



UNIVERSIDADE FEDERAL  
DE ALAGOAS

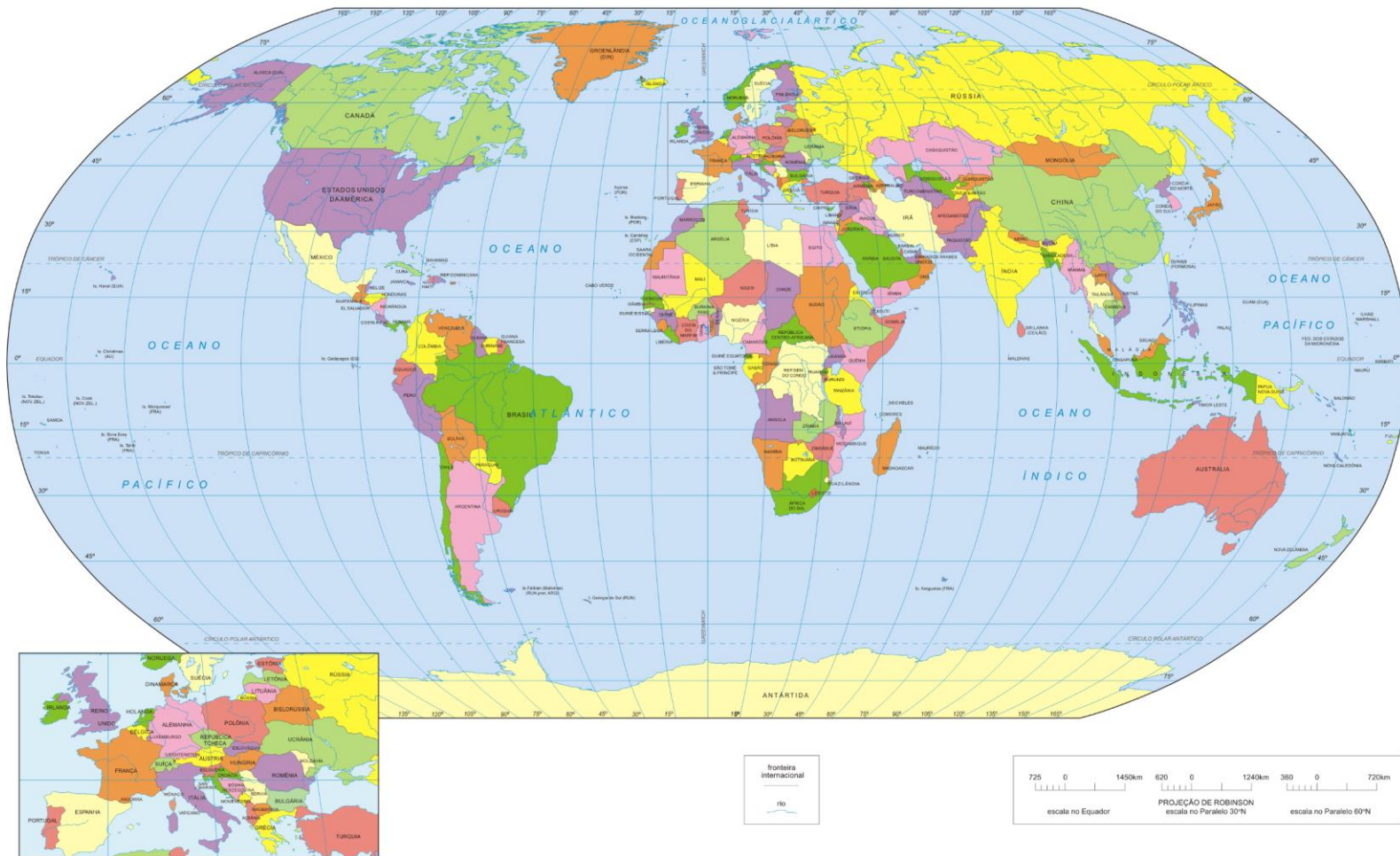
# The challenges of designing educational systems to promote an optimal learning experience



**NEES**  
Núcleo de Excelência em Tecnologias Sociais

Ig Ibert Bittencourt – [ig.ibert@ic.ufal.br](mailto:ig.ibert@ic.ufal.br)

# Planisfério Político



# BRAZIL





PE

AL

Recife

Recife  
1h30  
125km  
Maragogi

BR  
101SUL

PE  
60

- Porto de Galinhas
- Tamandaré
- S. José da Coroa Grande
- Peroba

Autocafé

Maragogi

Salinas do Maragogi

Maragogi  
1h30  
125km  
Maceió

AL  
101 NORTE

- Japaratinga
- Porto de Pedras
- São Miguel dos Milagres
- Sonho Verde

Ipióca

Salinas de Maceió

Ipióca  
20min  
18km  
Maceió

AEROPORTO / IPIÓCA  
40min / 38km

Maceió

AL  
101 NORTE

- Praia do Francês
- Praia do Gunga



**VEJA ONDE ESTÃO AS 10 MELHORES DICAS DE VIAGEM DE ALAGOAS**

**DISTÂNCIA ENTRE OS PRINCIPAIS ATRATIVOS E MACEIÓ**

Maragogi.....	131 km
Porto de Pedras.....	128 km
Passo de Camaragibe.....	89 km
Barra de Santo Antônio.....	45 km
Paripueira.....	36 km
Praia de Ipioca.....	22 km
Praia de Francês.....	20 km
Marechal Deodoro.....	30 km
Barra de São Miguel.....	35 km
Piaçabuçu.....	135 km
Penedo.....	160 km
Piranhas.....	280 km
Delmiro Gouveia.....	283 km



**SERGIPE**

**PERNAMBUCO**

**Serra da Barriga**

**Lagoas e Mares do Sul**

**Foz do Velho Chico**

*Costa dos Corais*



**Maceió, Alagoas, Brazil**



Maceió, Alagoas, Brazil



Bodega do Sertão, Maceió, Alagoas, Brazil





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# The challenges of designing educational systems to promote an optimal learning experience



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**General Motivation**

**Basic Theoretical Foundations**

**Designing for Optimal Experience**

**Challenges**

**Research Agenda**

**General Motivation**

**Basic Theoretical Foundations**

**Designing for Optimal Experience**

**Challenges**

**Research Agenda**

14<sup>th</sup> Century



14<sup>th</sup> Century



14<sup>th</sup> Century



14<sup>th</sup> Century



Few evolution in this area



1870 Paoli Classroom





Amor  
Se não há amor, não há fé, não há esperança.  
Onde há amor, há fé, há esperança, há vida.  
Nossa fé é de amor, não é de medo. Não é de desespero, é de amor. Não é de medo, é de amor. Não é de desespero, é de amor.  
Se não há amor, não há fé, não há esperança.







# Why students are usually disengaged in educational contexts ?

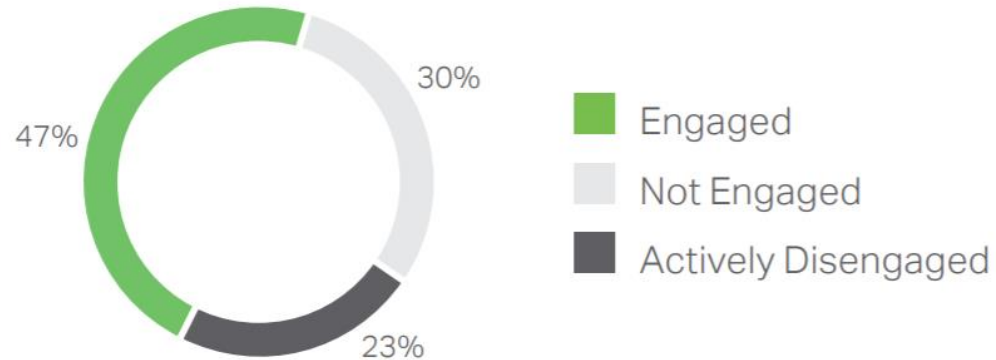


## Engagement

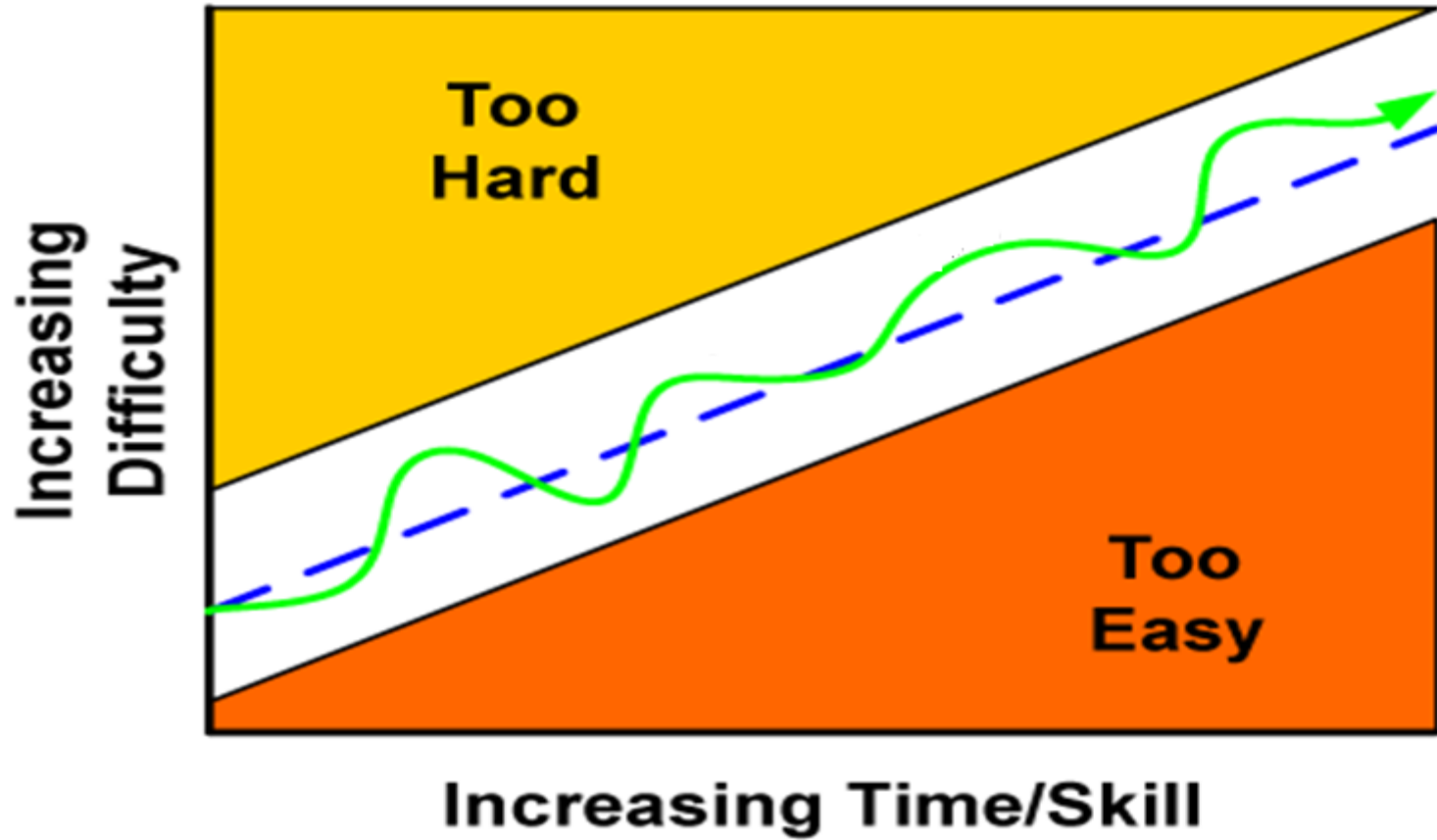
The Involvement in and Enthusiasm for School

### ENGAGEMENT INDEX

N=343,679



Gallup (2018). Gallup Student Poll: Engaged Today – Ready for Tomorrow. U.S. Overall. Fall 2018 Scorecard. 8pp





