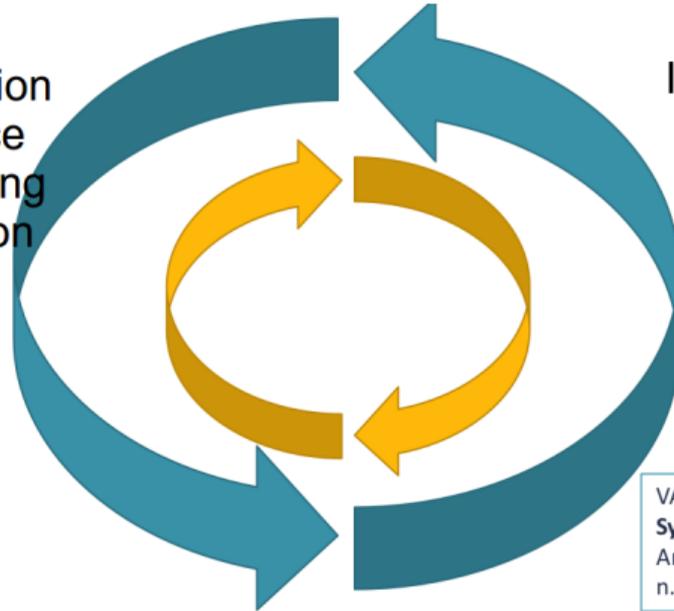
Gamification and ILE

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# Intelligent Tutoring Systems

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**ALEVEN, Vincent et al. Example-Tracing tutors: Intelligent tutor development for non-programmers. International Journal of Artificial Intelligence in Education, v. 26, n. 1, p. 224-269, 2016.**



## Mathtutor

Twenty people are going to a concert. There are eight more children than adults.

How many children and adults were at the concert?

Diagram illustrating the problem: A large bracket labeled "20" encompasses two smaller brackets. The top bracket is labeled "children" and contains a smaller bracket labeled "8" and another bracket. The bottom bracket is labeled "adults" and contains a single box. Below the diagram, the text reads: "Yes, indeed! So how many people is ONE unknown part?"

Number of children =

Number of adults =

2 x  = 12

1 x  = 12/2

Hint: If two parts together are 12 people, how many people would one part be?

Progress bar: Find Sum of Parts, Identify Given Values, Identify Unknown Part, Interpret Representations, Set-up Equation, Solve Equation.

Buttons: Previous, Next, Done.

# Intelligent Tutoring Systems

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## Genetics Tutor

1. Determine the dominance and linkage of the disease shown and then determine the probabilities that the labeled individuals are carriers of the disease.

**1. Determine the dominance/linkage for the pedigree.**

The disease allele for this trait is recessive.

The trait is autosomal.

**2. Enter the probability the selected individuals are carriers in the fields at the right.**

0.25\*0.5\*1/12\*0.5

The probability of inheriting the disease allele from V-4 is  $1/4 * 1/2 = 1/8$ .

The probability of inheriting the disease allele from V-5 is  $1/12 * 1/2 = 1/24$ .

What is the probability that VI-1 will inherit the allele from both parents?

← Previous    Next →

Hint    Done

# Intelligent Tutoring Systems

What you mean by inner loop and outer loop ?

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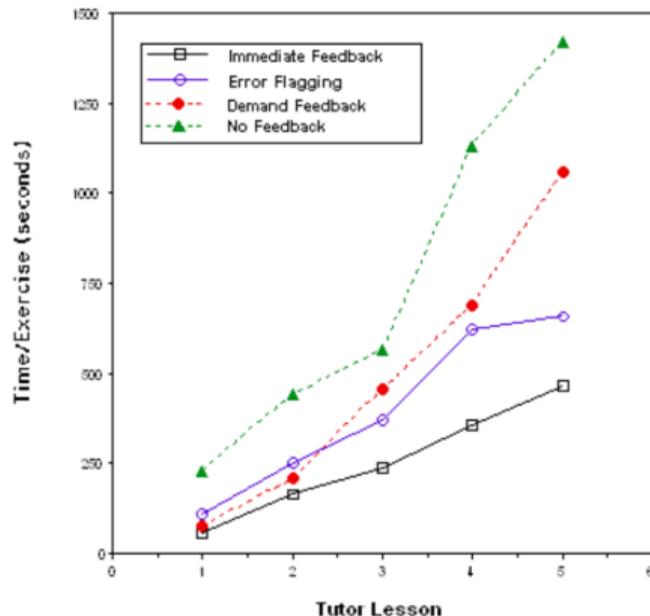
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## Feedback Studies in LISP Tutor (Corbett & Anderson, 1991)



Time to Complete  
Programming  
Problems in LISP Tutor

Immediate Feedback  
Vs  
Student-Controlled  
Feedback



# Intelligent Tutoring Systems

## Intelligent Tutoring Systems effectiveness

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### Improved teaching:

2 Sigma for human one-to-one tutoring

.50 Sigma for interactive multimedia,  
(raises the median score from 50% to 69%)

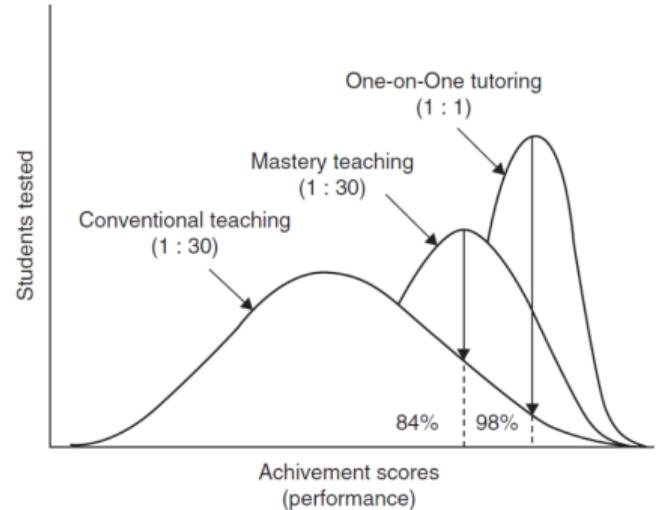
1.05 Sigma for intelligent tutors (raises the  
median score from 50% to 85%).

### Reduced Cost:

~63% less less expense to provide  
instruction with technology.

### Improved cost-efficiency:

Bring instruction to learners rather than  
bringing learners to the schoolhouse.



**FIGURE 1.1**

Advantages of one-to-one tutoring. (Adapted from Bloom, 1984.)



■ Woolf, B. P. (2010). *Building intelligent interactive tutors: Student-centered strategies for revolutionizing e-learning*

# Intelligent Tutoring Systems

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Int J Artif Intell Educ (2016) 26:536–537  
DOI 10.1007/s40319-015-0060-1



LETTER TO THE EDITOR

## Recent Meta-reviews and Meta-analyses of AIED Systems

Benoit du Boulay<sup>1</sup>

Published online: 6 August 2015

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It is pleasing to see that the 25th Anniversary of IAIED also brings a certain maturity to the field. In the last 5 years there have been a number useful and positive analyses of the effectiveness of AIED systems designed to tutor one-to-one. For example, VanLehn (2011) found that the effectiveness of the “step-based” intelligent tutoring systems he surveyed were nearly as effective as average human tutors, and that neither of these were as effective as expert human tutors, but certainly both better than providing the domain content without tutoring. “Step-based” means that the tutor evaluates and reacts to each step that the learner makes in a problem-solving session as opposed to evaluating only the final answer given by the learner.

In a meta-analysis, Ma et al. (2014) found similar sized results for step-based ITSs both when compared to a no tutoring condition and when compared to large group human teacher led-instruction, but no difference when compared to small group human tutoring or to one-to-one tutoring. The same authors analysed systems for teaching programming and also found a “a significant advantage of ITSs over teacher-led classroom instruction and non-ITS computer-based instruction” (Noshit et al. 2014). Likewise Kulik and Fletcher (2015) found similar sized improvements but distinguished between studies that used standardized tests and those where the tests were more specifically tuned to the system providing tuition. Smaller effect sizes were found by Stenbergen-Hu and Cooper (2013) in their meta-analysis of pupils using ITSs in a school setting. They also noted that lower-achievers seemed to do worse with ITSs than did the broad spectrum of school pupils. In a parallel study of university students, Stenbergen-Hu and Cooper (2014) found more positive effects for ITSs as compared to conventional instruction.

Finally in a large-scale study in the USA of the Cognitive Tutors, (Pans et al. 2014) found only limited evidence of the relative effectiveness of these tutors over conventional teaching, though we note that how the tutors were actually used in the classrooms

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March 2016, Vol. 86, No. 1, pp. 42–78  
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## Effectiveness of Intelligent Tutoring Systems: A Meta-Analytic Review

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J. D. Fletcher  
Institute for Defense Analysis

*This review describes a meta-analysis of findings from 50 controlled evaluations of intelligent computer tutoring systems. The median effect of intelligent tutoring in the 50 evaluations was to raise test scores 0.66 standard deviations over conventional levels, or from the 50th to the 75th percentile. However, the amount of improvement found in an evaluation depended to a great extent on whether improvement was measured on locally developed or standardized tests, suggesting that alignment of test and instructional objectives is a crucial determinant of evaluation results. The review also describes findings from two groups of evaluations that did not meet all of the selection requirements for the meta-analysis: six evaluations with nonconventional control groups and four with flawed implementations of intelligent tutoring systems. Intelligent tutoring effects in these evaluations were small, suggesting that evaluation results are also affected by the nature of control treatments and the adequacy of program implementations.*

**KEYWORDS:** intelligent tutoring systems, computer-assisted instruction, tutoring, meta-analysis

Computer tutoring is a late development in the long history of tutoring in education. Whereas human tutoring has been used in schools for 2,500 years—or for as long as schools have existed—computer tutoring is largely a product of the post half century. The first computer tutoring systems to be used in school classrooms (e.g., R. C. Atkinson, 1968; Suppes & Moringstater, 1969) showed the influence of the programmed instruction movement of the time: They presented instruction in short segments or frames, asked questions frequently during instruction, and provided immediate feedback on answers (Crowder, 1959; Skinner, 1958). A different type of computer tutoring system appeared in research laboratories and

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10.1002/jme.21022

## Intelligent Tutoring Systems and Learning Outcomes: A Meta-Analysis

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Simon Fraser University

Shanda G. Adnape  
Washington State University

John C. Noshit and Qing Liu  
Simon Fraser University

Intelligent Tutoring Systems (ITS) are computer programs that model learners' psychological states to provide individualized instruction. They have been developed for diverse subject areas (e.g., algebra, medicine, law, reading) to help learners acquire domain-specific, cognitive and metacognitive knowledge. A meta-analysis was conducted on research that compared the outcomes from students learning from ITS to those learning from non-ITS learning environments. The meta-analysis examined how effect sizes varied with type of ITS, type of comparison treatment received by learners, type of learning outcome, whether knowledge to be learned was procedural or declarative, and other factors. After a search of major bibliographic databases, 107 effect sizes involving 14,221 participants were extracted and analyzed. The use of ITS was associated with greater achievement in comparison with teacher-led, self-paced instruction ( $g = .41$ ), non-ITS computer-based instruction ( $g = .27$ ), and teacher or non-teacher ( $g = .28$ ). There was no significant difference between learning from ITS and learning from individualized human tutoring ( $g = .11$ ) or small-group instruction ( $g = .01$ ). Significant positive mean effect sizes were found regardless of whether the ITS was used as the principal means of instruction, a supplement to teacher-led instruction, an integral component of teacher-led instruction, or as aid to homework. Significant positive effect sizes were found at all levels of education, in almost all subject domains, and whether or not the ITS provided feedback on students' individualized performance. The study also found a significant effect size for learning in contrast with one analysis of procedural

**Keywords:** Intelligent Tutoring System, student needs, effect size, meta-analysis  
Supplemental materials: <http://dx.doi.org/10.1177/1056492612471212>

In 1970, computer scientist James Carroll published a report on SCORAR, a program designed to control feedback, provide interactive, instructional dialogues with a student about fourth- and fifth-grade geography (Carroll, 1970). SCORAR used natural language to answer a student's question or pose a question and give feedback about the correctness of the learner's response. Although the term Intelligent Tutoring System (ITS) was not used in Carroll's article, SCORAR is often regarded as the first ITS

(Carroll, Knudsen, & Anderson, 1997). Beyond the article, Carroll's dialogues with a student about fourth- and fifth-grade geography represented domain knowledge responses from the natural language interface. The separate, explicit domain representation allowed the program, in theory, to generate a diverse and contextually large set of questions posed by the learner. Framing his work as an extension and application of research in artificial intelligence, Carroll emphasized the fundamental difference between SCORAR and the other types of computer-assisted instruction being designed at the time. In particular, he distinguished a domain representation not only as the basis for modeling student knowledge.

