Emotions and inclusion in e-learning: student modelling and adaptive e-training

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Context

Emotions

Affect perception

Influence (motivation)

Impact on

Requires adaptation

Favours

Inclusion

Learning
Impact of technology

• XXI century:

Educational websites

Adaptive educational hipermedia (AH)

Collaborative systems (CSCL)

MOOCs, SPOCs, Moodle, YouTube, Educational websites
- Diversity of topics
- Anyone can be autor
- High-quality courses: MIT, Harvard, ...
- Resources: video, audio, text; forums, tests; etc.
- Thousands of courses and millions of users
  - Coursera: >1700 courses >23 mill. users
Impact of technology

• XXI century:

Educational websites

Adaptive educational hipermedia (AH)

Collaborative systems (CSCL)

Richer (adaptive) applications:
- Learning, training, therapies, rehabilitation, assistance, etc.
- Apps for smartphones, tablets, surfaces, ...
- Augmented reality, tangible interfaces,
- Adaptation to needs, context, emotions,
- Active learning. Different types of activities
- Adaptive educational games
Impact of technology

• XXI century:

Educational websites

Adaptive educational hipermedia (AH)

Collaborative systems (CSCL)

New approaches:
- Virtual worlds
- Social networks
- Collaborative games
- ...
New possibilities

INTERACTION!

Information about the user
New possibilities

Interactions:
- User-user
- User-resource

BIG DATA
Big Data

- A lot of information available
- Different sources → diverse formats
  - Logs from Moocs, Moodle, Websites
  - Interactions in social networks
  - Actions in applications
  - Teacher observations
  - …
MOOC edX UAM: La España del Quijote

7 lessons

Content:
- Videos
- Exercises
- Exams

3354 students
- Passed: 200
- Failed: 3154

Data analysed:
29/09/2014 - 14/02/2017
Weekly prediction models (decision trees)

\[
\begin{align*}
X_4 \leq 34.0 & \quad \text{entropy} = 0.327 \\ & \quad \text{samples} = 1687 \\ & \quad \text{value} = [1586, 101] \\ & \quad \text{class} = 0
\end{align*}
\]

\[
\begin{align*}
X_5 \leq 2.5 & \quad \text{entropy} = 0.014 \\ & \quad \text{samples} = 1567 \\ & \quad \text{value} = [1565, 2] \\ & \quad \text{class} = 0 \\
X_4 \leq 19.5 & \quad \text{entropy} = 0.292 \\ & \quad \text{samples} = 39 \\ & \quad \text{value} = [37, 2] \\ & \quad \text{class} = 0 \\
X_4 \leq 56.0 & \quad \text{entropy} = 0.669 \\ & \quad \text{samples} = 120 \\ & \quad \text{value} = [21, 99] \\ & \quad \text{class} = 1 \\
X_6 \leq 14.5 & \quad \text{entropy} = 0.38 \\ & \quad \text{samples} = 95 \\ & \quad \text{value} = [7, 88] \\ & \quad \text{class} = 1
\end{align*}
\]

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Big Data

- Log analysis
- Big data
- Learning Analytics (LA)
- User Modeling (UM)
User Modeling

• Adaptive systems and applications:

Resources

Teaching & learning strategies

Tools

Activities

Adaptation Engine

User

Adapted resources & tools

Adapted teaching
• Adaptive systems and applications:

Adapted resources & tools
Adapted teaching
User Modeling

(UM)
Abilities
Personality
Emotions
Learning style
Context
Interests
Preferences
Goals
etc.