**General Motivation**

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**Challenges**

**Research Agenda**











<https://www.thefamouspeople.com/china.php>







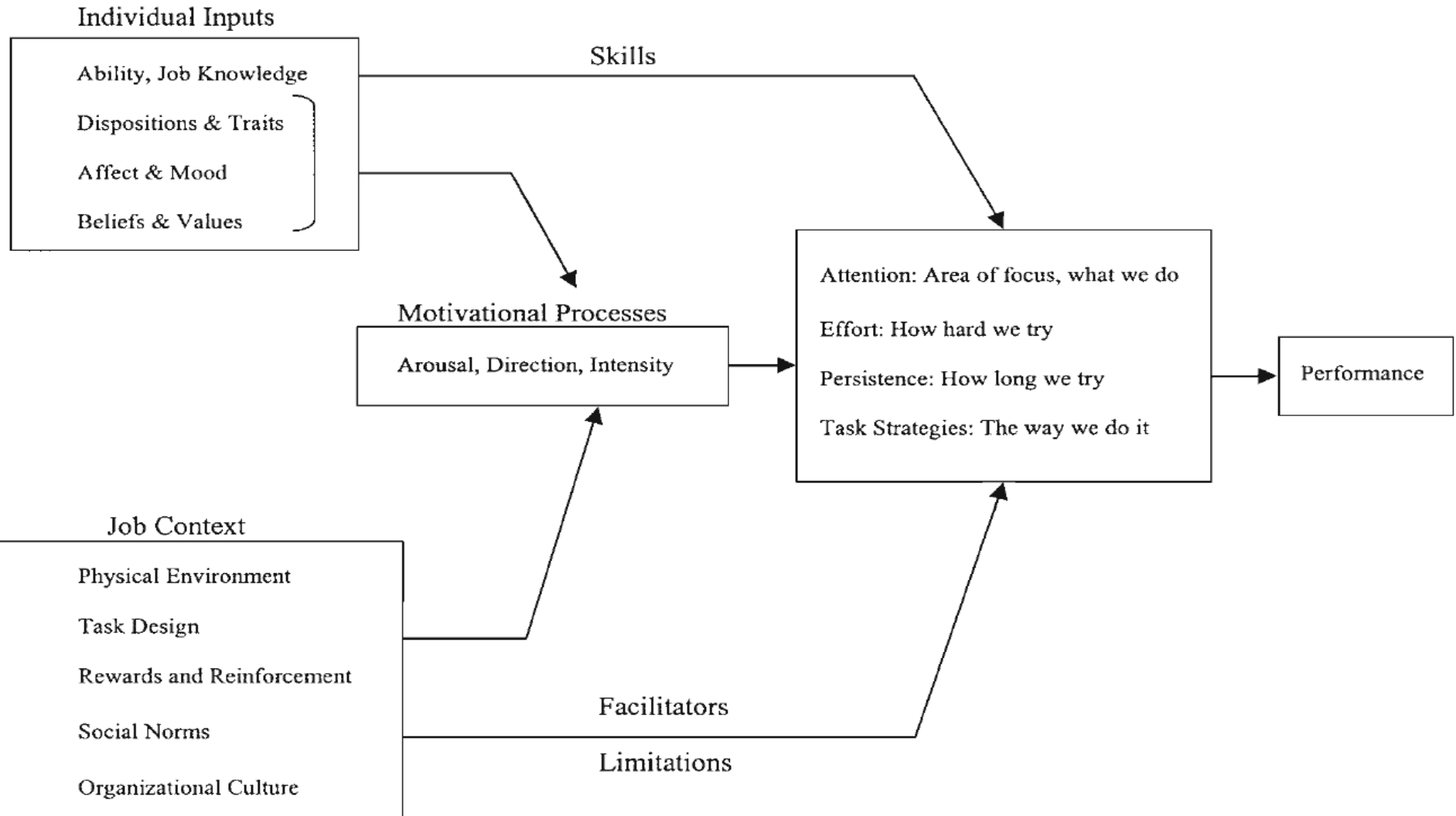
<https://asianmoviepulse.com/2012/11/zhang-ziyi-woman-of-many-talents/>



**What those people have in common ?**



# **Their Performance (and the way they perform)**

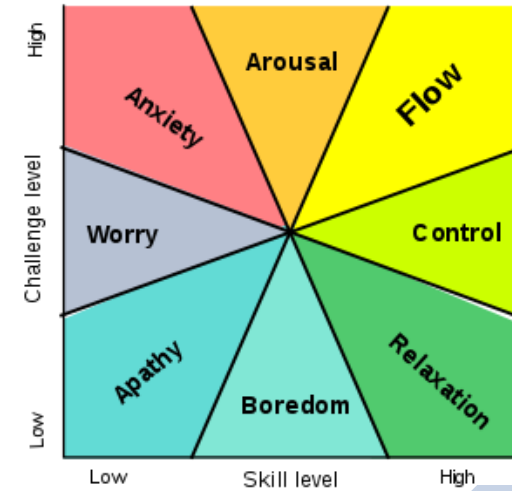
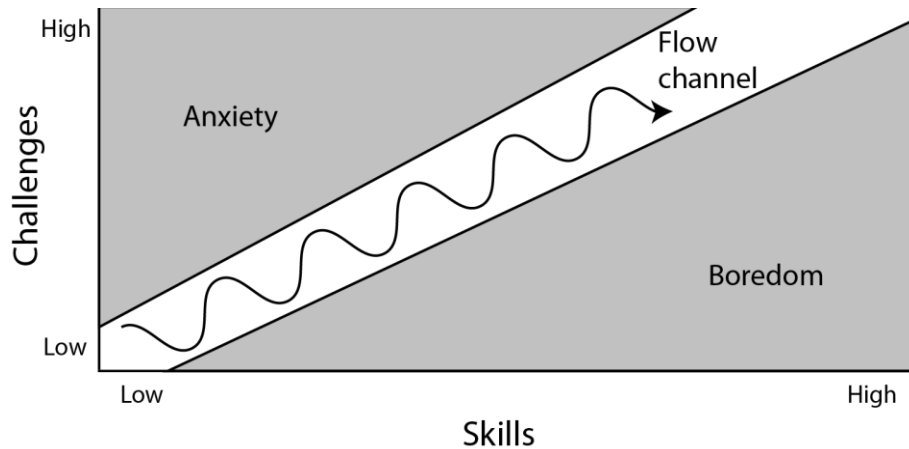






# Flow Theory: The Theory of Optimal Experience

- Flow represents those moments when everything comes together for the performer
- Flow is often associated with high levels of performance and is a positive psychological experience









# Flow Theory: The Theory of Optimal Experience

**Engagement:** Initial Interest (caused  
*initially by curiosity*)

**Absorption:** Continuous Interest (often caused *by challenge and fantasy*)

**Total Immersion:** Optimal Experience  
(*Flow Experience*)



# Flow Theory: The Theory of Optimal Experience



(1) Challenge-skill balance



(2) Clear Goals



(3) Unambiguous feedback



(4) Action-awareness merging



(5) Total concentration on the task at hand



(6) Sense of control



(7) Loss of self-consciousness



(8) Transformation of time



(9) Autotelic experience



**General Motivation**

**Basic Theoretical Foundations**

**Designing for Optimal Experience**

**Challenges**

**Research Agenda**



# Flow Theory: The Theory of Optimal Experience



(1) Challenge-skill balance



(2) Clear Goals



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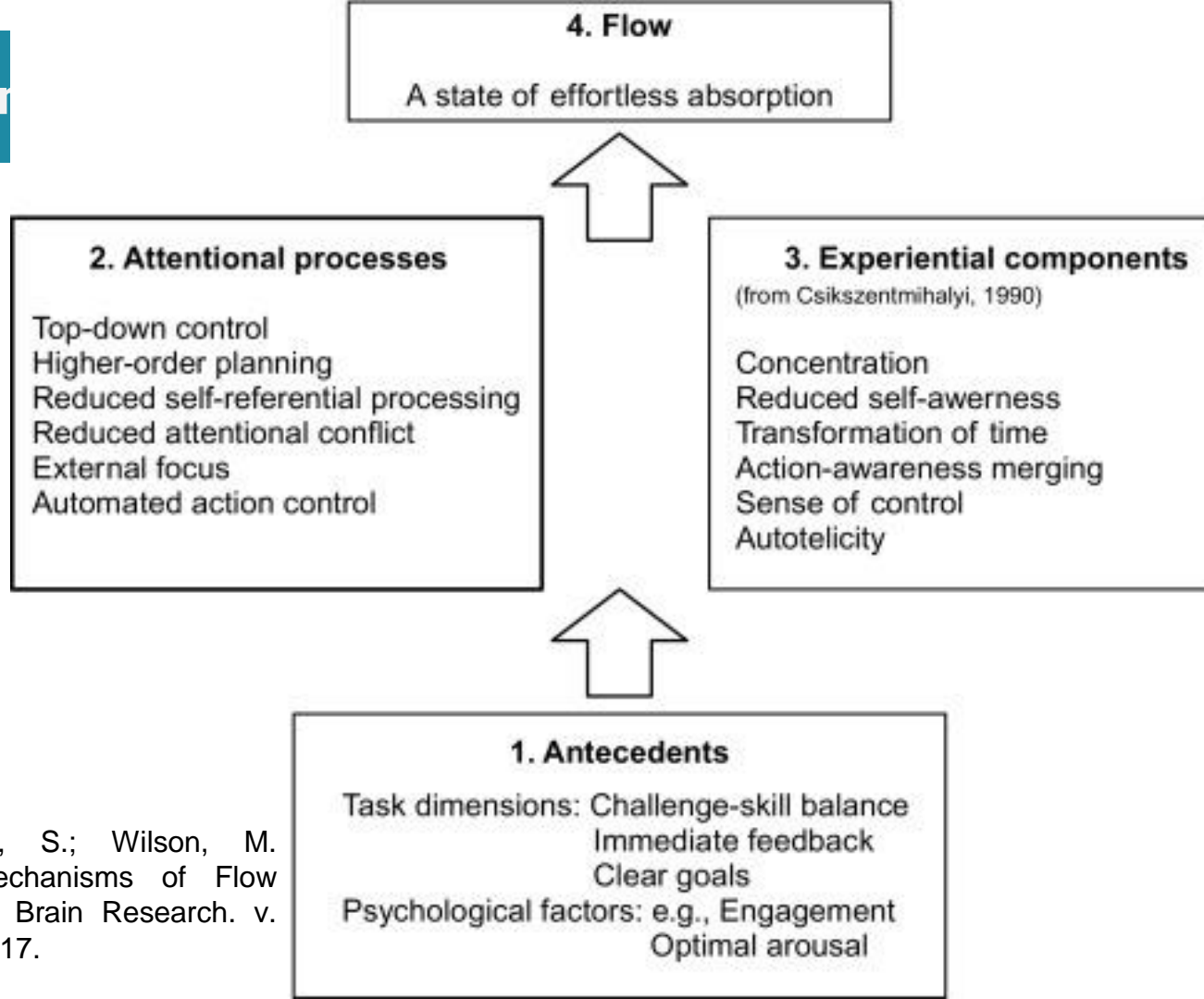
(7) Loss of self-consciousness