REP, another early example of an ITS (Shen, Bower, & Anderson, 1975) assigned programming tasks to students that modeled their individual learning needs and comprehension. The REP researchers constructed a domain representation that supported goal skills in programming variables in the programming tasks that exercised their students' performance on a task supported inferences about their acquisition of skills. Indeed, that task. In this early ITS, the many

that have been designed since, the student model was the result of an expert of the domain model. By the time a special issue on Intelligent Tutoring Systems appeared in the International Journal of Man-Machine Studies (Houtman & Brown, 1979) it was clear that a new type of instructional system and a new field of research



# Intelligent Tutoring Systems

Table 2

*Weighted Mean Effect Sizes for Characteristics of Intelligent Tutoring Systems (ITS)*

Moderator variables	N	k	Random-effects model						Fixed-effect model							
			Effect size		95% CI		Q <sub>B</sub>	p	Effect size		95% CI		Q <sub>B</sub>	p		
			g+	SE	Lower	Upper			g+	SE	Lower	Upper				
Type of ITS							4.18	.52						36.37	<.001	
Model tracing	5,970	21	0.35*	0.07	0.22	0.47			0.25*	0.03	0.20	0.31				
Constraint-based modeling	569	7	0.24	0.16	-0.08	0.56			0.20*	0.09	0.03	0.37				
Bayesian network modeling	1,417	10	0.54*	0.10	0.35	0.73			0.52*	0.06	0.41	0.63				
Expectation and misconception tailoring	142	3	0.34	0.35	-0.35	1.02			0.24	0.18	-0.12	0.59				
Other	4,425	53	0.44*	0.06	0.32	0.56			0.44*	0.03	0.38	0.50				
Not reported	1,798	13	0.40*	0.10	0.20	0.59			0.43*	0.05	0.32	0.54				
ITS intervention							2.41	.79						32.38	<.001	
Principal instruction	4,505	35	0.37*	0.07	0.23	0.51			0.32*	0.03	0.26	0.38				
Integrated class instruction	4,045	15	0.33*	0.08	0.17	0.49			0.25*	0.03	0.18	0.31				
Separate in-class activities	1,939	24	0.47*	0.10	0.27	0.67			0.53*	0.05	0.43	0.62				
Supplementary after-class instruction	933	8	0.43*	0.11	0.22	0.64			0.36*	0.07	0.23	0.48				
Homework	2,480	15	0.45*	0.07	0.32	0.59			0.46*	0.04	0.38	0.54				
Not reported	419	10	0.48*	0.13	0.23	0.74			0.47*	0.10	0.27	0.66				
Feedback provided?							4.55	.10						13.53	<.001	
No	1,411	10	0.54*	0.15	0.25	0.83			0.40*	0.05	0.30	0.51				
Yes	11,728	86	0.42*	0.04	0.34	0.50			0.37*	0.02	0.33	0.41				
Not reported	1,182	11	0.21*	0.10	0.02	0.41			0.15*	0.06	0.04	0.27				
Model misconception?							0.02	.99						5.14	.08	
No	1,508	21	0.40*	0.07	0.27	0.54			0.39*	0.05	0.29	0.49				
Yes	9,911	58	0.40*	0.05	0.31	0.49			0.33*	0.02	0.29	0.37				
Not reported	2,902	28	0.42*	0.10	0.23	0.61			0.43*	0.04	0.35	0.51				

Note. CI = confidence interval.  
\*  $p < .05$ .



# Intelligent Tutoring Systems

Table 3  
Weighted Mean Effect Sizes for Student and Study Characteristics

Moderator variables	N	k	Random-effects model						Fixed-effect model						
			Effect size		95% CI		Q <sub>B</sub>	p	Effect size		95% CI		Q <sub>B</sub>	p	
			g+	SE	Lower	Upper			g+	SE	Lower	Upper			
Grade levels							2.2	.82						25.74	<.001
Elementary school	1,496	19	0.31*	0.08	0.16	0.47			0.26*	0.05	0.16	0.37			
Middle school	810	10	0.41*	0.13	0.15	0.66			0.45*	0.07	0.31	0.59			
High school	4,355	14	0.40*	0.10	0.21	0.59			0.25*	0.03	0.18	0.31			
Postsecondary	6,767	60	0.43*	0.05	0.33	0.53			0.43*	0.03	0.38	0.48			
Mixed grades	771	3	0.61	0.32	-0.02	1.25			0.42*	0.07	0.28	0.57			
Not reported	122	1	0.33	0.18	-0.02	0.69			0.33	0.18	-0.02	0.69			
Subject domains							6.53	.48						50.67	<.001
Mathematics and Accounting	8,038	35	0.35*	0.05	0.24	0.45			0.29*	0.02	0.25	0.34			
Physics	2,890	24	0.38*	0.07	0.26	0.51			0.41*	0.04	0.33	0.49			
Computer Science	1,152	19	0.51*	0.11	0.30	0.72			0.46*	0.06	0.34	0.58			
Language and Literacy	1,075	14	0.34*	0.11	0.12	0.56			0.27*	0.06	0.15	0.39			
Chemistry	141	2	0.16	0.17	-0.17	0.48			0.16	0.17	-0.17	0.48			
Biology and Physiology	210	3	0.59*	0.27	0.07	1.11			0.51*	0.14	0.23	0.78			
Humanities and Social Science	671	8	0.63*	0.22	0.20	1.06			0.84*	0.08	0.68	1.01			
Others and Not Reported	144	2	1.23	0.96	-0.65	3.10			0.53	0.17	0.20	0.87			
Prior domain knowledge							3.45	.49						11.87	.02
Low	5,265	32	0.38*	0.06	0.27	0.49			0.37*	0.03	0.31	0.43			
Medium	1,356	17	0.28*	0.08	0.12	0.45			0.27*	0.06	0.16	0.38			
High	77	2	0.51	0.29	-0.06	1.07			0.53*	0.23	0.07	0.98			
Varied	2,699	22	0.48*	0.12	0.25	0.71			0.27*	0.04	0.19	0.34			
Not reported	4,924	34	0.46*	0.06	0.34	0.58			0.41*	0.03	0.35	0.47			

Note. CI = confidence interval.  
\*  $p < .05$ .



# Intelligent Tutoring Systems

## Motivation and Engagement in ITS!!!

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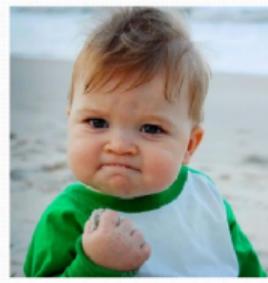
Gamification

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Grand Challenges



- Students can sometimes become **disengaged** and **bored** while using ITS (particularly, in a long-term interaction). (Arroyo et al., 2007) (Bell & McNamara, 2007) (Baker et al., 2010) (Jackson & McNamara, 2013)
- **Motivated, challenged** and **intrigued** students may have better learning performance. (VanLehn, 2011)



# Intelligent Tutoring Systems

## Affective Computing

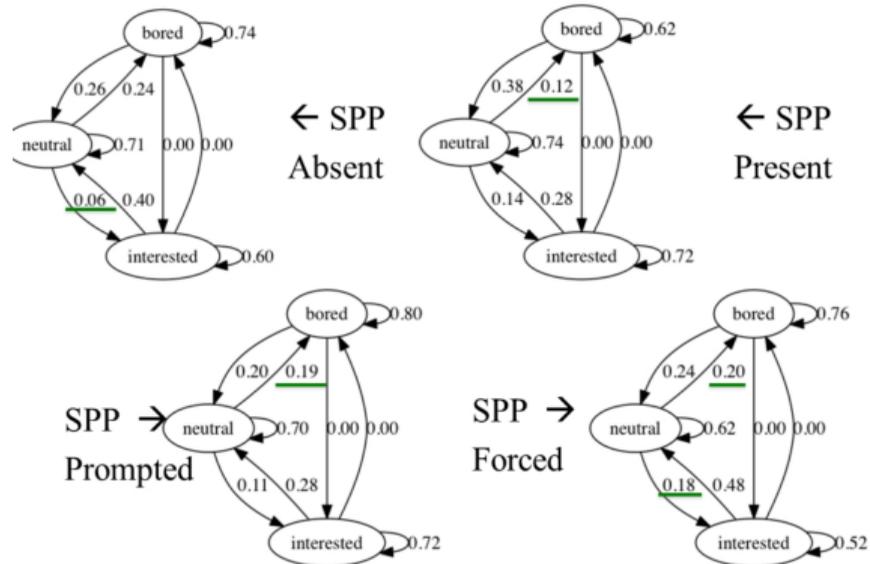
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Grand Challenges

### Student Interest • Ten thousand Data Points N~230



<https://uqam.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=54a93016-5360-44e1-b134-a21c41952fbd>



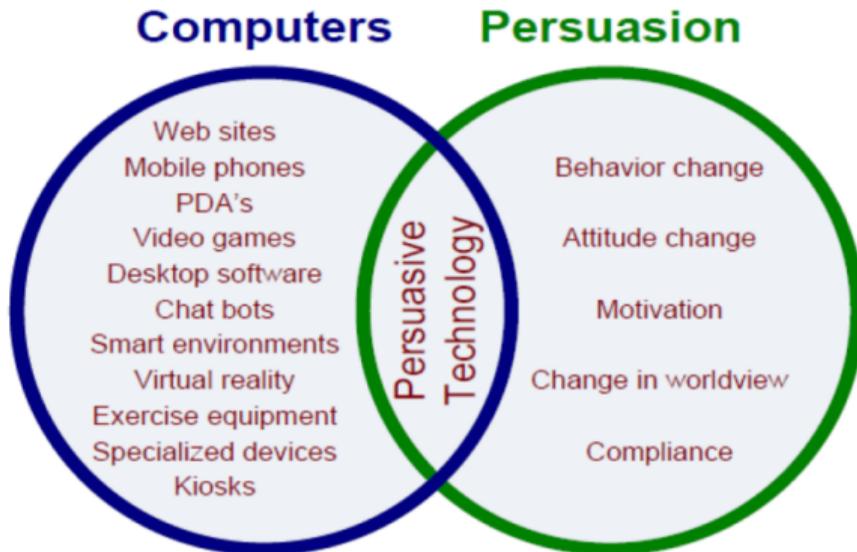
# Persuasive Technology

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■ Brian J Fogg. Persuasive technologies. Communications of the ACM, 42(5):26–29, 1999.