INFLUENCE

ADAPTATION

GROUPING
User Modeling

Questionnaires

Personality: NEO Five Factor Inventory (60)
- Extraversion
- Neuroticism
- Conscientiousness
- Openness to experience
- Agreeableness

Intelligence: Primary Mental Abilities (102)
- Verbal (50)
- Spatial (22)
- General reasoning (30)

Learning styles: Felder-Solomon (44)
- Sensing/intuitive
- Active/reflective
- Visual/verbal
- Sequential/global
UM acquisition

Mouse movements

Learning styles (ILS)

Offline processing

seq

accuracy = 94.4%

sequential

r = -0.8

global
UM acquisition

Mouse movements

Sequential learning style

Global learning style

Learning style Predictor

Any AND

AND

AND

Any

Any

Any

AND
AH-questionnaire: An adaptive hierarchical questionnaire for learning styles
A Ortigosa, P Paredes, P Rodriguez
Computers & Education 54 (4), 999-1005, 2010
• **Adaptive** version of Silverman-Solomon questionnaire

Sensing-intuitive trait:

(max: 6 questions)
Detecting and making use of emotions to enhance student motivation in e–learning environments. P Rodriguez, A Ortigosa, RM Carro.
IJCEELL 24 (2), pp. 168-183, 2014
UM acquisition

- Natural language processing (essays)
- Dictionaries of emotions

12 essays of one student:

Joy, Disgust, Anger, Happiness, Empathy, Fear, Sadness, Intellectually, Neutral, Surprise, Spirituality, Negative

Zinck & Newen (2008)
UM acquisition

- Mouse movements
- Shortened Adaptive Questionnaires
- Essays
- State messages in Facebook: *SentBuk*
- Interactions in Facebook: *TP2010*
- Messages in Twitter

*Sentiment analysis in Facebook and its application to e-learning*

UM acquisition

- Popularity
- Network of friends
- Users express emotions naturally

- Sentbuk: Sentiment analysis in Facebook
Natural language processing techniques

SentBuk Sentiment Analysis:
- Positive, neutral, negative msgs.
- Positive, neutral, negative friends
- Evolution along the time

> 83% accuracy
Natural language processing techniques

SentBuk Sentiment Analysis:
- Positive, neutral, negative msgs.
- Positive, neutral, negative friends
- Evolution along the time
UM acquisition

Mouse movements

Shortened Adaptive Questionnaires

Essays

State messages in Facebook: SentBuk

Interactions in Facebook: TP2010

Messages in Twitter

*Predicting user personality by mining social interactions in Facebook*

A Ortigosa, RM Carro, JI Quiroga

*Journal of Computer and System Sciences 80 (1), 57-71, 2014*
TP-2010

- Infers personality from actions in Facebook:
  - Machine learning with data from more than 11000 users
  - > 80% accuracy

Personality prediction

Friend comparison

Personality-based friend recommendation
UM acquisition

Mouse movements
Shortened Adaptive Questionnaires
Essays

State messages in Facebook: SentBuk
Interactions in Facebook: TP2010
Messages in Twitter

Learning styles
Emotions & emotional states
Personality

Inferring User Personality from Twitter. J. Llanos, A Ortigosa, RM Carro (sent).
– Emotional states in learning contexts

  o Affect student **motivation**
    → **outcome** of the learning process
    (Sheng et al, 2009)

  o Potential **needs** in different situations
    → **adaptive** e-learning systems
Sources of information:

• Emoticons, checkboxes (explicit).

• Texts written: essays, messages, comments, ...

• Activity and (inter)actions

• Sensors: heart rate, sweating, blood pressure

Goal:
The least intrusive way
Emotions

• Benefits for e-learning:
  – Opportunity: propose motivating tasks dynamically
    Ej: CoMoLE\(^1\)
  – Inferring them from specific texts allows the detection of:
    o Which aspects the student [don’t] like about a course
    o Doubts about specific subjects
    o Course ongoing

→ feedback for teachers

• Emotions can **influence the student behaviour**

• **Difficult to control**

• People with **cognitive limitations**:
  – Need help to identify and manage emotions

• PRODIS Foundation + UAM: **PROMENTOR**
  – 2 years of training for labour integration
Inclusion

• **Colaborations:**
  - PRODIS
  - Psychopedagogical offices: AHD, dyslexia,…
  - Schools: socialization and social integration
  - Hospitals : prosthesis
  - Other entities: occupational therapy
  - Projects:
    - Spanish Ministry: *Adapting Social & Intelligent Environments to Support people with special needs* (ASIES, TIN2010-17344)
    - Spanish Ministry: *E-Integra* (TIN2013-44586-R)
    - CAM: *eMadrid, S2013/ICE-2715: promoting the research and development of educational technologies.*
Inclusion