(8) Transformation of time



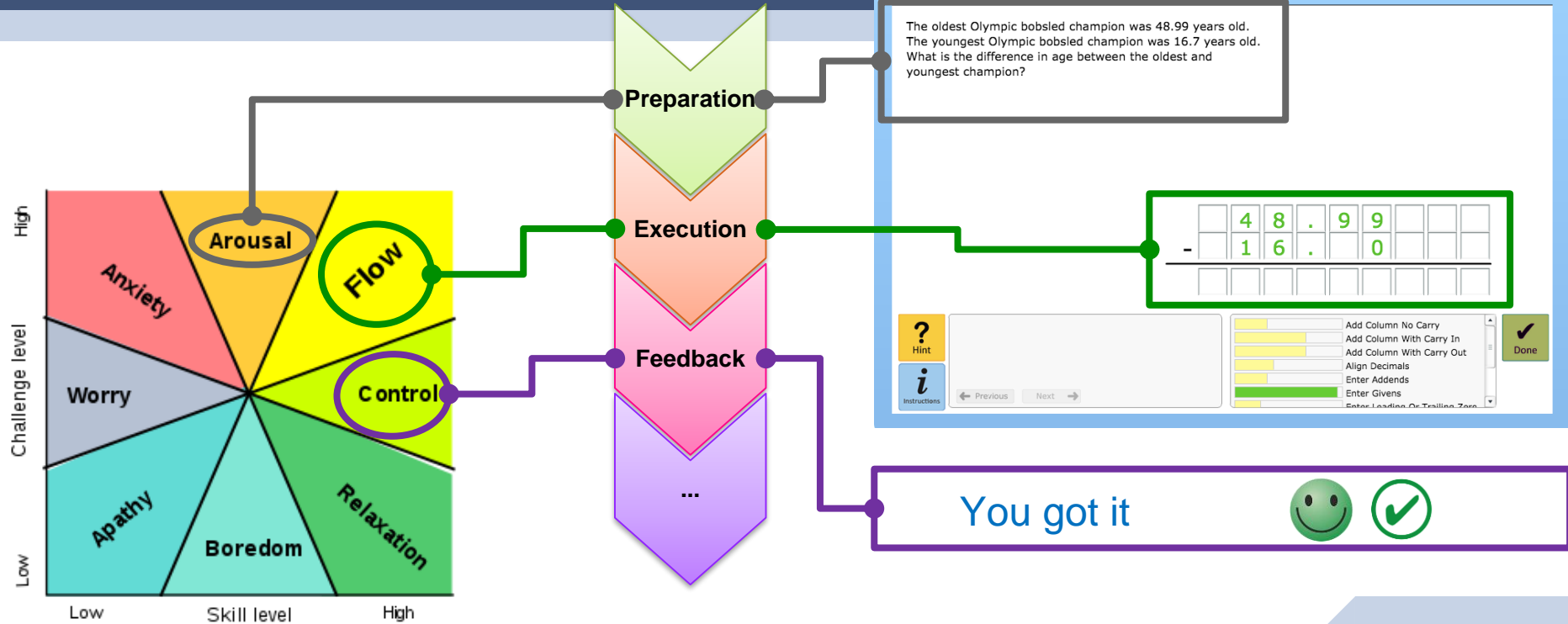
(9) Autotelic experience

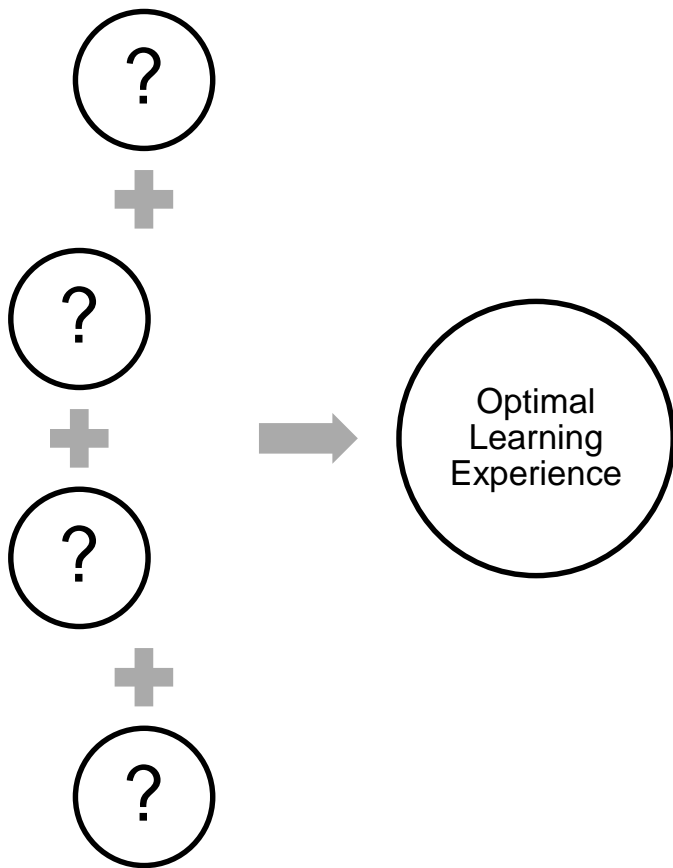






# Flow Theory: Decomposing the learning process into learning scenarios and stages

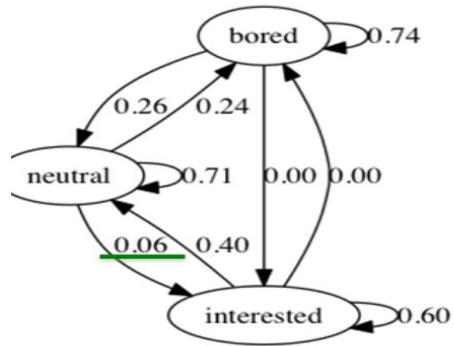




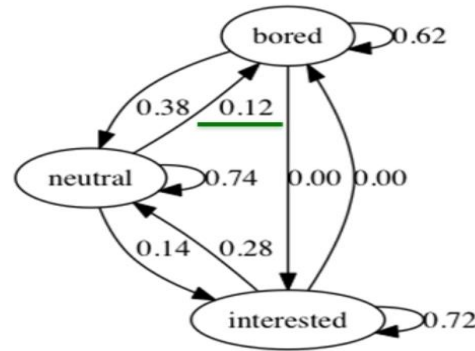


# Affective, Cognitive and Metacognitive approaches

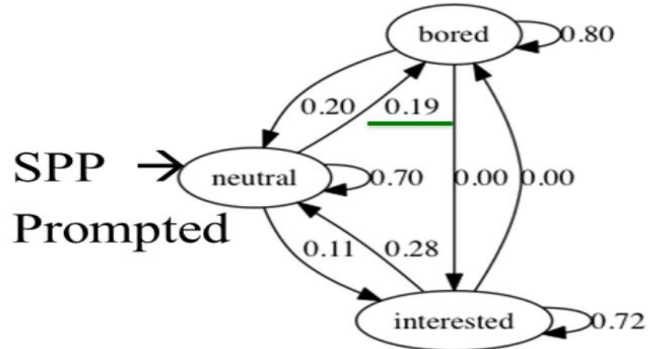
Student Interest • Ten thousand Data Points N~230



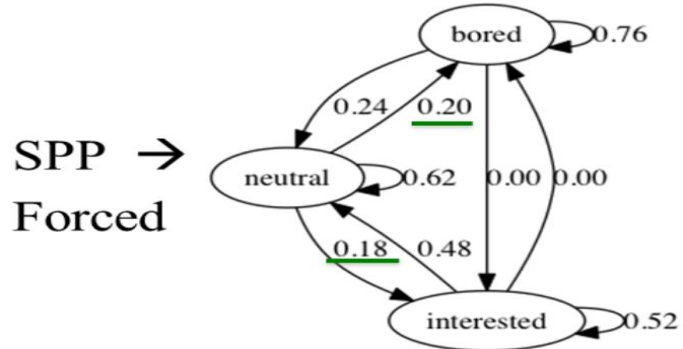
← SPP  
Absent



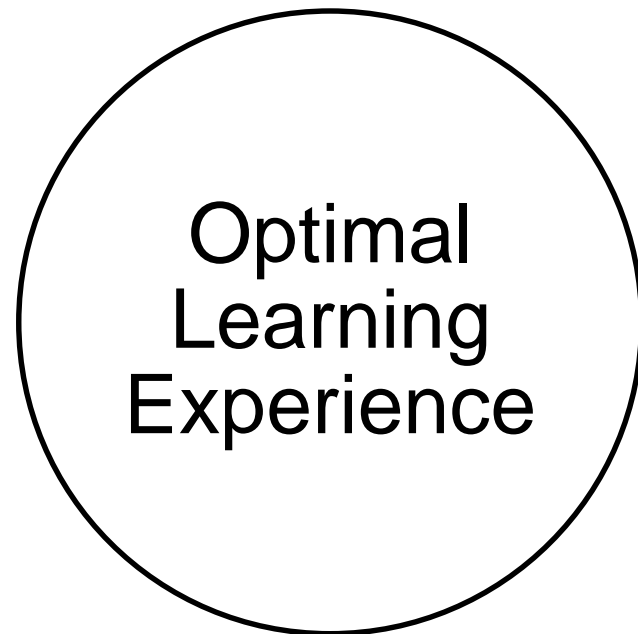
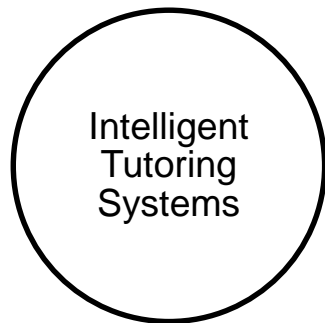
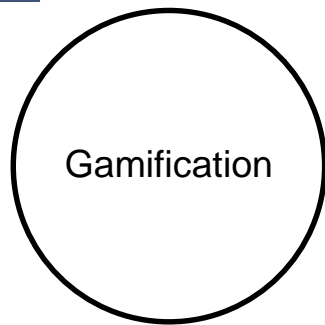
← SPP  
Present

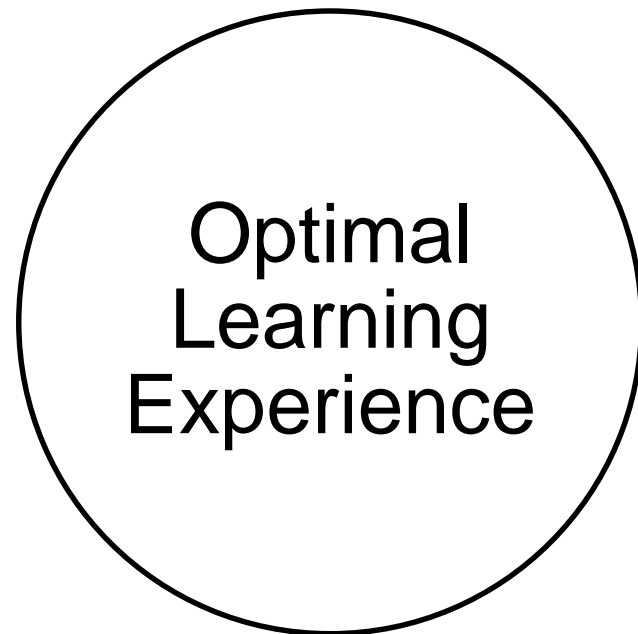
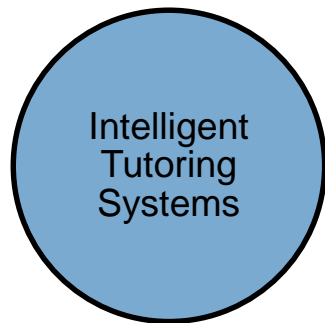
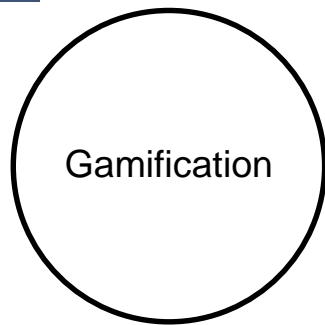