# Persuasive Technology

Why ?

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Grand Challenges

- 1 To help the individual achieve their personal goals, e.g. quit smoking or fight alcoholism, lose weight, eat healthier, exercise more
- 2 To encourage contribution to group / society goals, e.g. save energy, reduce waste, reduce noise, vote, volunteer, etc;
- 3 To achieve a third party's goals, e.g. increase sales, optimize system load, improve service, e.g. advertisement, P2P file-sharing systems
- 4 Areas: Health, Environment/Society, Personal Improvement, **Education**, and so on

■ Brian J Fogg. Persuasive technologies. Communications of the ACM, 42(5):26–29, 1999.



# Persuasive Technology

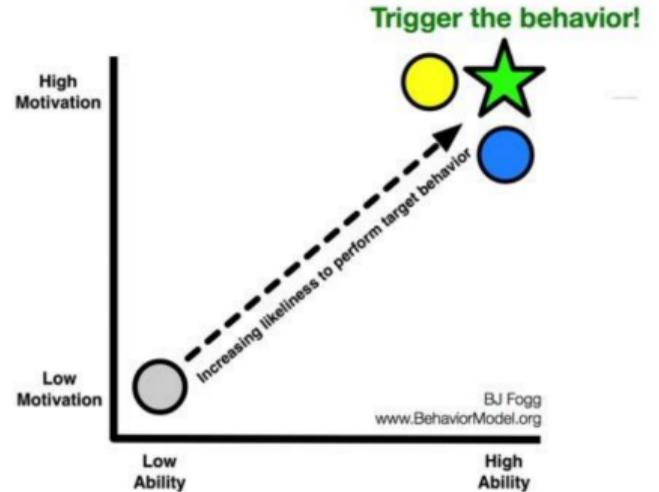
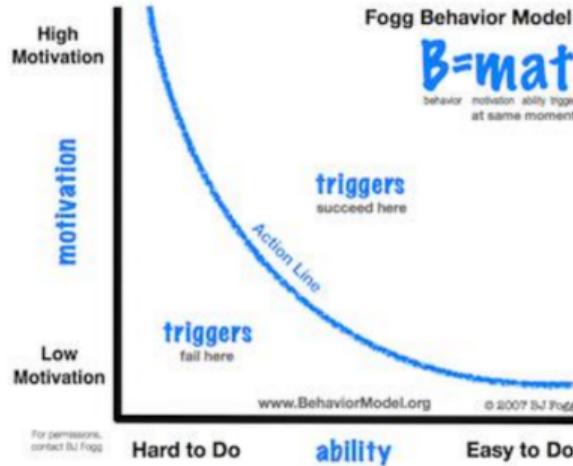
## Fogg's Model

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Grand Challenges



■ [captology.stanford.edu](http://captology.stanford.edu)



# Gamification



## Gamification is the use of game design elements in non-game contexts

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining gamification. In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15). ACM



## Gamification is the use of game design elements in non-game contexts

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining gamification. In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15). ACM

## Gamification is the use of game elements and game design techniques in non-game contexts.

Werbach, K., & Hunter, D. (2012). For the win: How game thinking can revolutionize your business. Wharton Digital Press.



# Gamification

What is and What is not Gamification!!!

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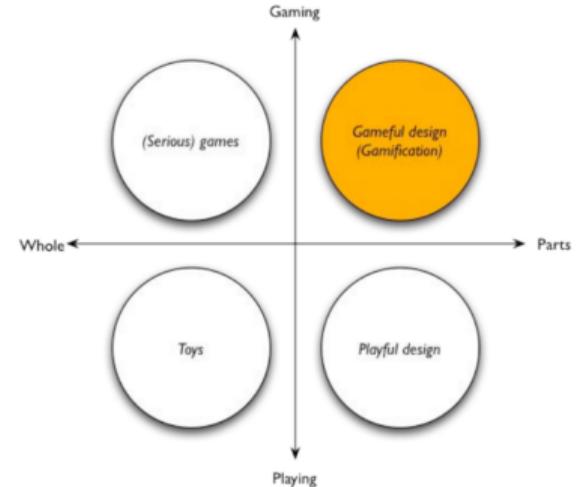
Gamification

Gamification and ILE

Grand Challenges

In gamification:

- The users **are motivated and engaged by the game elements and rules**
- The game design elements are **applied for part of non-game context.**



- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining gamification. In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15). ACM



# Gamification

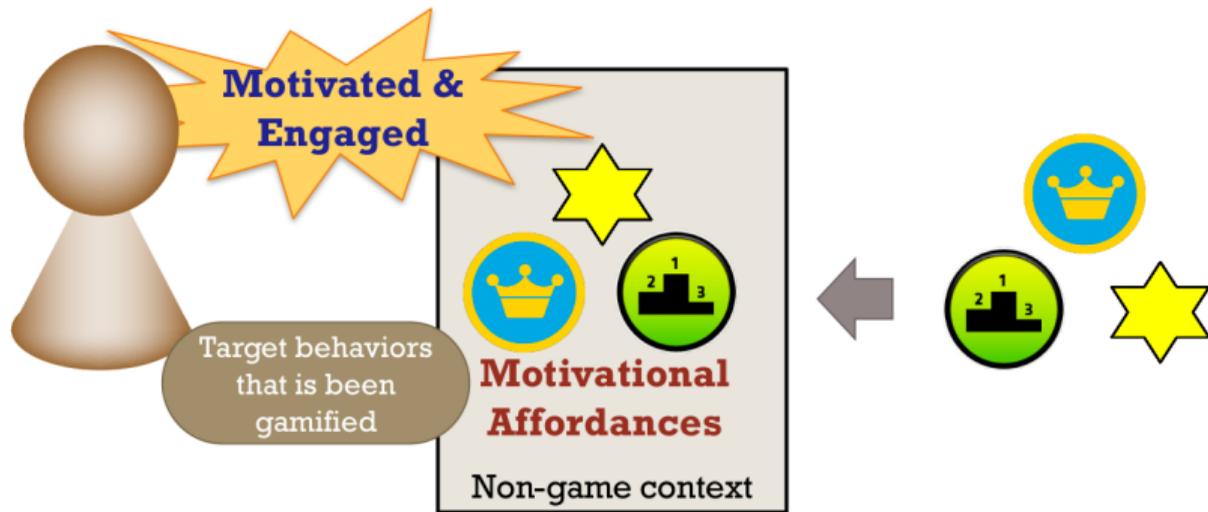
Triggering the behavior!!!

AIED

Gamification

Gamification and ILE

Grand Challenges



- Chalco, G.; Isotani, S. Gamification of Collaborative Learning Scenarios: An Ontological Engineering Approach to Deal with Motivational Problems caused by CSCL Scripts. PhD Thesis. University of São Paulo, 2018



# Gamification

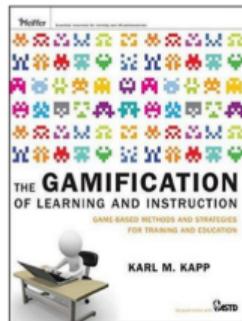
## Does Gamification Work ?

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Gamification

Gamification and ILE

Grand Challenges



(Kapp, 2012)

### A Systematic Mapping on Gamification Applied to Education

Simone de Sousa Borges  
University of São Paulo (ICMC) – USP  
São Carlos, SP - Brazil  
sborges@icmc.usp.br

Vinicius H. S. Durelli  
University of São Paulo (ICMC) – USP  
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Seiji Isotani  
University of São Paulo (ICMC) – USP  
São Carlos, SP - Brazil  
sisotani@icmc.usp.br

(Borges et al., 2014)

2014 47th Hawaii International Conference on System Science

### Does Gamification Work? — A Literature Review of Empirical Studies on Gamification

Juho Hamari  
School of Information Sciences,  
University of Tampere  
juho.hamari@uta.fi

Jonna Koivisto  
School of Information Sciences,  
University of Tampere  
jonna.koivisto@uta.fi

Harri Sarsa  
School of Science,  
Aalto University  
harri.sarsa@aalto.fi

(Hamari et al., 2014b)

Int. J. Human-Computer Studies 74 (2015) 14–31

Contents lists available at ScienceDirect

### Int. J. Human-Computer Studies

journal homepage: [www.elsevier.com/locate/ijhcs](http://www.elsevier.com/locate/ijhcs)

### Gamification in theory and action: A survey<sup>a,b</sup>

Katie Seaborn<sup>a,\*</sup>, Deborah I. Fels<sup>b</sup>

<sup>a</sup> University of Toronto, 5 King's College Road, Toronto, Ontario, Canada M5S 2K8  
<sup>b</sup> Ryerson University, 350 Victoria Street, Toronto, Ontario, Canada M5B 2K3

(Seaborn et al., 2015)



# Gamification

## Duolingo

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The screenshot displays the Duolingo interface for Spanish skills. At the top, the navigation bar includes 'Home', 'Words', 'Discussion', and 'Labs'. The user's profile 'diegodermeval' is visible with a crown level of 44, 0 hearts, and 9 lives. A notification banner reads 'Introducing Crown Levels' with the text 'Get five times more exercises and reach higher fluency as you level up.' The main content area is titled 'Spanish skills' and features a 'Shop' button. Below this, five course icons are shown: 'Basics 1' (level 3), 'Phrases' (level 3), 'Basics 2' (level 3), 'Food' (level 2), and 'Animals' (level 2). On the right, a 'Crown Level' widget shows a crown with the number 44. Below it, a 'Daily Goal' widget shows a progress circle at 0/1 xp gained, a 0 day streak, and 11 hours left. A progress bar at the bottom of the daily goal widget shows a flat line at 0 across the days of the week (Su, M, Tu, W, Th, F, Sa).

# Gamification

## Meu Tutor: A Brazilian ITS

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Gamification and ILE

Grand Challenges



**ENEM**

**Olavo Holanda**

5 Segundo  
4 Seguidores  
2 Mensagens

**1º RANK**

1000 Pontos ganhos  
6 Troféus ganhos

Pontos: 1060 de 1112 para o nível 2

**DISCIPLINAS**  
Clique na disciplina para iniciar seus estudos

**Matemática** 72%

PORTUGUÊS

FÍSICA

QUÍMICA

BIOLOGIA

GEOGRAFIA

LITERATURA

HISTÓRIA

ESPAANHOL

INGLÊS

**MISSÕES**

**Missão 4204** 15 pts  
Responder 1 prova com acerto maior que 50% da disciplina Matemática 0/1  
Recomendar 3 conteúdos da disciplina Matemática 0/3  
**Ativar Missão**

**Missão 1939** 27 pts  
Seguir 1 amigo 0/1  
Convidar 4 amigos 0/4  
**Ativar Missão**

**Missão 5823** 264 pts  
**Ativar Missão**

**RANKING**

**1º Wilson** Nível 3 2050 pts

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Grand Challenges



# Gamification and AIED

# Gamification and AIED

## First Workshop

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 [gile.nees.com.br](http://gile.nees.com.br)

Ig Ibert Bittencourt



## Workshop on Gamification of Intelligent Educational Systems

at the 19th International Conference on Artificial Intelligence in Education (AIED 2018)

London, UK

### Goals

Artificial Intelligence in Education is an interdisciplinary field that integrates researchers with different backgrounds (Computer Science, Engineering, Education, Psychology, instructional design and others) but has one common goal: to use Artificial Intelligence techniques to support new learning experiences where students can work mediated by technology and learn more effectively. The support of robust learning is a complex issue due to many factors (e.g., psychological, technological, personal, instructional, etc.) that affect learning processes and hence, the learning outcome. To tackle this problem, researchers in the field have always been innovative. Through the analysis of different learning settings, researchers have found ways to integrate major advances in Artificial Intelligence, Learning Science, Experimental Psychology, Human-Computer Interaction and other areas to leverage the development of Intelligent Educational Systems. For teachers, an intelligent educational system offers better ways to create/reuse/share content, new methodologies and instruments to deploy effective learning activities and accurate tools to analyze students' progress throughout the learning process. For students, it allows for the presenting the content in an intelligent and adaptive fashion, which enables the restructuring of learning content according to students' needs and stimulates the occurrence of deep and long-term understanding.