TRAINING

• Helping them to develop abilities

ASSISTING

• Helping them to overcome difficulties in the meanwhile
Therapies for children with AHD:

**Personalized therapies:**
- AHD level
- Progress

**Facilitating the therapist work:**
- It conducts the therapy (dynamic difficulty variation)
- Interaction data stored
- Visualization
AHD therapies for children:

Sin necesidad de la intervención del terapeuta

**Sedixia**: Android app for children with dyslexia (6-11 years)

**Therapy support**
- Different activities and exercises
- Dynamically generated

**Follow up**
- Interactions stored
- Results and progress visualization
The Squares: integration and socialization

Children:

- Play a dynamic version of “The Squares” game
- Through a multi-touch table
- Acquire adaptive and socialization skills while playing

Therapists:

- Infinite game variations in one
- Interaction data stored automatically
- Tools for data visualization and analysis
Inclusion

• Collaboration of:
  – School Director, specialists, parents.

• Players:
  – 52 children from CEIP Príncipe de Asturias (Madrid)
  – 6-10 years old

The Squares: A Multi-touch Adaptive Game for Children Integration
J Llanos, RM Carro, SIIE 2015, pp. 137-140.
The Squares: analysis and visualization
Inclusion

- **SilverTouch**: myoelectric prosthesis training
  Team: Profs. of Medicine, Physiotherapists at the hospital, Primary school teachers.

*SilverTouch: Game-based Training for Children with Myoelectric Prostheses.*
F.G Costales, R.M. *Intelligent User Interfaces* 2017, ACM, pp. 93-96
Inclusion

Dynamic round adaptation:
- #balloons, distance, speed
- #points, distribution
- Size of dresses
Inclusion

What should I dress today?

- Game-based and situation-based learning
  *Through a multi-touch table*
- Different situations, weather, etc.
- Hygiene and appearance

Designing and delivering adaptive educational games through multi-touch surfaces for users with cognitive limitations.

M. Moraleda and R.M Carro. SIIE 2013.
Inclusion

TRAINING • Helping them to develop abilities

ASSISTING • Helping them to overcome difficulties in the meanwhile
What should I wear today?

- Personalised assistance *through the smartphone*
- Photos of their clothes
- **Different modes**: tell me, suggest me, I choose. *Varying as they learn.*
- Checking *agenda and forecast.*

“MyDressRecommender: a distributed mobile dress recommender for users with special needs”. J.A Rojo and R.M Carro. *SIIE 2013*
**WSI-Go (Where should I go?): Guidance Outdoors**

- Case of study with PROMENTOR students at UAM.

**Authoring tool: labelling**

**Adapted mobile guidance**

(Street View with annotations and sounds) Guidance while they learn

*Where should I go?: guiding users with cognitive limitations through mobile devices outdoors. A. G. García de Marina, R. M. Carro, and P. Haya. Interacción 2012*
**AngryEmail**: e-mail tool that detects negative emotions *(words, expressions, emoticons)*

- High level of **anger detected**
  - message retained for 5 minutes
  - “Are you sure?”

- Prevents the users from sending messages that they later regret.
- Especially important for people with cognitive limitations

AngryEmail? emotion-based e-mail tool adaptation. RM Carro, FJ Ballesteros, A Ortigosa, G Guardiola, E Soriano. Ambient Assisted Living and Home Care 2012, 399-406
Authoring Tools

Developed for most of the applications:

- Occupational therapies
- TrainLearning (Hot Potatoes+courses)
Conclusions

- Difficult to measure short and medium term **impact**.
- **Privacy** and information **security**:
  - The more information available, the richer the adaptation.
  - New data protection law in Europe (April 2018)
    - Users obliged to **protect themselves**
    - Mechanisms for the students to:
      - know what the system knows
      - delete this information, if wished
Conclusions

It is possible to combine expert knowledge in a fruitful way!

Specialists
- Know the real needs and theories
- Need the technological means

Computer engineers
- Know the means and the potential of technology
- Need to know the needs and theories beyond

All together
- Think and design useful solutions to specific problems

→ Multidisciplinarity
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