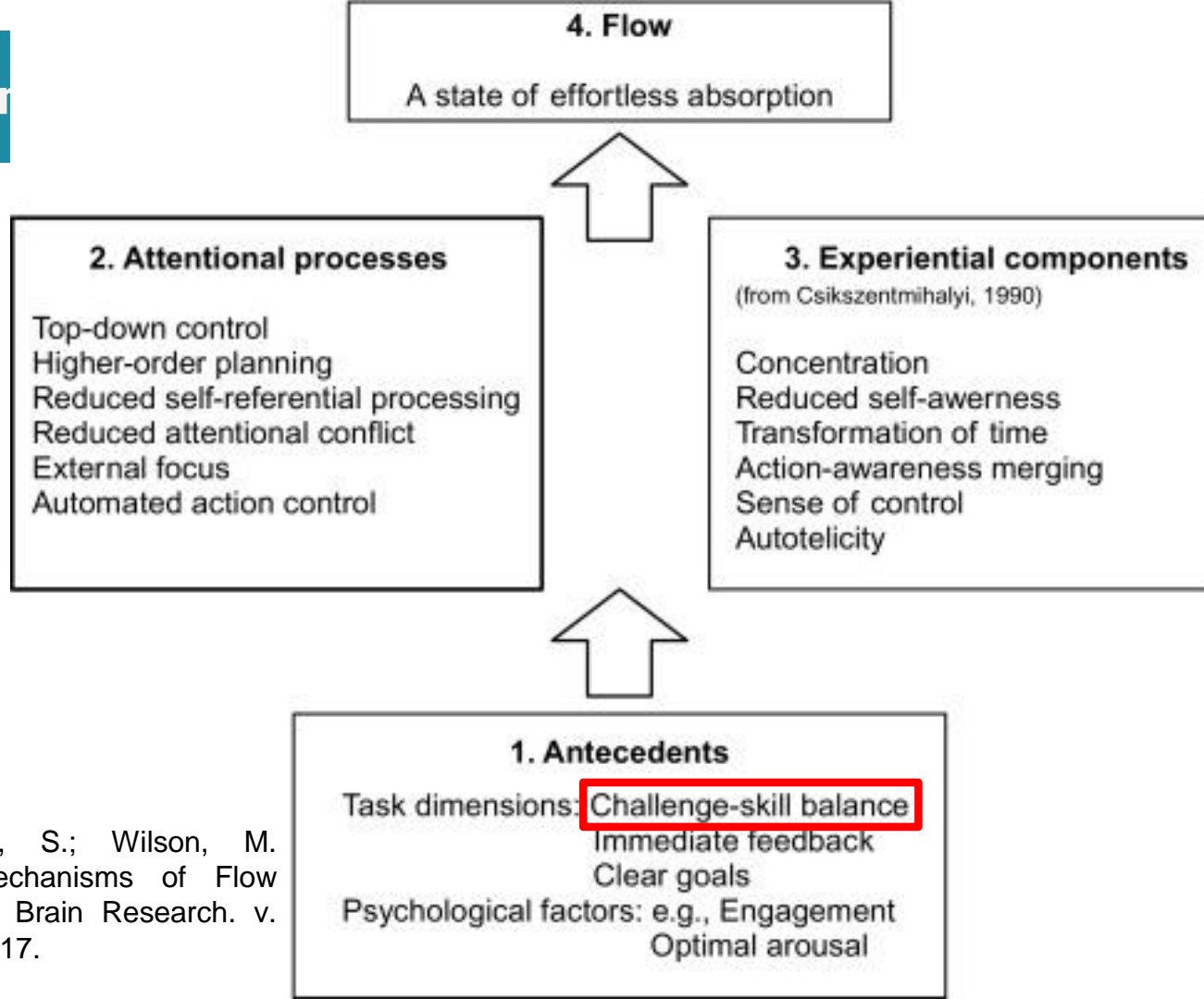
SPP →  
Prompted



SPP →  
Forced



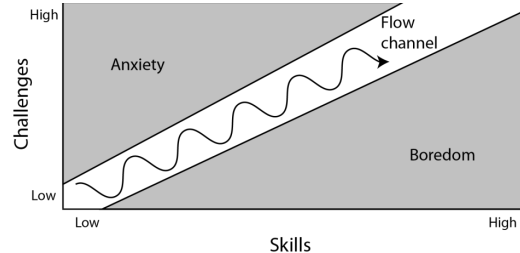


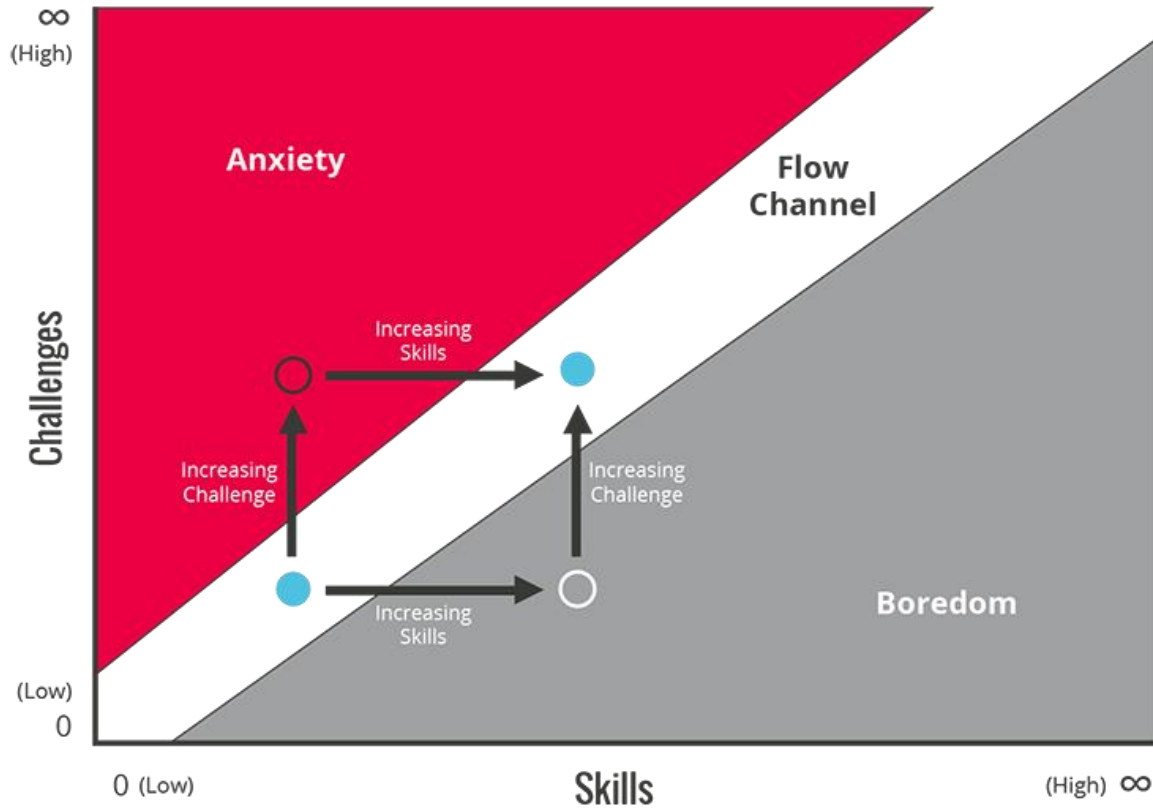




# Why Intelligent Tutoring Systems ?

- The concept of challenge-skill balance is crucial to the definition of flow
- Flow occurs only when the individual moves beyond his or her average experience of challenge and skill
- When the perceived challenges are matched by a belief in having the skills to meet the challenge, the stage is set for flow to occur





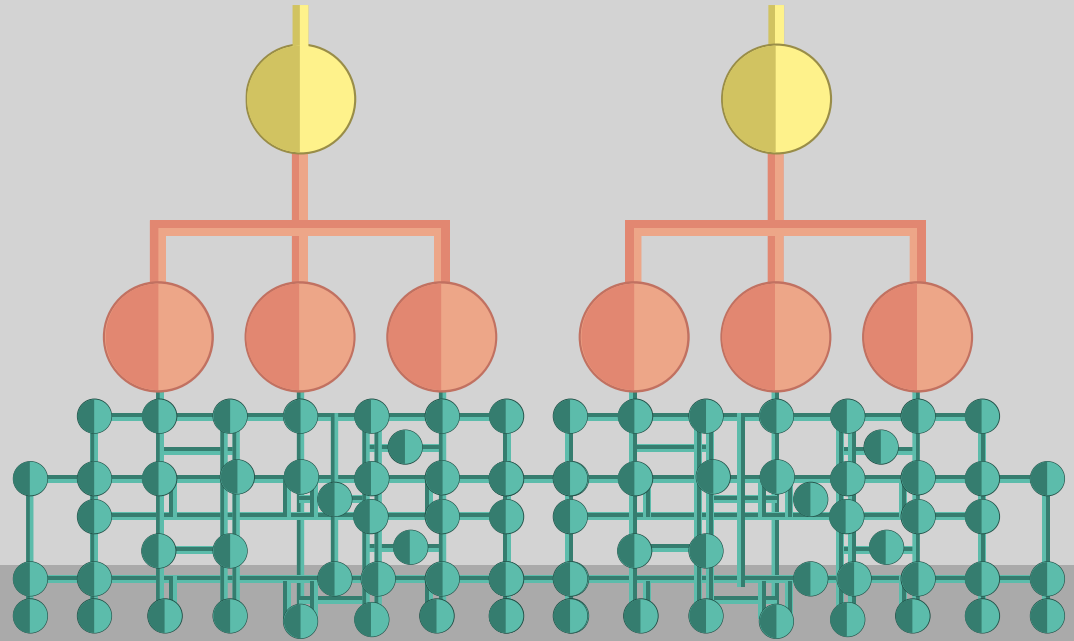
Mihaly Csikszentmihalyi, Flow Channel, Adapted from 1990 Flow: The Psychology of Optimal Experience

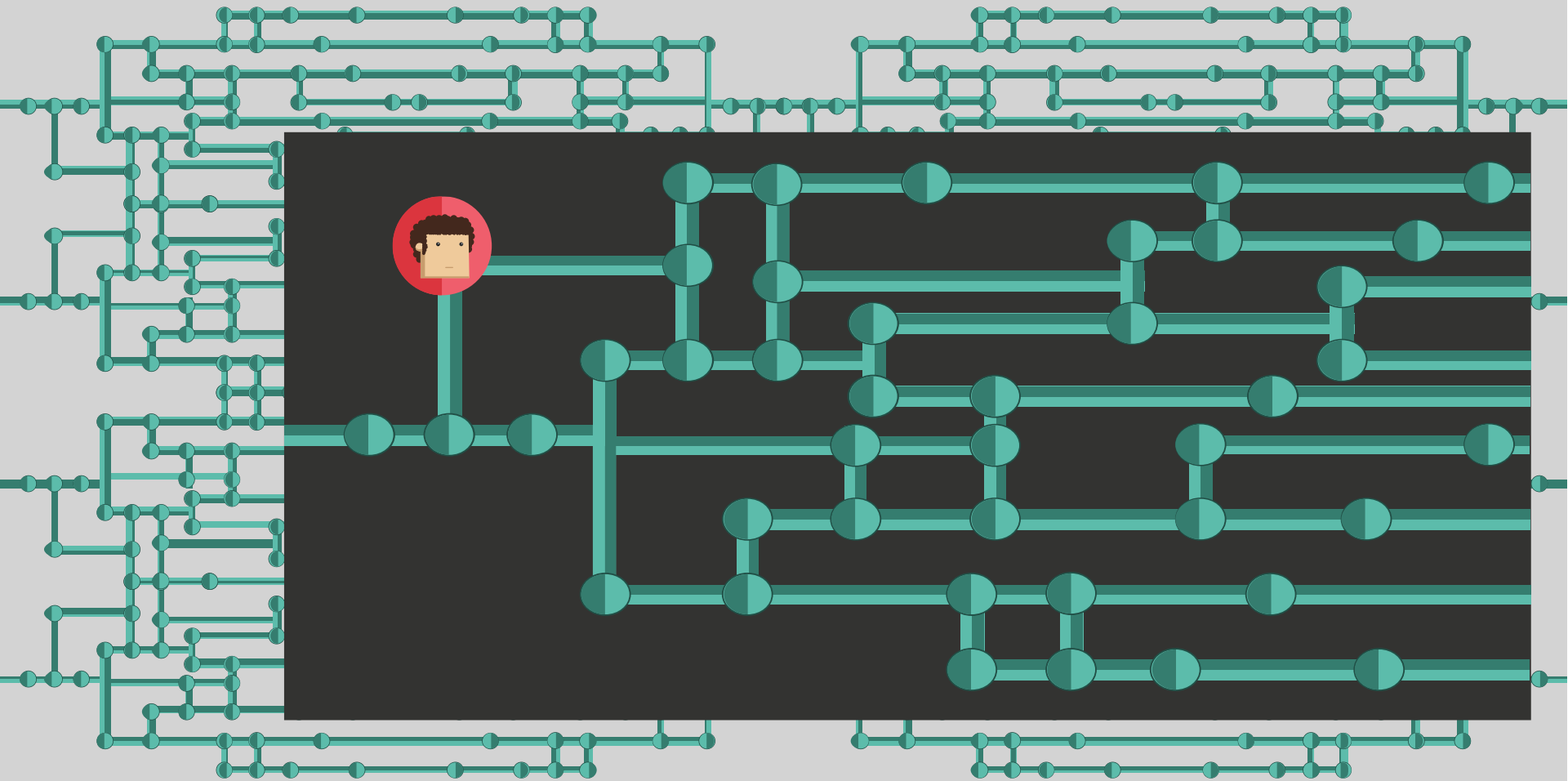


Course

Subjects

Skills







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.

1 2 3 4 5 6 7 8 9 10
✖

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

How many children and adults were at the concert?

Number of children =

Number of adults =

Yes, indeed! So how many people is ONE unknown part?

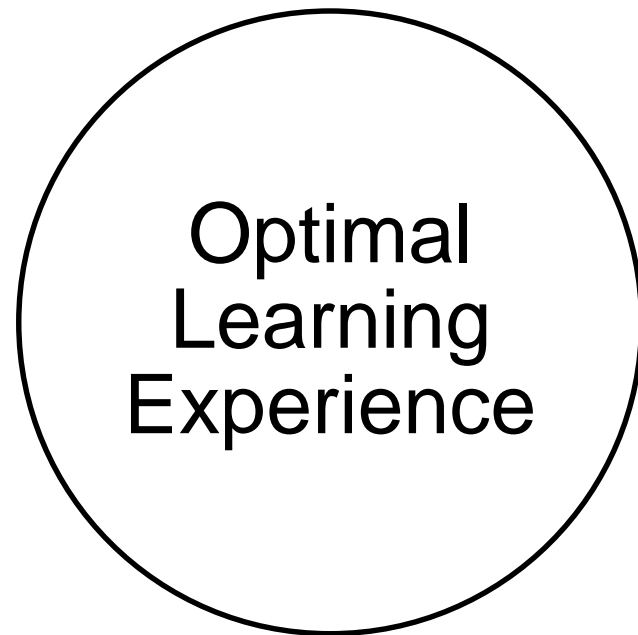
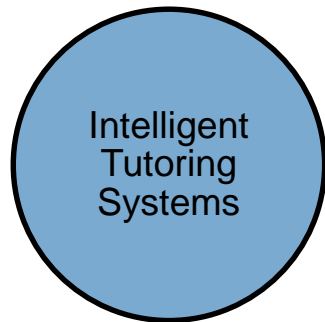
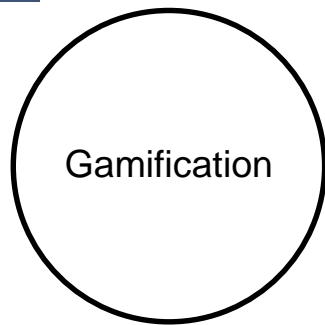
?  
Hint

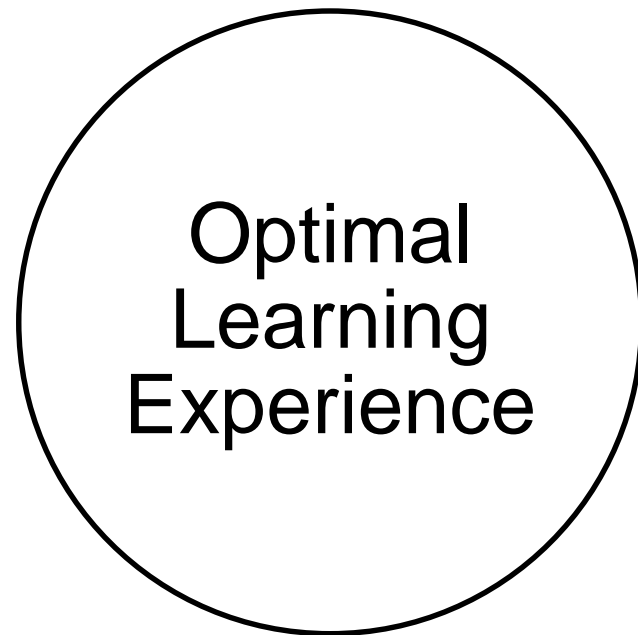
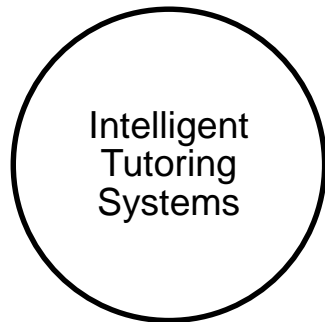
If two parts together are 12 people, how many people would one part be?