However, it is still very common that students become disengaged or bored during the learning process by using intelligent educational systems. On the other hand, there is a growing interest in gamification as well as its applications and implications in the field of Artificial Intelligence in Education since it provides an alternative to engage and motivate students during the process of learning. The term Gamification originated in the digital media industry, however, such a term only gained widespread acceptance after late 2010. Gamification refers to the use of game-based elements such as mechanics, aesthetics, and game thinking in non-game contexts aimed at engaging people, motivating action, enhancing learning, and solving problems [1].

Indeed, gamification has risen to significance in the past six years and shows no sign of slowing growth. The first wave of gamification research has predominantly consisted of (1) definitions, frameworks and taxonomies for gamification and game design elements; (2) technical papers describing systems, designs, and architectures; and (3) effect and user studies of gamified systems [2]. Such phenomenon also occurred in the context of education

# Gamification and ILE

## Ways of Approaching

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**Gamification and ILE**

Grand Challenges



# Gamification and ILE

## Ways of Approaching

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## Gamification-based Design

### Gamifying an Intelligent Learning Environment

# Gamification and ILE

## Ways of Approaching

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## Gamification-based Design

Gamifying an Intelligent Learning Environment

## Intelligent Gamification

Use Artificial Intelligence in a Gamified Educational Environment



# Gamification and ILE

## Ways of Approaching

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## Gamification-based Design

Gamifying an Intelligent Learning Environment

## Intelligent Gamification

Use Artificial Intelligence in a Gamified Educational Environment

## Amplified Gamification

Combine Gamification with Artificial and Human Intelligence into an Educational Environment



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# Gamification-based Design

## Gamifying an Intelligent Learning Environment



# Gamification-based Design

## Gamification and Intelligent Tutoring Systems

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- Students can sometimes become **disengaged** and **bored** while using ITS (particularly, in a long-term interaction). (Arroyo et al., 2007) (Bell & McNamara, 2007) (Baker et al., 2010) (Jackson & McNamara, 2013)
- **Motivated, challenged** and **intrigued** students may have better learning performance. (VanLehn, 2011)



# Gamification-based Design

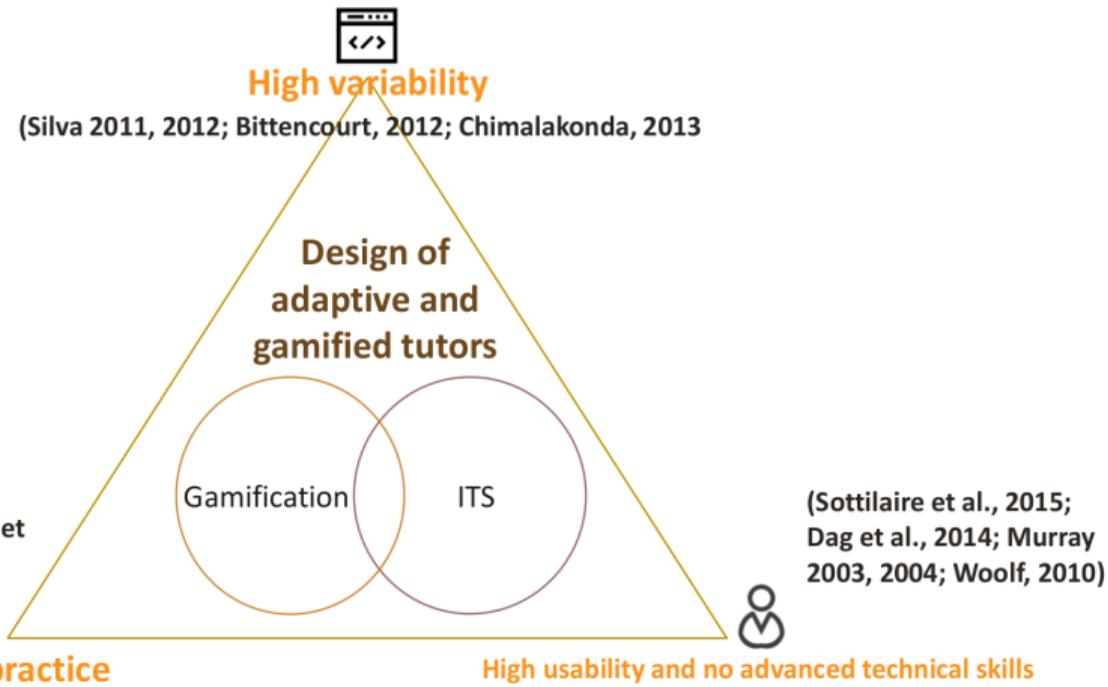
## Gamification and Intelligent Tutoring Systems

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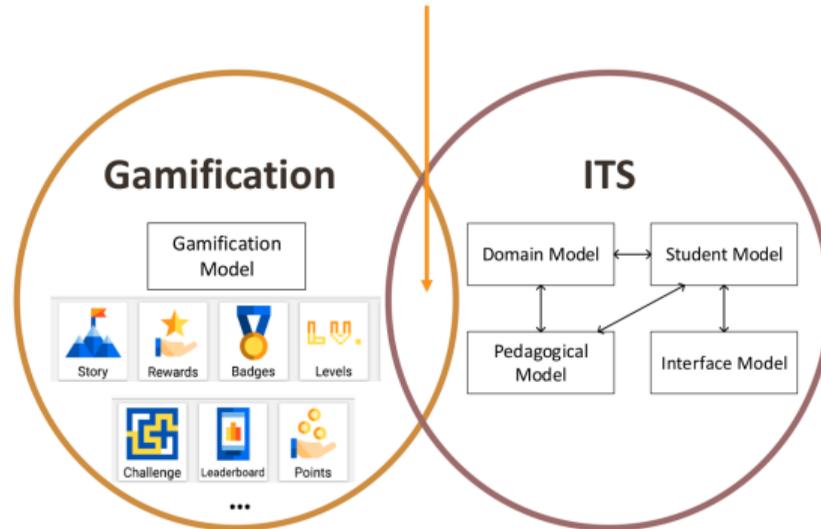
Gamification

Gamification and ILE

Grand Challenges



## Gamified and Adaptive Tutoring Systems



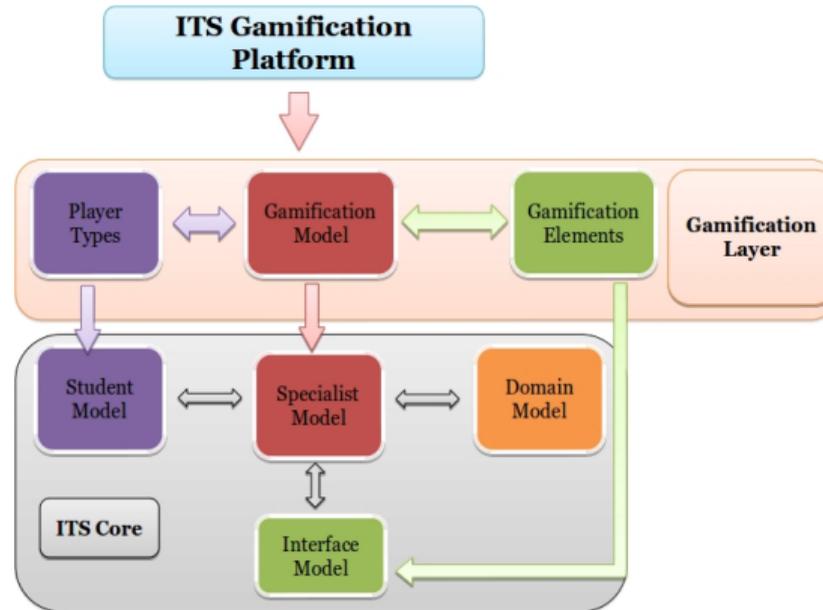
Dermeval, D.; Bittencourt, I. I. Authoring Gamified Intelligent Tutoring Systems. PhD Thesis. Federal University of Alagoas, 2017



# Gamification-based Design

## Gamification and Intelligent Tutoring Systems

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■ Fernando, R.; Isotani, S. Personalized Gamification based on Gamer Types. PhD Thesis. University of São Paulo, 2018



# Gamification-based Design

## Meu Tutor: A Brazilian ITS

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Gamification and ILE

Grand Challenges



**ENEM**

**Olavo Holanda**

5 Seguidos  
4 Seguidores  
2 Mensagens

1000 Pontos ganhos  
6 Troféus ganhos

1000 de 1112 para o nível 2

**DISCIPLINAS**  
Clique na disciplina para iniciar seus estudos

**Matemática** (Progress: 72%)

**PORTUGUÊS**

**FÍSICA**

**QUÍMICA**

**BIOLOGIA**

**GEOGRAFIA**

**LITERATURA**

**HISTÓRIA**

**ESPAANHOL**

**INGLÊS**

**MISSOES**

**Missão 4204** 15 pts  
Responder 1 prova com acerto maior que 50% de disciplina Matemática 0/1  
Recomendar 3 conteúdos da disciplina Matemática 0/3  
**Alisar Missão**

**Missão 1939** 27 pts  
Seguir 1 amigo 0/1  
Convidar 4 amigos 0/4  
**Alisar Missão**

**Missão 5823** 264 pts  
**Mostrar Missões** **Atualizar**

**RANKING**

1º **Wilson** Nível 3 2850 pts

# Gamification-based Design

## Meu Tutor: A Brazilian ITS

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Grand Challenges



The screenshot displays the user interface for 'Meu Tutor' (My Tutor), a gamified Intelligent Tutoring System (ITS) for ENEM preparation. The interface is organized into several sections:

- User Profile:** Shows the user's name 'Olavo Holanda', a profile picture, and statistics: 5 Segundos (Seconds), 4 Seguidores (Followers), and 2 Mensagens (Messages).
- Progress and Rewards:** A '1º CADA' (1st Place) badge is highlighted. It shows '1060 Pontos ganhos' (Points earned) and '6 Troféus ganhos' (Trophies earned). A progress bar indicates 'Pontos: 1060 de 1112 para o nível 2' (Points: 1060 of 1112 for level 2) with a 95% completion rate.
- DISCIPLINAS (Subjects):** A grid of subject cards is shown. The 'Matemática' (Mathematics) card is highlighted with a red box, showing a progress bar at 72%. Other subjects include PORTUGUÊS, FÍSICA, QUÍMICA, BIOLOGIA, GEOGRAFIA, LITERATURA, HISTÓRIA, ESPANHOL, and INGLÊS.
- MISSÕES (Missions):** A list of missions is displayed, each with a title, points, and a description. The 'Missão 4204' (15 pts) mission is highlighted with a red box. It includes tasks like 'Responder 1 prova com acerto maior que 50% da disciplina Matemática' and 'Recomendar 3 conteúdos da disciplina Matemática'. Other missions include 'Missão 1939' (27 pts) and 'Missão 5823' (264 pts).
- RANKING:** A ranking section is visible at the bottom, showing the user's position (1º) and score (2055 pts) relative to other users like 'Wilson'.