← Previous
Next →

■	<input type="text"/>		Find Sum of Parts
■	<input type="text"/>		Identify Given Values
■	<input type="text"/>		Identify Unknown Part
■	<input type="text"/>		Interpret Representations
■	<input type="text"/>		Set-up Equation
■	<input type="text"/>		Solve Equation

✓  
Done







## Why Gamification ?

**Engagement:** Initial Interest (caused  
*initially by curiosity*)

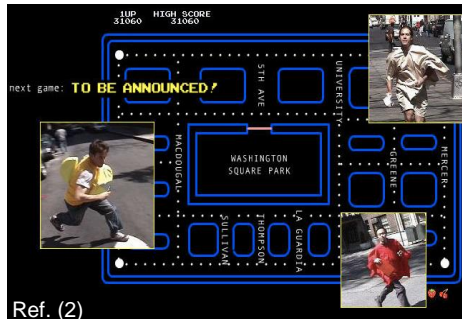
**Absorption:** Continuous Interest (often caused *by challenge and fantasy*)

**Total Imersion:** Optimal Experience  
(*Flow Experience*)

# Ludus

## Gamification

### Serious Games



### Play

### Playful design

# Paidia

Whole

Part

1. Photo (<https://goo.gl/R4fAwA>) by Serious-Game.fr/CC 2.0
2. Photo (<https://goo.gl/aAHg1t>) © pacmanhattan.com
3. Photo (<https://flic.kr/p/51xSd1>) by Chris Messina/CC BY-NC-SA 2.0



*“the use of **game design elements** in nongame contexts”*

(Deterding, Dixon, Khaled, & Nacke, 2011)

*“Gamification is not itself a product; one [a teacher] does not create a gamification as one creates a game. Instead, one [a teacher] adds game elements to change a process that already exists to change how that process influences people”<sup>1</sup>*

<sup>1</sup>Gamification Science, Its History and Future: Definitions and a Research Agenda

Richard N. Landers, Elena M. Auer, Andrew B. Collmus, and Michael B. Armstrong

The image shows a screenshot of the Duolingo Spanish progress page. The interface includes a blue header with the Duolingo logo and navigation links (Home, Words, Activity, Discussion, Immersion). The user's profile 'Roy\_Stripling' is visible with a Spanish flag, a fire icon, a shield icon with '112', and a bell icon. The main content area is titled 'Spanish skills' and features a 'Start next lesson' button. Below this is a 'Lingot store' button and several skill icons: Basics 1, Phrases, Basics 2, Food, Animals, and Plurals. On the right side, the 'Spanish progress' section shows a progress bar from 10 to 11, a '2353 XP' badge, and a '409 Words' badge. A 'Strengthen skills' button is also present. At the bottom right, a 'Leaderboard' section shows the user's name 'Roy\_Stripling' and '2353 XP'.

duolingo Home Words Activity Discussion Immersion Roy\_Stripling 0 112

Spanish skills Start next lesson

Lingot store

Basics 1

Phrases Basics 2

Food Animals Plurals

Spanish progress

10 11

2353 XP W 409 Words

Strengthen skills

Leaderboard

This week This month All time

Roy\_Stripling 2353 XP

Progress Bar

Points

Leaderboard





Olavo Holanda

- 5 Seguindo
- 4 Seguidores
- 2 Mensagens

# ENEM



1060 Pontos ganhos

6 Troféus ganhos

95%



Pontos: 1060 de 1112 para o nível 2

## DISCIPLINAS

Clique na disciplina para iniciar seus estudos

**Matemática**

3 72% 4

EM BREVE PORTUGUÊS EM BREVE

EM BREVE FÍSICA EM BREVE

EM BREVE QUÍMICA EM BREVE

EM BREVE BIOLOGIA EM BREVE

EM BREVE GEOGRAFIA EM BREVE

EM BREVE LITERATURA EM BREVE

EM BREVE HISTÓRIA EM BREVE

EM BREVE ESPANHOL EM BREVE

EM BREVE INGLÊS EM BREVE

## 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

Mais Missões

Atualizar

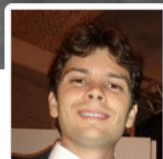
## RANKING

1º



Wilkson  
Nível 3

2855 pts



Olavo Holanda

9 Amigos

Centro De Estudos  
Psicopedagogicos

Maceió - AL



2647 Pontos ganhos

10 Troféus ganhos

Pontos: 2647

### Sugestão MeuTutor

Missão 4722

94

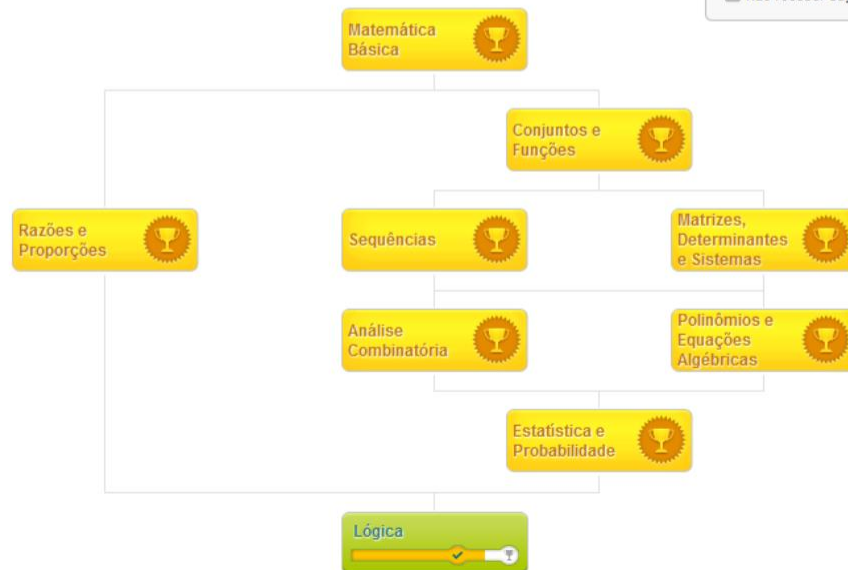
Avaliar 8 conteúdos da disciplina  
Matemática 0/8  
Assistir 7 vídeos na disciplina Matemática 0/7

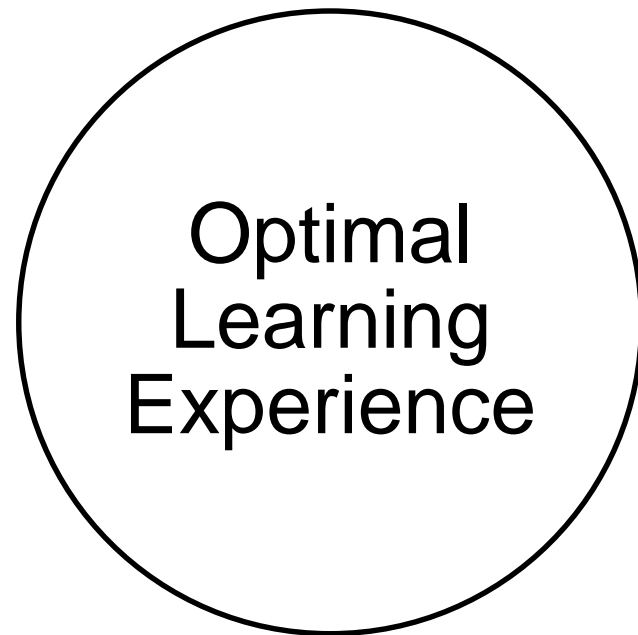
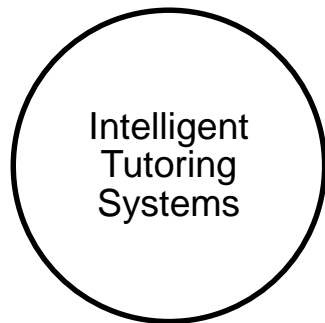
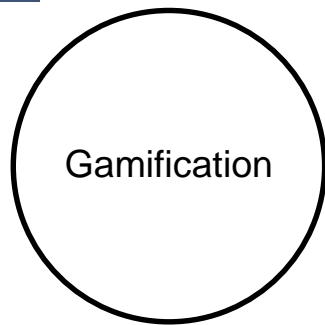
ACEITAR MISSÃO

Não receber sugestões de missões durante essa sessão

## MATEMÁTICA

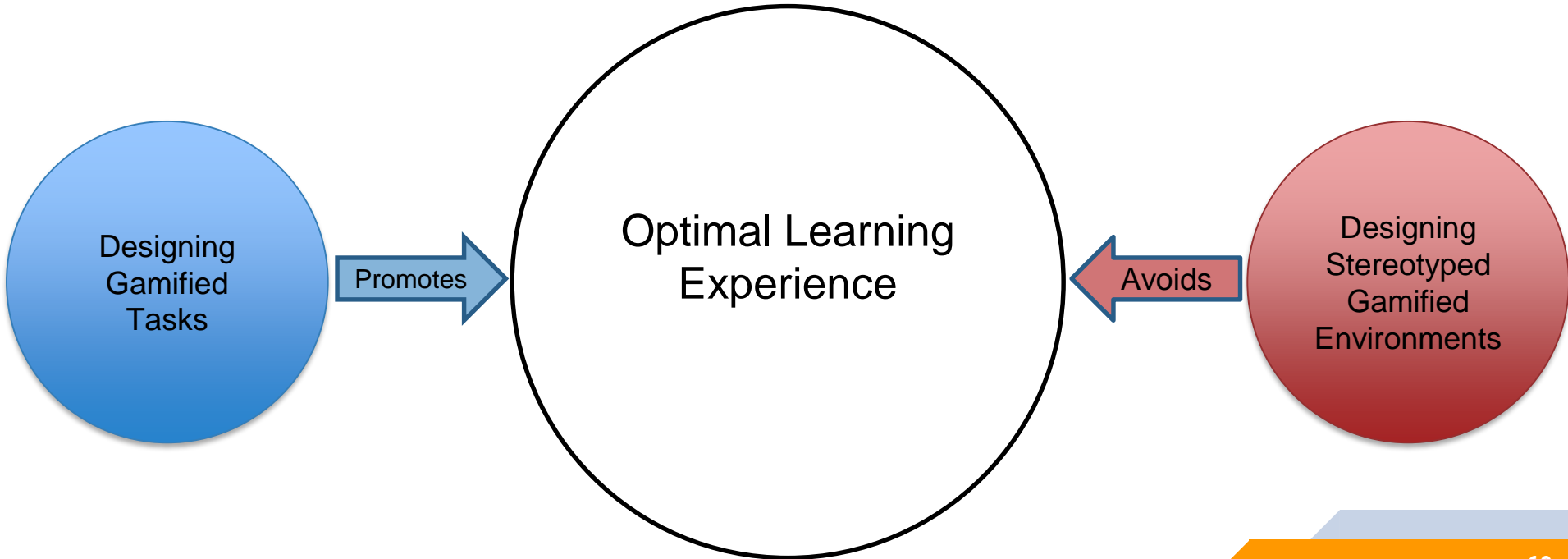
Clique no assunto para iniciar seus estudos





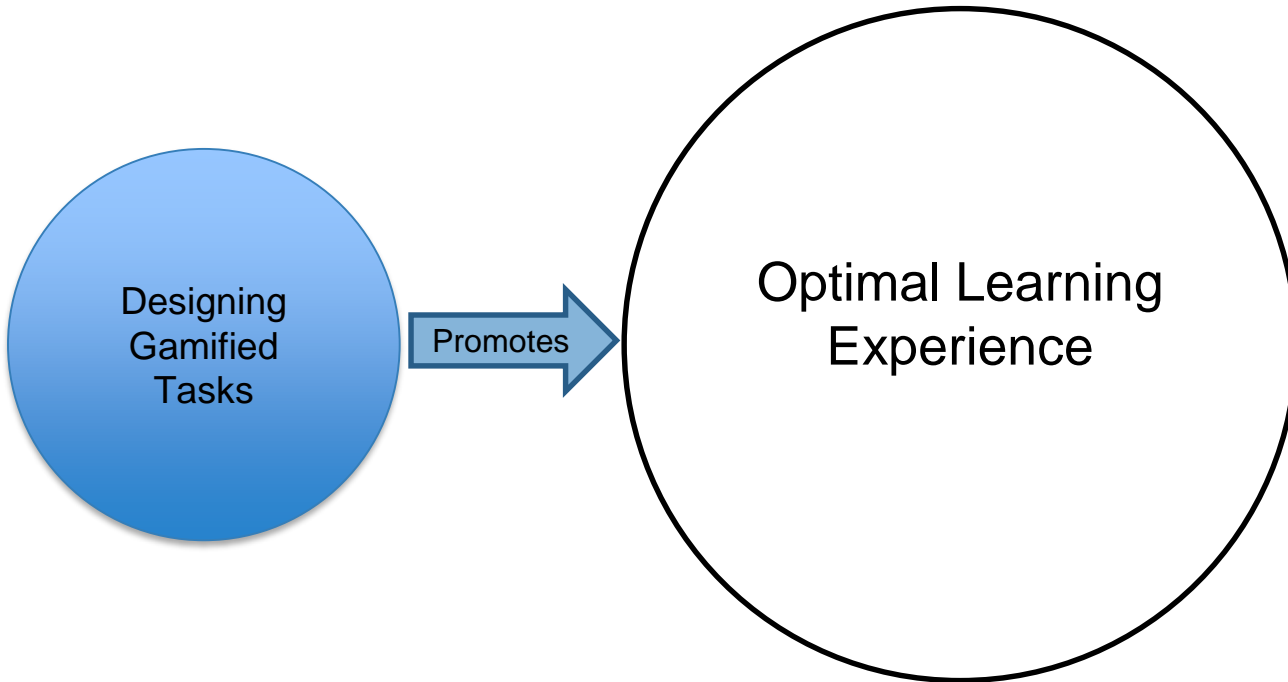


## How to tackle the problem ?





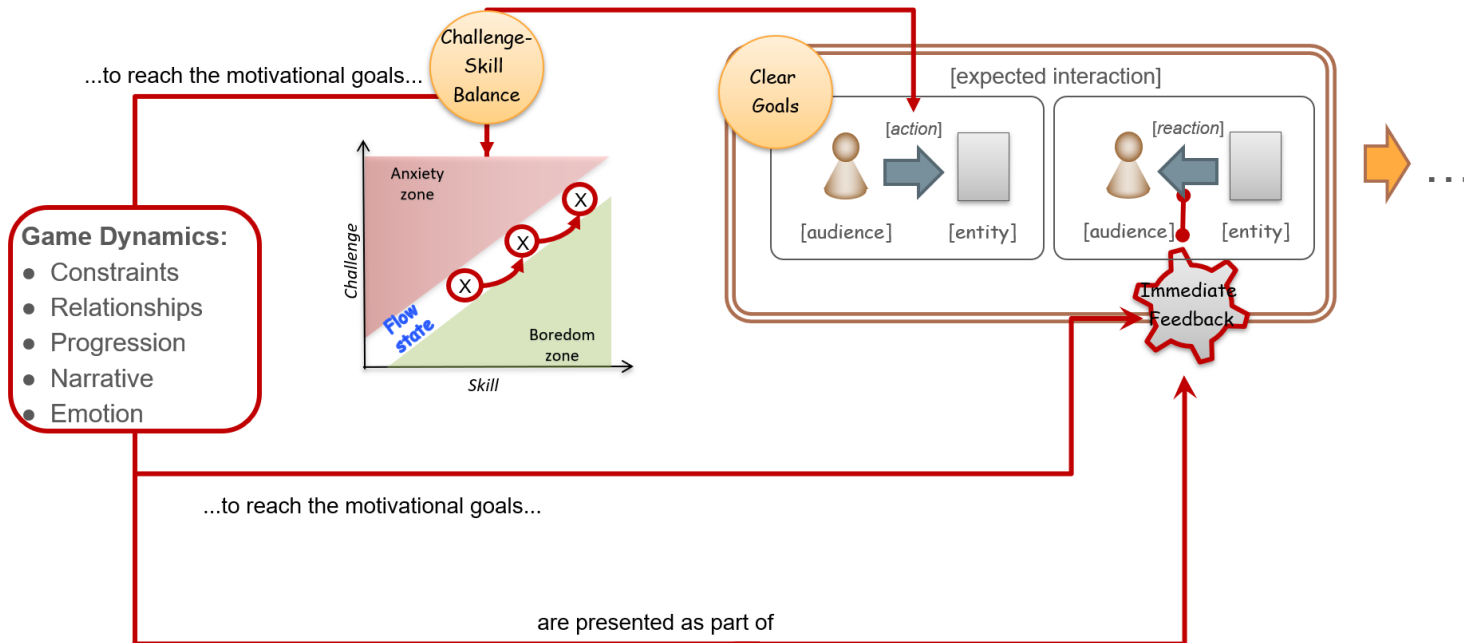
## How to tackle the problem ?



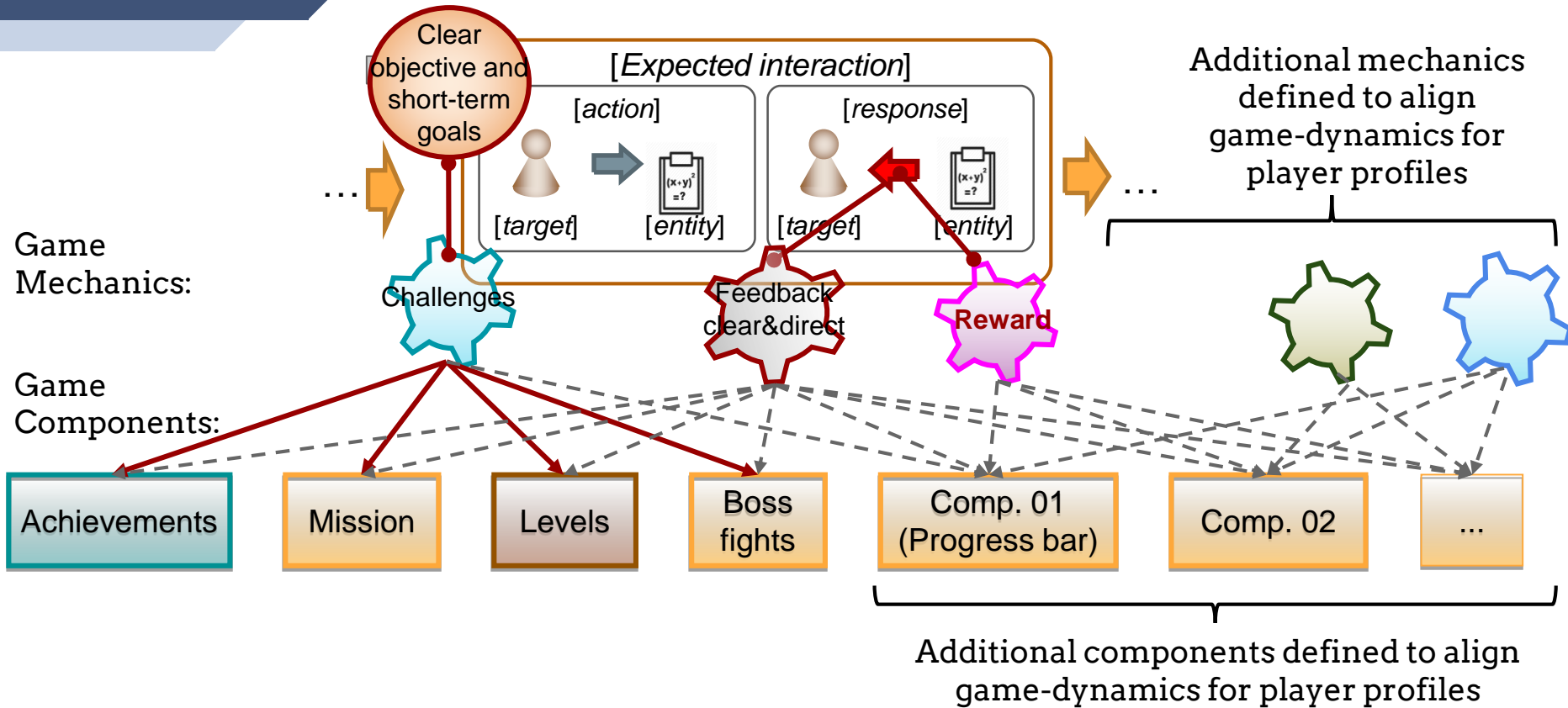


# Designing gamified tasks to achieve Flow - GamiFlow

## Designing the Expected-behavior

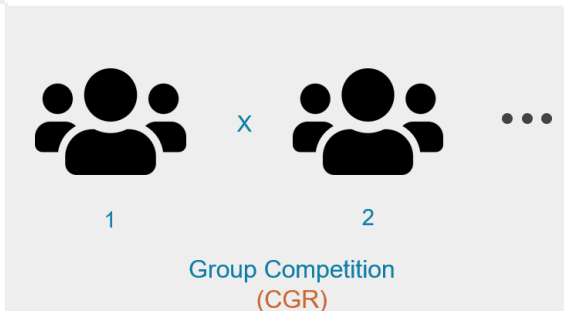
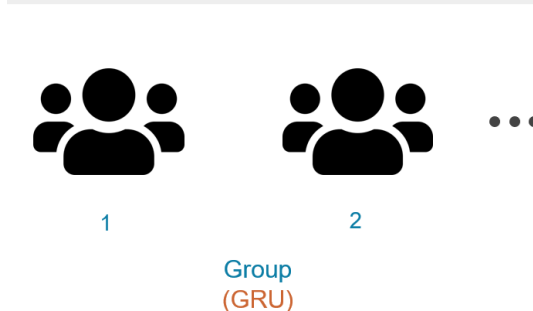
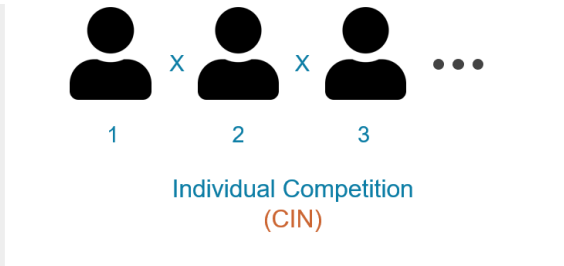
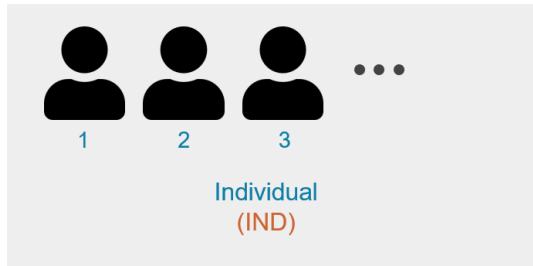
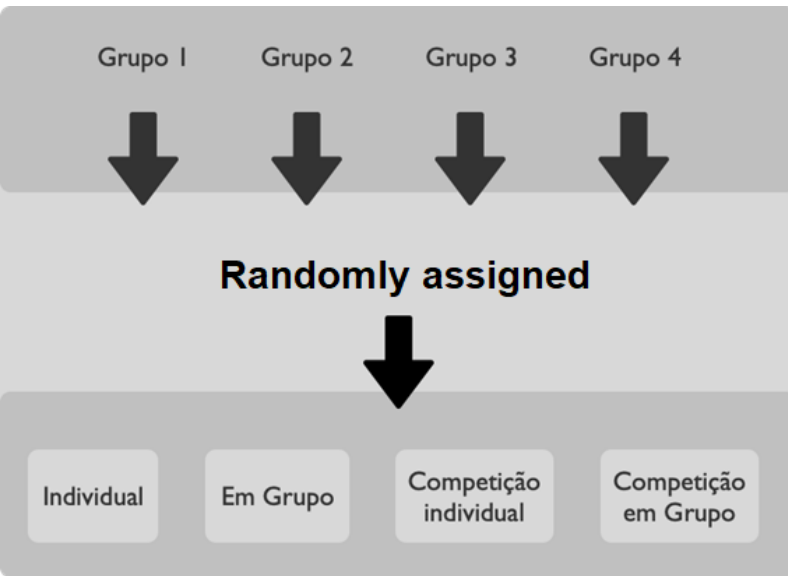








# Designing gamified tasks to achieve Flow





# Designing gamified tasks to achieve Flow



Jogo Experimental

COMEÇAR

## Dados pessoais

Usuário

Sugestão: use sua matrícula

Nome

Data de Nascimento

Sexo  
Escolha um opção

REGISTRAR



Aguardando os seus colegas.