# Gamification-based Design

Meu Tutor: A Brazilian ITS

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Gamification and ILE

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**ENEM**

**Olavo Holanda**

- 9 Amigos
- Centro De Estudos Psicopedagogicos
- Maceió - AL

4371 Pontos ganhos

10 Troféus ganhos

3 CONTEÚDOS

39%

Pontos: 4371 de 6305 para o nível 4

**MATEMÁTICA**

Clique no assunto para iniciar seus estudos

- Matemática Básica
- Conjuntos e Funções
- Razões e Proporções
- Sequências
- Matrizes, Determinantes e Sistemas
- Análise Combinatória
- Polinômios e Equações
- Estatística e Probabilidade
- Lógica

MEUTUTOR.COM.BR



# Gamification-based Design

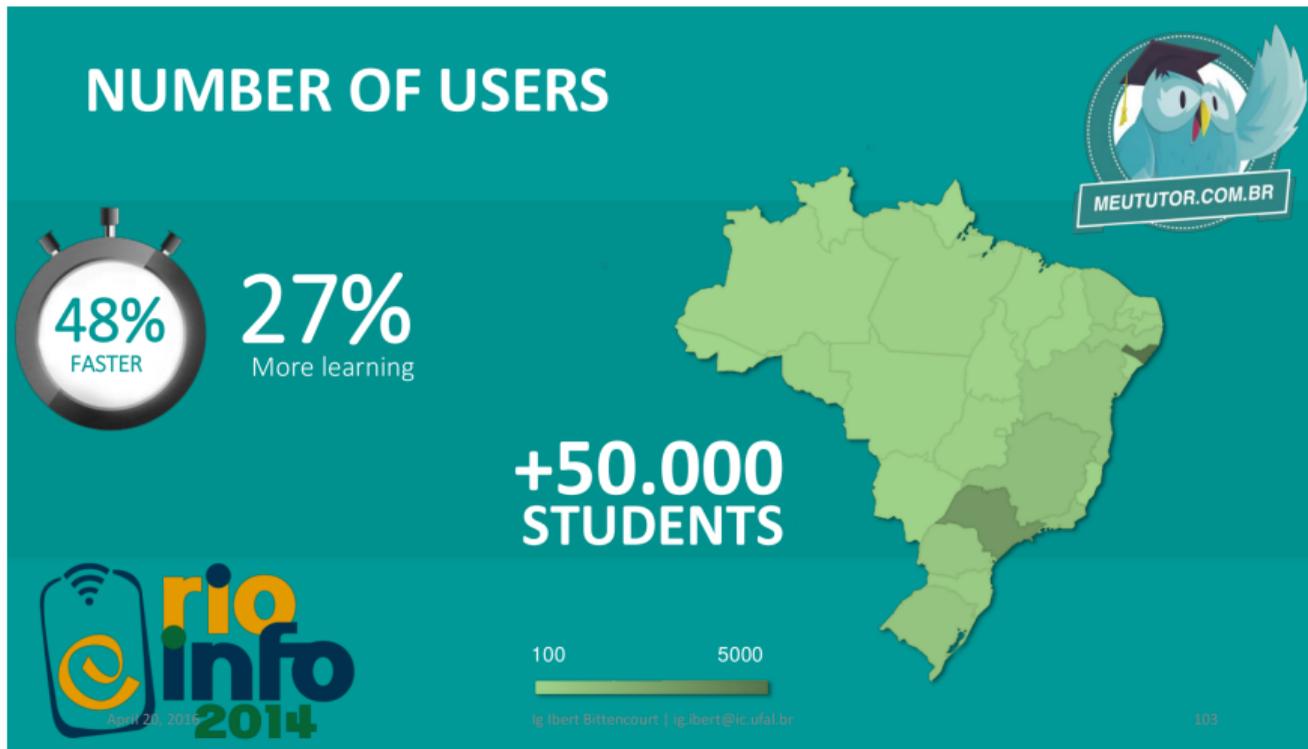
## Meu Tutor: A Brazilian ITS

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Grand Challenges



# Intelligent Gamification

## Use Artificial Intelligence in a Gamified Educational Environment

# Cognitive Gamification

## Player Types: BrainHex Model

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- NACKE, L. E., BATEMAN, C., & MANDRYK, R. L. (2014). BrainHex: A neurobiological gamer typology survey. Entertainment computing, 5(1), 55-62

# Cognitive Gamification

## Player Types: BrainHex Model

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	Competition & Comparison	Cooperation	Customization	Personalization	Praise	Self-monitoring & Suggestion	Simulation	Reward
Achiever		.15				.10		.10
Conqueror	.25			.12		.12	.14	
Daredevil	-.10					-.14	.11	
Mastermind	.12		.10	.12		.14	.12	
Seeker	.10		.19	.11	.10			
Socializer	.11	.17	-.12		-.12	-.13		
Survivor	.17	-.20	-.13			.27		-.14

Orji, R., Vassileva, J., Mandryk, R. Modeling the efficacy of persuasive strategies for different gamer types in serious games for health. *User Modeling and User-Adapted Interaction*. (2014) doi: 10.1007/s11257-014- 9149-8

# Cognitive Gamification

## Meu Tutor: A Brazilian ITS

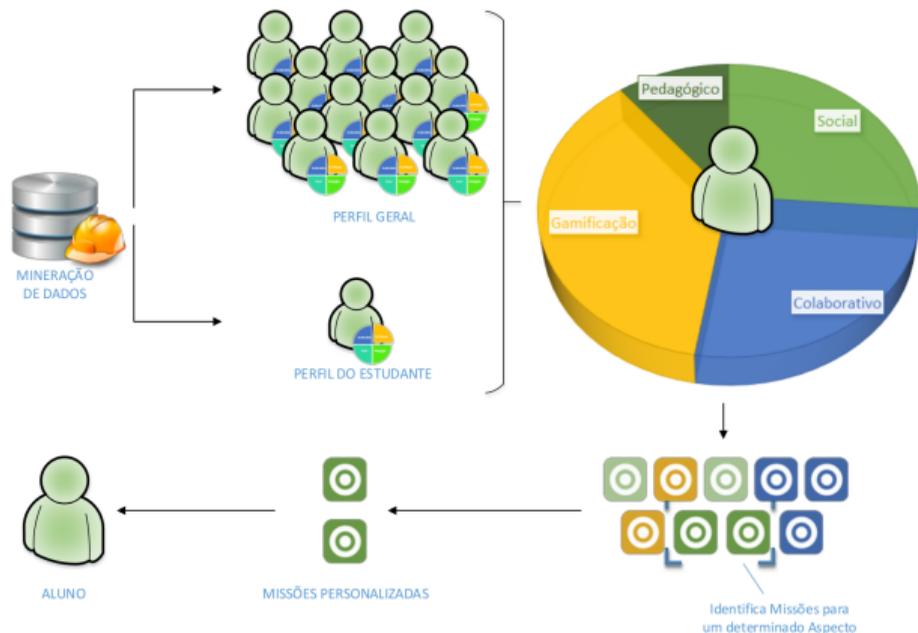
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## Personalized Missions



- Paiva, R.; Bittencourt, I.; Tenório, T.; Isotani, S. ; Jacques, P. What do students do on-line? Modeling students' interactions to improve their learning experience. Computers in Human Behavior, v. 64, p. 769-781, 2016.

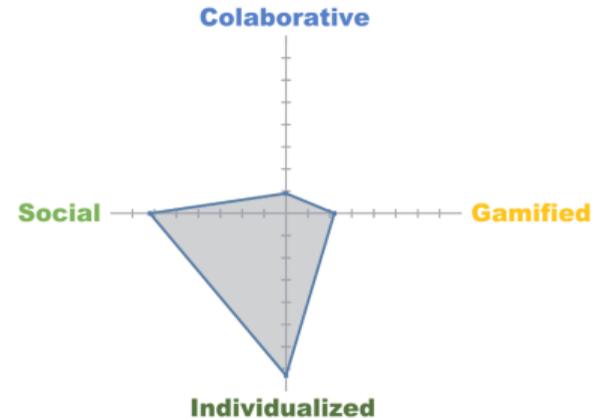
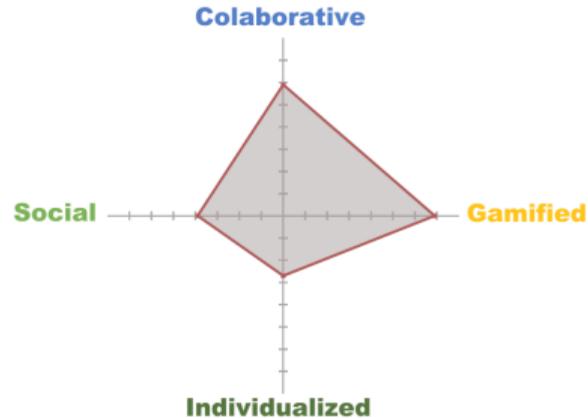


# Cognitive Gamification

Meu Tutor: A Brazilian ITS

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## Personalized Missions



■ Paiva, R.; Bittencourt, I.; Tenório, T.; Isotani, S.; Jacques, P. What do students do on-line? Modeling students' interactions to improve their learning experience. *Computers in Human Behavior*, v. 64, p. 769-781, 2016.



# Cognitive Gamification

## Meu Tutor: A Brazilian ITS

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The screenshot displays the 'Meu Tutor' interface for a user named Olavo Holanda. The user's profile shows 9 friends and 2647 points. A 'Sugestão Meu Tutor' (My Tutor Suggestion) pop-up window is highlighted with a red box, showing a mission 'Missão 4722' with a score of 94. The mission details are: 'Avaliar 8 conteúdos da disciplina Matemática' (0/8) and 'Assistir 7 vídeos na disciplina Matemática' (0/7). Below the pop-up is a hierarchical tree of math topics: Matemática Básica, Conjuntos e Frações, Razões e Proporções, Sequências, Estatística e Probabilidade, Lógica, Funções, Matrizes, Determinantes e Sistemas, Análise Combinatória, and Potências e Equações Algébricas. Each topic is represented by a yellow button with a trophy icon.

■ Paiva, R.; Bittencourt, I.; Tenório, T.; Isotani, S. ; Jacques, P. What do students do on-line? Modeling students' interactions to improve their learning experience. Computers in Human Behavior, v. 64, p. 769-781, 2016.