Escolha uma foto para você

TIRAR FOTO



## Designing gamified tasks to achieve Flow



Pergunta



Resposta



Resultado



Desafios

x34



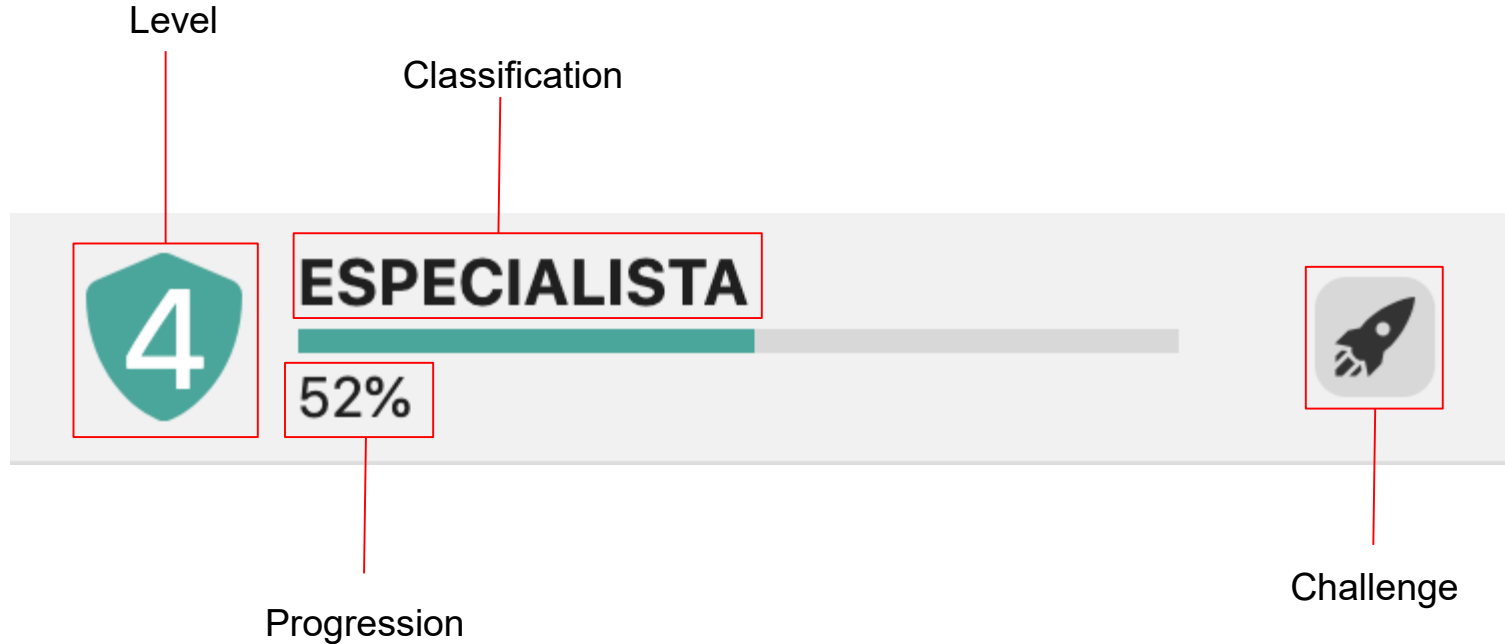
## Designing gamified tasks to achieve Flow - Context

The image displays four sequential screens from a mobile application, illustrating different stages of a gamified task:

- Screen 1 (Challenge):** Titled "Novo desafio!!" (New challenge!!). It informs the user they have "Conseguido o primeiro acerto" (Achieved the first correct answer) and offers "1 pts" (1 point). A "CONTINUAR" (Continue) button is visible at the bottom.
- Screen 2 (Question):** Shows a progress bar for "NOVATO" at 0%. The question is "Qual a cor do cavalo branco de napoleão?" (What is the color of Napoleon's white horse?). The options are:
  - Azul (Blue)
  - Verde (Green)
  - Amarelo (Yellow)
  - Branco (White)
  - Cinza (Grey)A "RESPONDER" (Answer) button is at the bottom.
- Screen 3 (Success):** Shows a progress bar for "ESPECIALISTA" at 52%. It features a green thumbs-up icon and the text "Parabéns! Você acertou" (Congratulations! You got it right). A "CONTINUAR" (Continue) button is at the bottom.
- Screen 4 (Failure):** Shows a progress bar for "ESPECIALISTA" at 52%. It features a red thumbs-down icon and the text "Que pena! Não foi dessa vez." (What a pity! It wasn't this time). A "CONTINUAR" (Continue) button is at the bottom.



## Designing gamified tasks to achieve Flow - Dynamics





# Designing gamified tasks to achieve Flow - Competition

**4 ESPECIALISTA**  
45 pts - 52%

Questão:

Qual a cor do cavalo branco de napoleão?

- Azul
- Verde
- Amarelo
- Branco
- Cinza

RESPONDER

**2 INICIANTE**  
8 pts - 10%

Alexandre (45 pts)

Joana (40 pts)

Marcos (30 pts)

João (30 pts)

José (26 pts)

Diogo (19 pts)

Márcio (12 pts)

Vanessa (11 pts)

Bruno



# Designing gamified tasks to achieve Flow - Collaboration

1 NOVATO 0%

Conheça o seu grupo:

Roberto Bernardes  
João da Silva  
Fabiano Falcão

Vocês deverão colaborar para realizar as atividades, portanto se aproximem.

CONTINUAR

1 NOVATO 0%

Questão:

Qual a cor do cavalo branco de napoleão?

- Azul
- Verde
- Amarelo
- Branco
- Cinza

RESPONDER

1 NOVATO 0%



Ajude a Roberto Bernardes responder a próxima questão.





## Designing gamified tasks to achieve Flow - Questionnaire

Responda as perguntas abaixo de acordo com a sua experiência durante o jogo.

Eu me sinto desafiado(a), mas acredito que minhas habilidades vão me permitir enfrentar o desafio.

Discordo                      Neutro                      Concordo

1   2   3   4   5

Eu faço os movimentos corretos sem pensar em como fazê-los

Discordo                      Neutro                      Concordo

1   2   3   4   5

Eu sei exatamente o que quero fazer.

Discordo                      Neutro                      Concordo

1   2   3   4   5

É muito claro para mim como está meu desempenho.



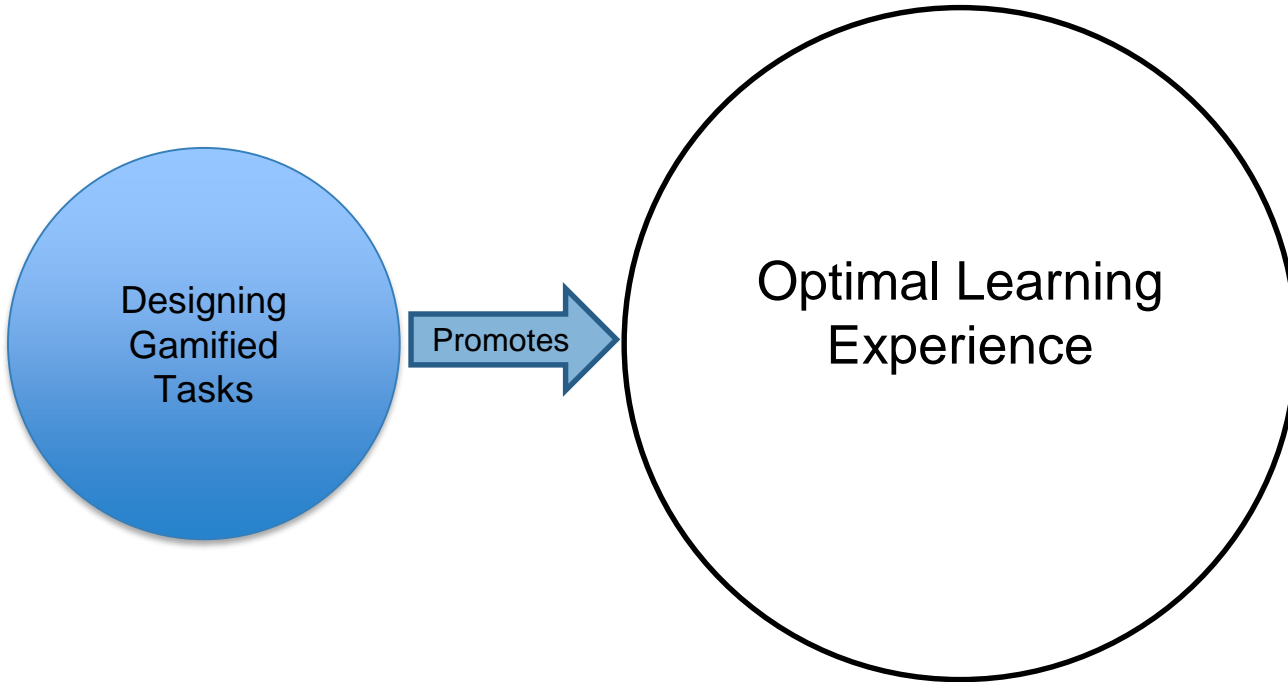


## Designing gamified tasks to achieve Flow

- Competition ( $p = .171$ ) and Collaboration ( $p = .358$ ) does not affect the flow experience
- **Interaction of Competition and Collaboration promotes the flow experience ( $p = .008$ )**
- Competition lead students to more answers and errors
- No correlation between Player Types and Flow Experience