# Cognitive Gamification

## Meu Tutor: A Brazilian ITS

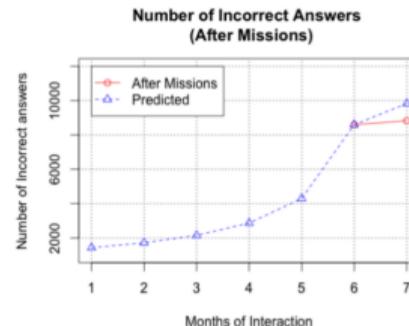
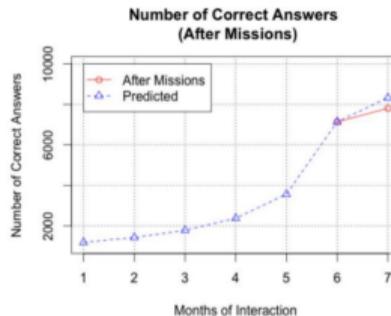
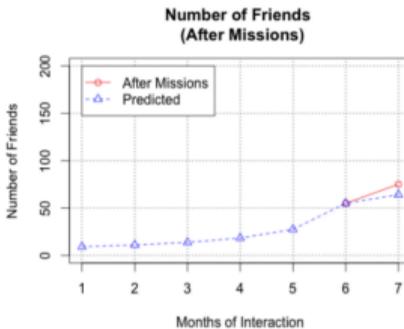
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# Personalized Missions



■ Paiva, R.; Bittencourt, I.; Tenório, T.; Isotani, S. ; Jacques, P. What do students do on-line? Modeling students' interactions to improve their learning experience. Computers in Human Behavior, v. 64, p. 769-781, 2016.



# Amplified Gamification

Combine Gamification with Artificial and Human Intelligence into an Educational Environment

# Amplified Gamification

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Grand Challenges

Int J Artif Intell Educ (2016) 26:600–614  
DOI 10.1007/s40593-016-0105-0



ARTICLE

## Stupid Tutoring Systems, Intelligent Humans

Ryan S. Baker<sup>1</sup>

...

So let me pose the possibility of a different way that the excellent online learning systems of tomorrow could be developed. Perhaps we do not in fact need intelligent tutoring systems. Perhaps instead what we need, what we are already developing, is *stupid tutoring systems*.<sup>3</sup> Tutors that do not, themselves, behave very intelligently. But tutors that are *designed intelligently*, and that *leverage human intelligence*.

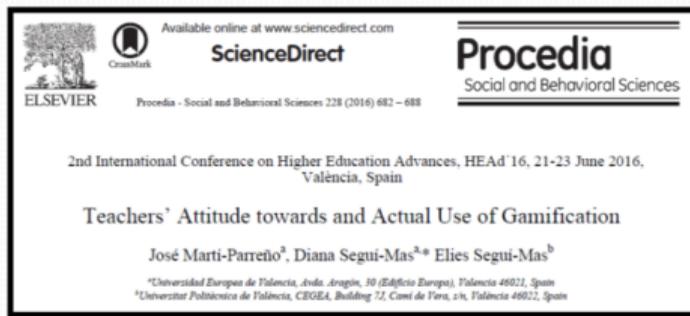
**In other words, perhaps what we need is stupid tutoring systems, and intelligent humans.**

■ Baker, R.; Stupid Tutoring Systems, Intelligent Humans. International Journal of Artificial Intelligence in Education. (2016). 26:600-614.



# Amplified Gamification

## Teachers' attitudes towards use of gamification



(Martí-Parreño et al., 2016)



(Sánchez-Mena and Martí-Parreño, 2016)

- Motivate students
- Facilitate students' learning;
- Show a **positive attitude** towards gamification;
- Main barrier: **the lack of time and resources** available.”;

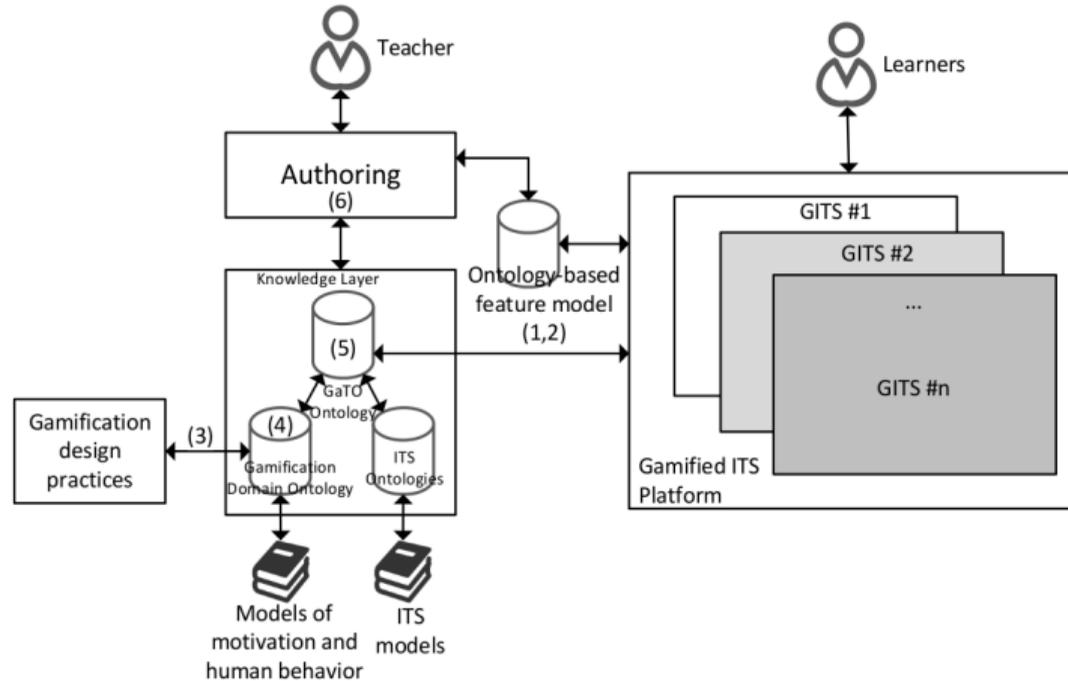
■ Dermeval, D. ; Paiva, R. ; Borges, D. ; Bittencourt, I.; Vassileva, J. . Authoring Tools for Designing Intelligent Tutoring Systems: a Systematic Review of the Literature. International Journal of Artificial Intelligence in Education, v. 1, p. 1-49, 2017.



# Amplified Gamification

## AGITS: Authoring Gamified ITS

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Grand Challenges



Dermeval, D.; Bittencourt, I.; et al. Amplifying Teachers Intelligence in the Design of Gamified Intelligent Tutoring Systems. Lecture Notes in Computer Science. 1 ed.: Springer International Publishing, 2018, v. , p. 68-73..





# Amplified Gamification

## AGITS: Authoring Gamified ITS

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Gamification

Gamification and ILE

Grand Challenges

### #3 Identify evidence-supported combinations of game design elements for achieving particular behaviors in the e-learning domain;

- For each empirical paper in the e-learning domain reported by three SLRS on gamification:
  - **Hamari et al. (2014)**. Does gamification work?--a literature review of empirical studies on gamification;
  - **Borges et al. (2014)**. A systematic mapping on gamification applied to education;
  - **Seaborn and Fels (2015)**. Gamification in theory and action: A survey.
- We identified the **behaviors** with **positive evidence** and the **set of game elements** used for achieving it. <sup>80</sup>

■ Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



# Amplified Gamification

## AGITS: Authoring Gamified ITS

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Gamification

Gamification and ILE

Grand Challenges

### #3 Identify evidence-supported combinations of game design elements for achieving particular behaviors in the e-learning domain;

 Participation	 Story	 Rewards	 Badges	 Levels	 Challenge	 Leaderboard	 Points	
 Performance	 Story	 Feedback	 Rewards	 Badges	 Levels	 Challenge	 Leaderboard	 Points
 Competition	 Leaderboard	 Points						
 Enjoyment	 Story	 Rewards	 Badges	 Avatars	 Challenge	 Points		
 Exploration	 Levels	 Challenge	 Boss Fight					
 Effectiveness	 Leaderboard	 Badges	 Points					

81

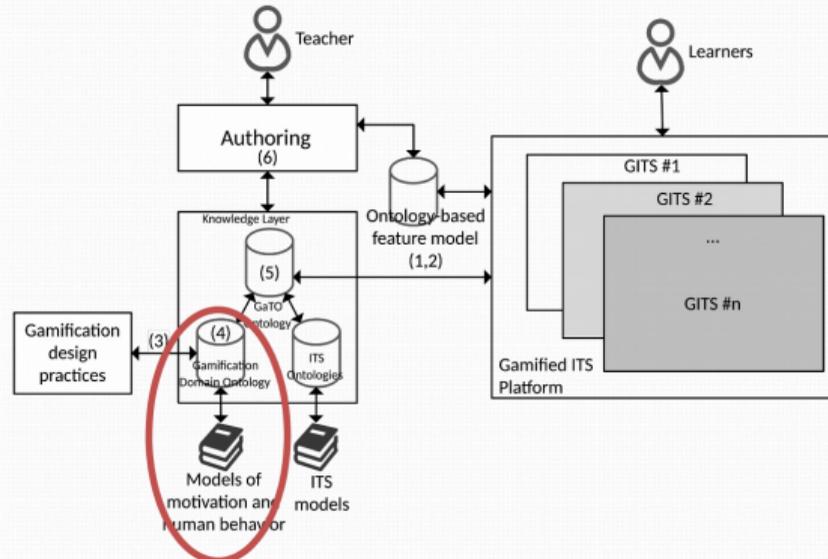
- Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



# Amplified Gamification

## AGITS: Authoring Gamified ITS

### GaTO: Gamified Tutoring Ontology



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- Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



### #4 Develop a Gamification Domain Ontology (GaDO)

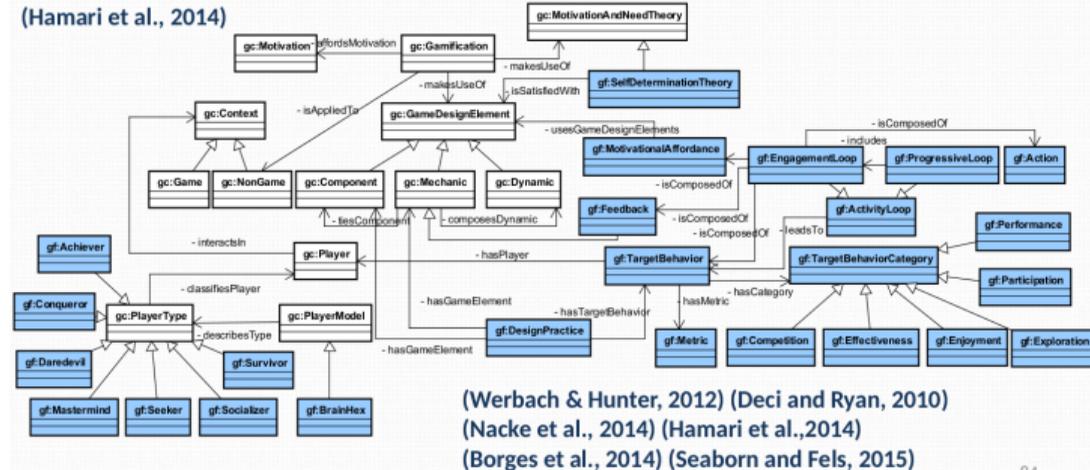
- GaDO is composed by two sub-ontologies:
  - GaDO-core: represent **core gamification concepts** (e.g., gamification definition, game design element, player model, and so on);
  - GaDO-full: represent gamification concepts (e.g., gamification design framework, particular combination of game design elements, specific player models, and so on) of **particular theories and frameworks**;
- Each ontology was developed using the using an ontology engineering methodology (METHONTOLOGY). (Gómez-Pérez 1996; Fernández et al. 1997)



Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change. (To be Submitted)

### #4 Develop a Gamification Domain Ontology (GaDO)

(Deterding et al., 2011)  
(Werbach & Hunter, 2012)  
(Hamari et al., 2014)