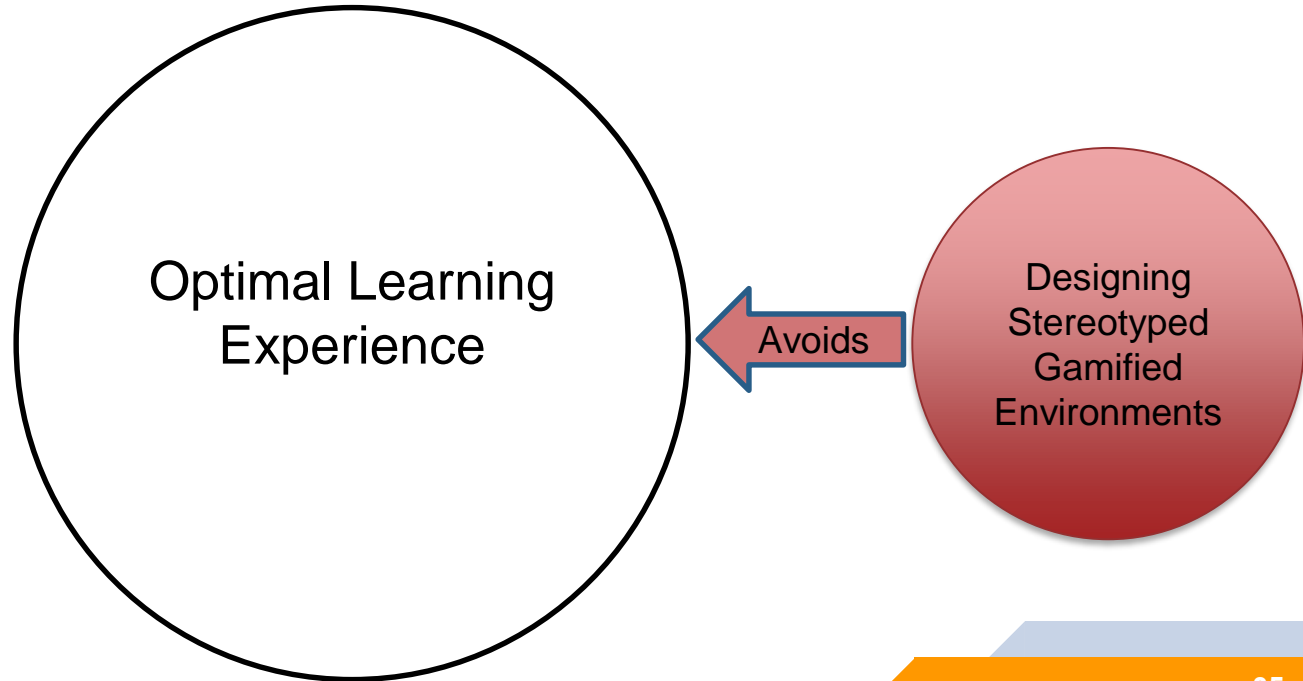


## How to tackle the problem ?



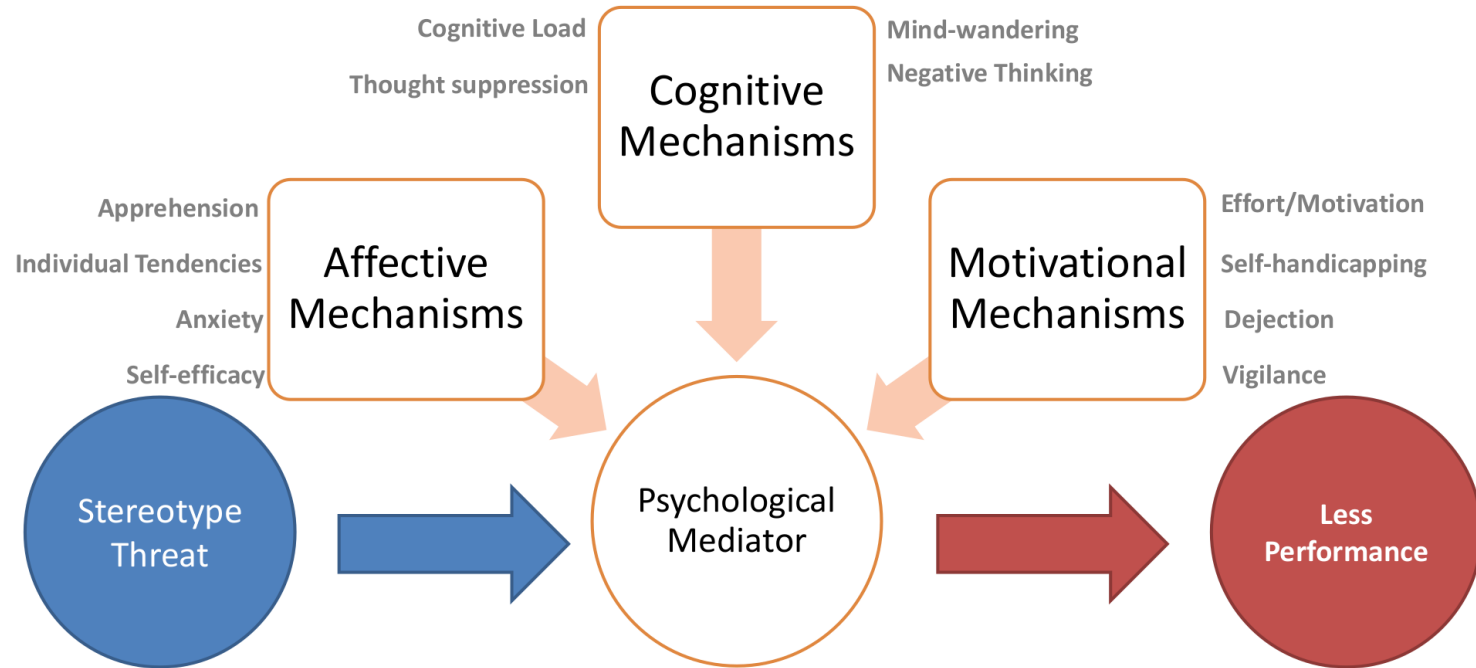


## How to tackle the problem ?



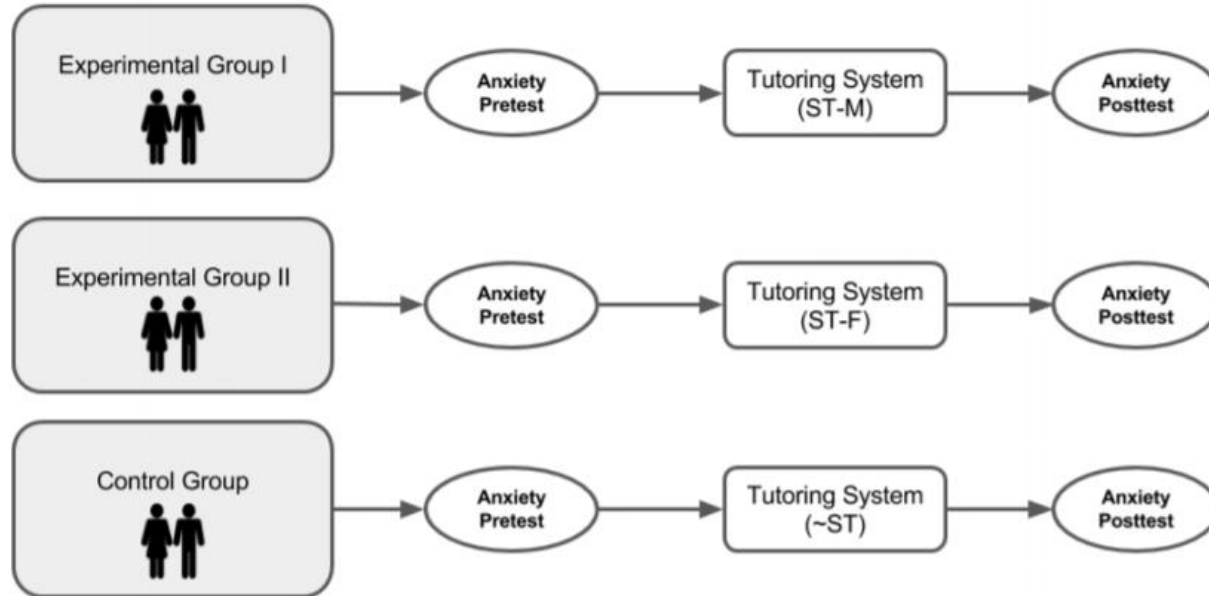


# Designing stereotyped gamified environments





# Designing stereotyped gamified environments





# Designing stereotyped gamified environments

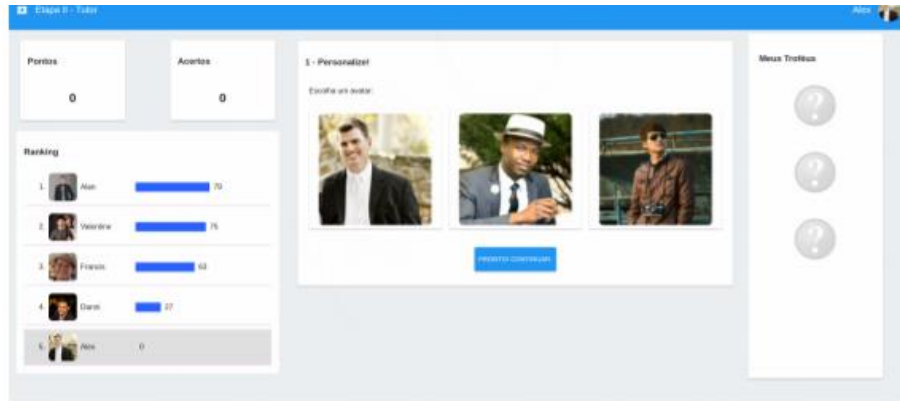


Figure 5: System stereotyped for men

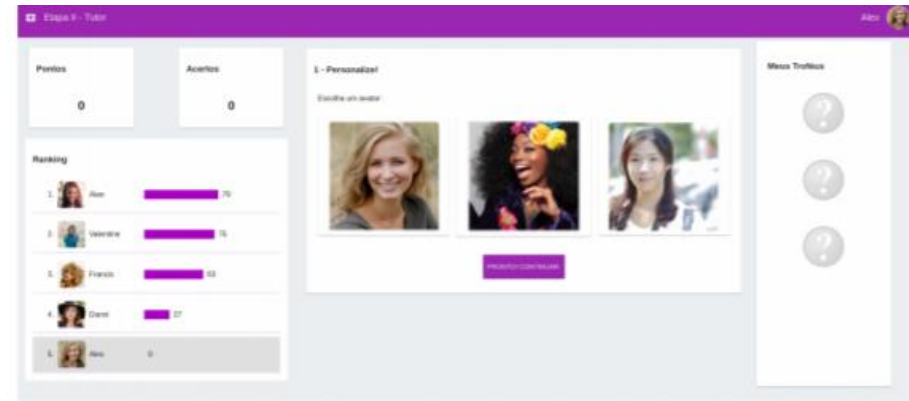


Figure 6: System stereotyped for women





## Designing stereotyped gamified environments

Table 4: Anxiety differences according to gender (comparison between pretest and posttest)

(I)	(J)	Gender	Test type	Statistics	df	p-value	Mean Difference (I-J)	Effect Size	Decision
ST-F (pre)	ST-F(post)	f	Paired t-test	t = -0.10	15	0.923	-0.10	Cohen's d = -0.02	Failed to reject
		m	Paired t-test	t = 0.11	24	0.913	0.10	Cohen's d = 0.01	Failed to reject
ST-M (pre)	ST-M(post)	f	Paired t-test	t = -4.16	14	0.001	-5.50	Cohen's d = -0.70	Reject
		m	Paired t-test	t = -3.88	28	0.001	-6.20	Cohen's d = -0.88	Reject
~ST (pre)	~ST(post)	f	Paired t-test	t = 4.19	13	0.001	4.00	Cohen's d = 0.50	Reject
		m	Paired t-test	t = 5.31	27	0.000	4.60	Cohen's d = 0.60	Reject



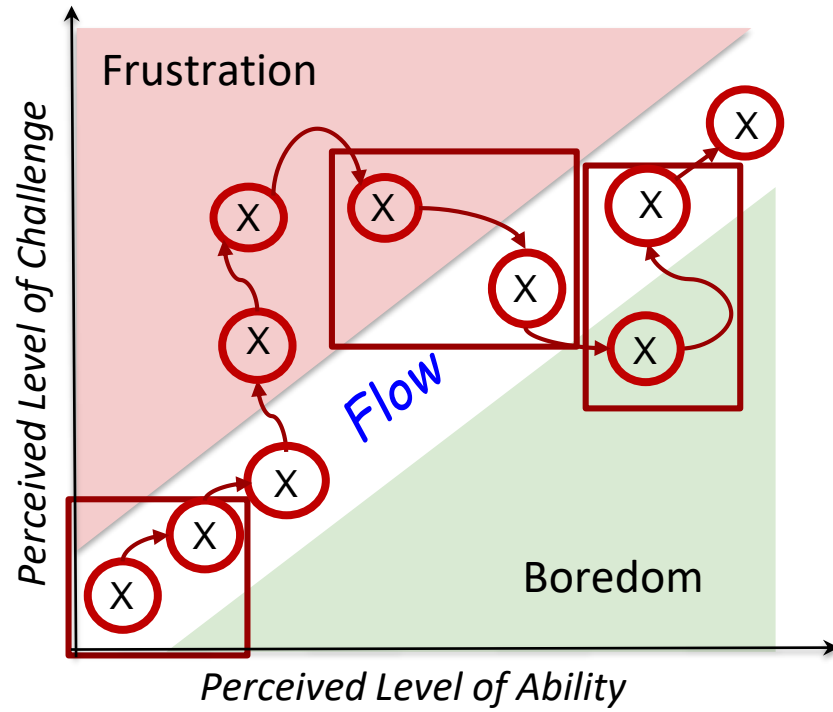
**General Motivation**

**Basic Theoretical Foundations**

**Designing for Optimal Experience**

**Challenges**

**Research Agenda**





**General Motivation**


**Basic Theoretical Foundations**

**Designing for Optimal Experience**

**Challenges**

**Research Agenda**





**Grand Challenge:** How the design and use of educational systems can promote an optimal learning experience ?

**Phase 1 (Basic Research): Instrument validation & Small-scale experiments**

1. Validation of Flow and Gamification Questionnaires (Long and Short DFS-2 and GAMEFULQUEST)
2. Machine Learning Algorithm(s) for Stereotyped Learning and Gamified Systems
3. Design Gamified Tasks to Small-scale experiments
4. GamiFlow validation

**Phase 2 (In Vivo Studies): Small-scale studies (students and classrooms)**

1. GamiFlow and stereotyped gamification empirical studies
2. EEG studies\*
3. Flow Detectors

**Phase 3 (In Situ Studies): Large-scale studies (schools and A/B tests)**

1. GamiFlow and non-stereotyped gamification experiments
2. Re-Design of Commercial Learning Environments

**Phase 4 (Cross-Cultural Studies and Innovation): Very Large-scale studies (BRICS + Europe)**

1. GamiFlow and non-stereotyped gamification experiments
2. Technology Transfer

**Thank you!**

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