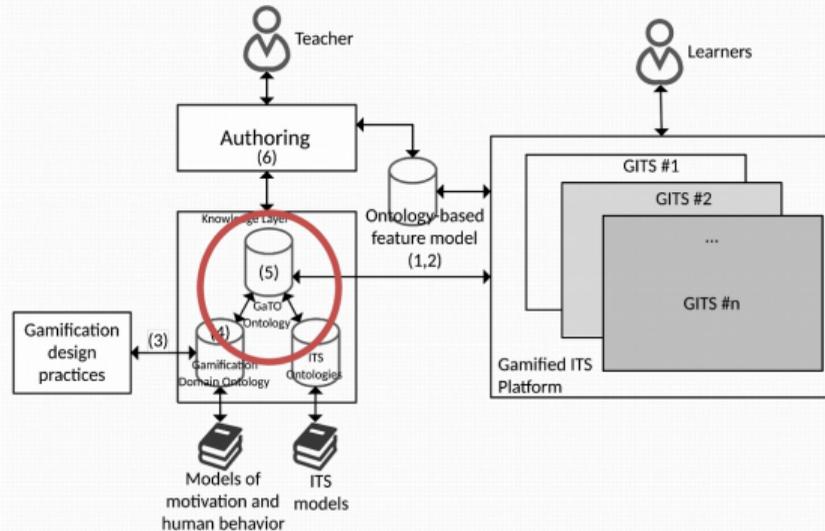
Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



# Amplified Gamification

## AGITS: Authoring Gamified ITS

### GaTO: Gamified Tutoring Ontology



85

Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



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### #5 Develop an integrated ontological model of Gamified Tutoring Ontology (GaTO)

- GaTO:
  - It was also developed using the METHONTOLOGY;
  - Connects gamification and ITS concepts;
  - Reuse the Gamification Domain Ontology;
  - Reuse an existing ITS ontology.

(Bittencourt et al., 2009)



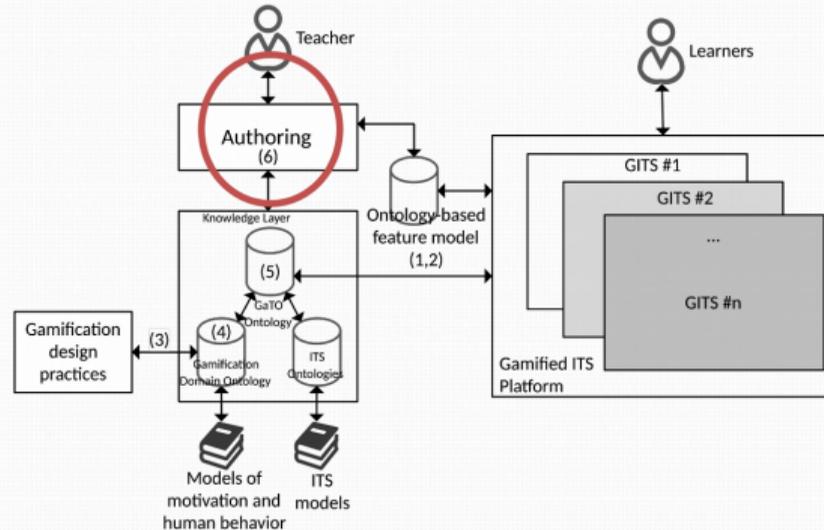
- Dermeval, D.; Bittencourt, I.; Vassileva, J.; Isotani, S.. GaTO: an Ontological Model to Apply Gamification in Intelligent Tutoring Systems. *Frontiers in Artificial Intelligence: AI for Human Learning Behavior Change*. (To be Submitted)



# Amplified Gamification

## AGITS: Authoring Gamified ITS

### AGITS: an authoring solution for designing gamified intelligent tutoring systems



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# Amplified Gamification

## AGITS: Authoring Gamified ITS

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Gamification and ILE

Grand Challenges



Customizing Tutor

Arnie Fields

### My First Gamified Intelligent Tutor

- 1 Start**

You can start by selecting a tutor template or creating a new tutor.

**Create ITS from scratch**  
Create a new tutor step by step and explore all features that we bring for you!

**Using a Template**  
Save time using a tutor already configured for use! But, feel free to modify whatever you need.
- 2 Define Domain
- 3 Define Pedagogical Model
- 4 Define Gamification Model
- 5 Define Evaluation Methods
- 6 Define Reports

ALL RIGHT Save changes and continue

I CHANGED MY MIND Discard changes and go back

Dermeval, D.; Bittencourt, I.; et al. Amplifying Teachers Intelligence in the Design of Gamified Intelligent Tutoring Systems. Lecture Notes in Computer Science. 1 ed.: Springer International Publishing, 2018, v. , p. 68-73..

# Amplified Gamification

## AGITS: Authoring Gamified ITS

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The screenshot shows the 'Customizing Tutor' interface. At the top, there's a search bar and a user profile for 'Annee Fritts'. Below that, a progress bar indicates four steps: 1. Educational Level (selected), 2. Domain, 3. Gamification, and 4. Apply template. A 'click outside to dismiss' bar is visible. The main content area is titled 'Select the educational level context on which you will use the gamified tutor:'. It features five icons: 'Middle School Class' (highlighted with a blue border), 'High School Class', 'College Class', 'Test preparation', and 'Other'. Below the icons, there's a detailed description for 'Middle School Class', including a 'Pedagogical Model' section with a calendar icon, an 'Evaluation Methods' section with a checklist icon, and a 'Reports' section with a laptop icon. At the bottom, there are two buttons: 'ALL RIGHT Save changes and continue' and 'I CHANGED MY MIND Discard changes and go back'.

# Amplified Gamification

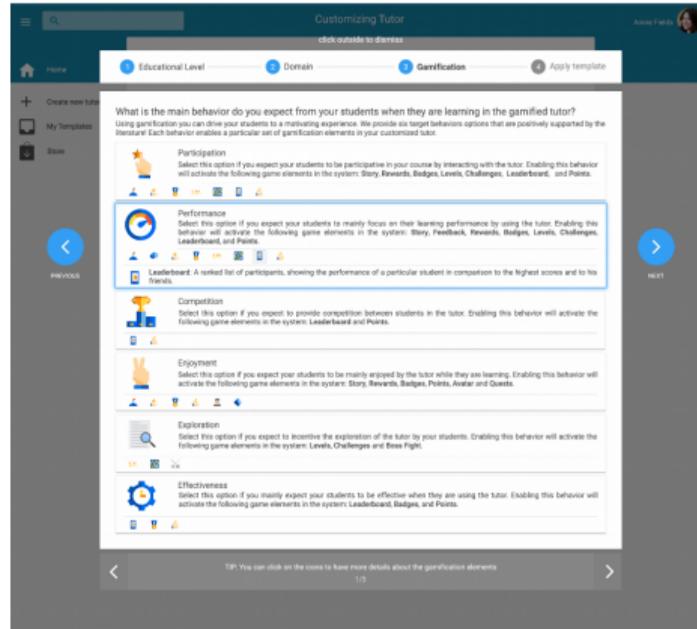
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# Amplified Gamification

## AGITS: Authoring Gamified ITS

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AGITS

Meu Sistema Educacional Adaptativo

Matemática para o 9º Ano

Parabéns, Ana! Você concluiu Sentido...

Desafios

Relações Quadráticas

Geometria

Sentido Numérico e Álgebra

Funções

Início

Era uma vez...

Ranking

Arthur S. Farias	4175
Thiago Nunes	4115
Ana Soares	4055
Emily Caroline	4175
Najane Kroth	4175

129

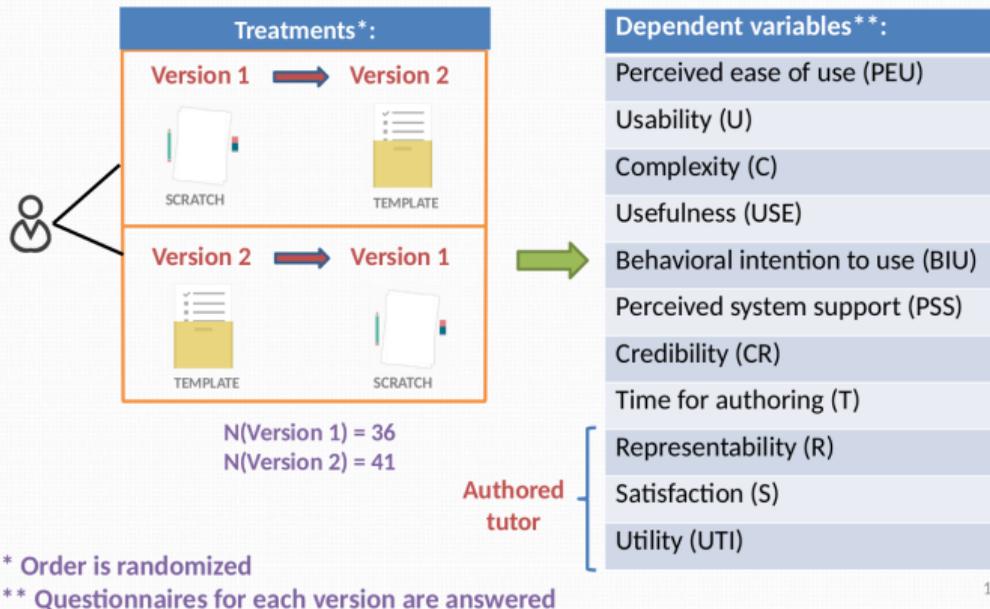
LV3

Dermeval, D.; Bittencourt, I.; et al. Amplifying Teachers Intelligence in the Design of Gamified Intelligent Tutoring Systems. Lecture Notes in Computer Science. 1 ed.: Springer International Publishing, 2018, v. , p. 68-73..

# Amplified Gamification

## AGITS: Authoring Gamified ITS

### 2<sup>nd</sup> Experimental evaluation with teachers: design



Dermeval, D.; Bittencourt, I.; et al. Amplifying Teachers Intelligence in the Design of Gamified Intelligent Tutoring Systems. Lecture Notes in Computer Science. 1 ed.: Springer International Publishing, 2018, v. , p. 68-73..

# Amplified Gamification

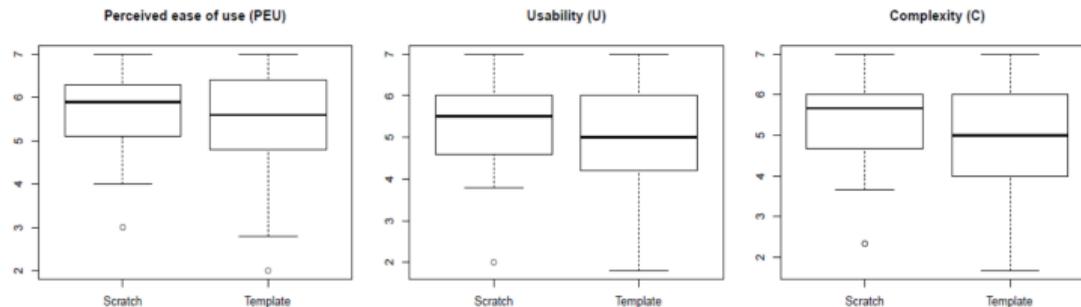
## AGITS: Authoring Gamified ITS

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Metric	Null hypothesis	Alternative hypothesis	Method	p-value
Perceived ease of use (PEU)	H1-0: V1 = V2	H1-1: V1 ≠ V2	Wilcoxon test	0.643764588
Usability (U)	H2-0: V1 = V2	H2-1: V1 ≠ V2	Welch Two Sample t-test	0.535877832
Simplicity (C)	H3-0: V1 = V2	H3-1: V1 ≠ V2	Wilcoxon test	0.387900237
Time for authoring (T)	H9-0: V1 = V2	H9-1: V1 ≠ V2	Wilcoxon test	0.00081419

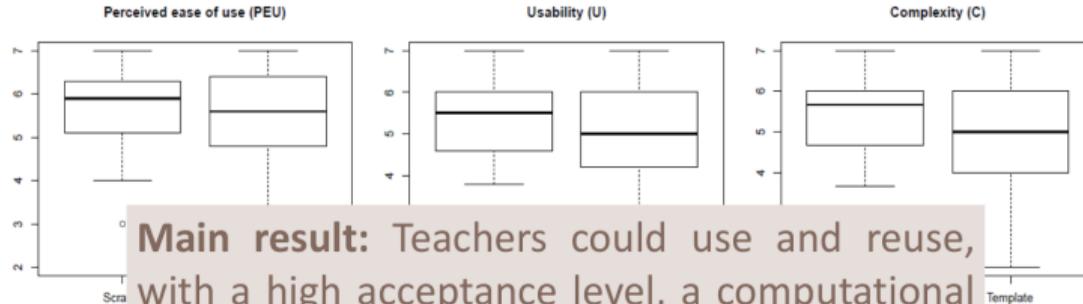
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# Amplified Gamification

## AGITS: Authoring Gamified ITS

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**Main result:** Teachers could use and reuse, with a high acceptance level, a computational solution that considers the high complexity of designing gamified ITS in less than 5 minutes.

Metric	H1-0: V1 = V2	H1-1: V1 ≠ V2	Test	p-value
Perceived ease of use (PEU)	H1-0: V1 = V2	H1-1: V1 ≠ V2	Wilcoxon test	0.643764588
Usability (U)	H2-0: V1 = V2	H2-1: V1 ≠ V2	Welch Two Sample t-test	0.535877832
Simplicity (C)	H3-0: V1 = V2	H3-1: V1 ≠ V2	Wilcoxon test	0.387900237
Time for authoring (T)	H9-0: V1 = V2	H9-1: V1 ≠ V2	Wilcoxon test	0.00081419



Dermeval, D.; Bittencourt, I.; et al. Amplifying Teachers Intelligence in the Design of Gamified Intelligent Tutoring Systems. Lecture Notes in Computer Science. 1 ed.: Springer International Publishing, 2018, v. , p. 68-73..

# Gamification

## Grand Challenges

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**Grand Challenges**



## Gamification as Research Area

There is no well-grounded theory about gamification.



### Gamification as Research Area

There is no well-grounded theory about gamification.

### Stereotyped Gamification

Gamified environments are (uncousciously) been gender-stereotyped.



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### Long-term Motivation

There is no evidence



### Gamification as Research Area

There is no well-grounded theory about gamification.

### Stereotyped Gamification

Gamified environments are (uncousciously) been gender-stereotyped.

### Long-term Motivation

There is no evidence

### Autotelic Learning Experience

There are no strong evidences about gamification and flow theory



# Gamification as Research Area

There is no well-grounded theory about gamification.



# Grand Challenges about Gamification

## Gamification Research

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journal homepage: [www.elsevier.com/locate/comphumbeh](http://www.elsevier.com/locate/comphumbeh)



Editorial

### The maturing of gamification research

*Keywords:*

Gamification

Gameful design

Motivational design

crowdsourcing, and word-of-mouth-marketing, all of which make employee customer engagement a crucial capacity for organisations. Meanwhile, policy-makers around the globe awake to motivation, engagement, and user experience as vital levers for public policy goals in health, education, or civic engagement. Taken together, these technical, cultural, economic, and political forces afforded and demanded a design practice that harnessed the potential of computing technology for improving user experience and engagement across domains and industries – and gamification filled this niche (Deterding, 2015).



# Scientific Research

## Knowledge Dimensions

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# Stereotyped Gamification

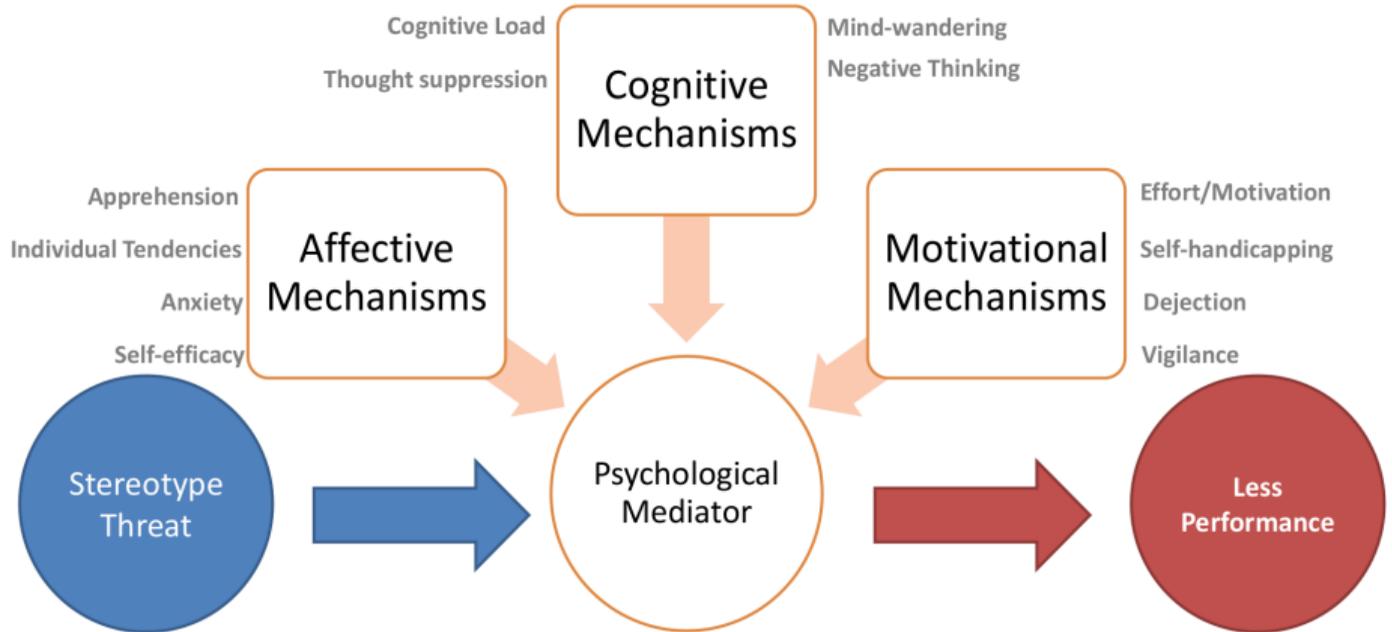
Gamified environments are (uncousciously) been gender-stereotyped.



# Grand Challenges about Gamification

## Stereotyped Gamification

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# Grand Challenges about Gamification

## Stereotyped Gamification

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Computers & Education

Volume 115, December 2017, Pages 161-170



### Does gender stereotype threat in gamified educational environments cause anxiety? An experimental study

Josmarino Albuquerque <sup>a</sup>, Ig I. Bittencourt <sup>a</sup>, Jorge A.P.M. Coelho <sup>b</sup>, Alan P. Silva <sup>a</sup>

[Show more](#)

<https://doi.org/10.1016/j.compedu.2017.08.005>

[Get rights and content](#)

#### Highlights

- An experimental study about gender stereotype threat and anxiety is conducted.
- The experiment was conducted in a gamified educational environment.
- Male-stereotyped environments increased females' anxiety.

# Long-term Motivation

There is no evidence



# Grand Challenges about Gamification

## Long-term Motivation

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The screenshot displays the Duolingo mobile application interface. At the top, the navigation bar includes 'Home', 'Words', 'Discussion', and 'Labs'. The user's profile 'diegodermeval' is visible with a crown level of 44, 0 hearts, and 9 lives. A notification banner reads 'Introducing Crown Levels' with a green owl icon. The main content area is titled 'Spanish skills' and features a 'Shop' button. Below this, five skill icons are shown: 'Basics 1' (3 crowns), 'Phrases' (3 crowns), 'Basics 2' (3 crowns), 'Food' (2 crowns), and 'Animals' (2 crowns). On the right, a 'Crown Level' card shows a crown with the number 44. Below it, a 'Daily Goal' card shows a progress ring at 0/1 xp gained, a 0 day streak, and 11 hours left. A progress bar at the bottom of the daily goal card shows a 0% completion rate across the days of the week (Su, M, Tu, W, Th, F, Sa).

# Grand Challenges about Gamification

## Long-term Motivation

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duolingo Home Words Discussion Labs diegodermeval 0 9

Introducing Crown Levels  
Get five times more exercises and reach higher fluency as you level up.

Crown Level  
44

Daily Goal  
0/1 xp gained  
0 day streak  
11 hours left

Spanish skills Shop

Basics 1

Phrases Basics 2

Food Animals

**Maximum Engagement  
Three Monts**

# Autotelic Learning Experience

There are no strong evidences about gamification and Flow Channel



# Grand Challenges about Gamification

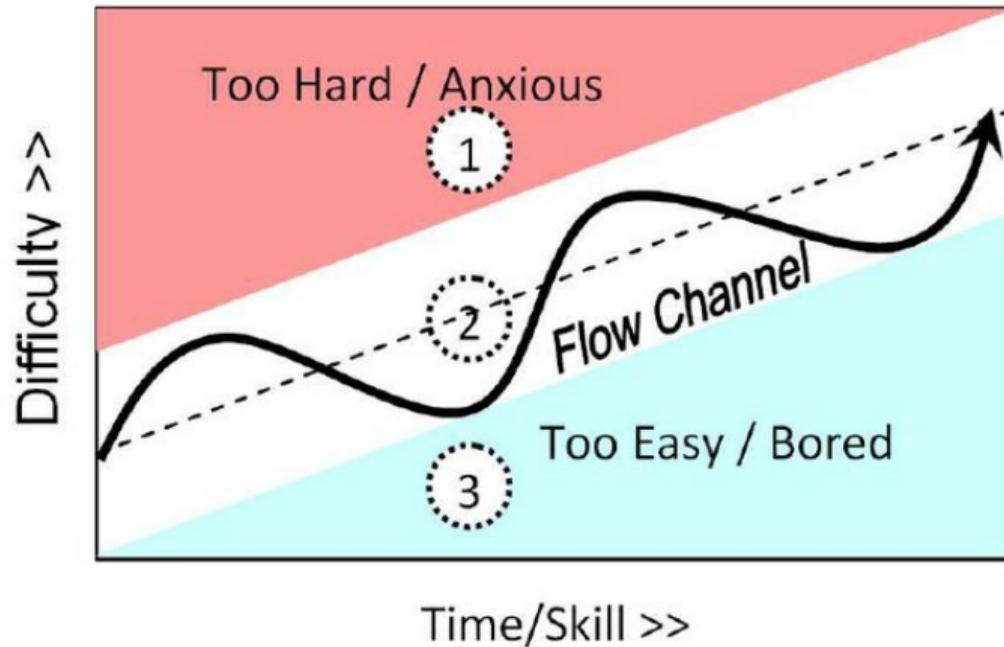
## Autotelic Learning Experience

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Núcleo de Excelência em Tecnologias Sociais

## Gamification and Intelligent Learning Environments From Theories to Evidences

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