Learning analytics for Virtual Learning Environments

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Our Learning Analytics Research lines

- Technological issues
  - Effective processing of the data
  - Compatibility between different sources
- Useful indicators
- Useful visualizations
- Know the relationships among indicators. Know the causes
- Evaluation of the learning process
- Actuators: Recommenders, adaptive learning, etc.
Inference of indicators

- Pedagogical theories
- Best practices
- Adapted models from other systems
- Indicators that can predict other interesting indicators
Examples of indicators I

Effectiveness, efficiency, interest

Learning profiles

Behaviours

Skills

Emotions

Example II: Inference of optional activities

Example III: Inference of more precise indicators: Effectiveness

Example IV: Inference of emotions

Example V: HMM for emotion detection

- Each emotion has its corresponding HMM.
- Events are normalized and used as observations for a HMM.
- Two current approaches:
  - Probability of emotion HMM is mapped to emotion level.
  - Emotion with highest probability in HMM.

# Level of relationship

- 30.3% hint avoider
- 25.8% video avoider
- 40.9% unreflective user
- 12.1% hint abuser

<table>
<thead>
<tr>
<th></th>
<th>Hint avoid.</th>
<th>Video avoid.</th>
<th>Unrefl. User</th>
<th>Hint abuser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hint avoidance</td>
<td>1</td>
<td>0.382</td>
<td>0.607</td>
<td>-0.186</td>
</tr>
<tr>
<td>Video avoid.</td>
<td>0.382</td>
<td>1</td>
<td>0.289</td>
<td>0.096</td>
</tr>
<tr>
<td>Unrefl. user</td>
<td>0.607</td>
<td>0.289</td>
<td>1</td>
<td>0.317</td>
</tr>
</tbody>
</table>
Analysis of optional activities

- 76.81% of students who accessed did not use any optional activities

- Difference of use per course and depending on type of optional activities

- 55 goals (50.9% completed)

- 40 votes (26 positive, 13 indifferent, 1 negative)

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Percentage of activities accessed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Regular learning activities</td>
<td>2.48%</td>
</tr>
<tr>
<td>Optional activities</td>
<td>76.81%</td>
</tr>
</tbody>
</table>
# Level of relationship: optional activities vs learning activities

<table>
<thead>
<tr>
<th>Optional activities sig. (2-tailed) N = 291</th>
<th>Exercises accessed:</th>
<th>Videos accessed:</th>
<th>Exercise abandonment:</th>
<th>Video abandonment:</th>
<th>Total time:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.429* (p=0.000)</td>
<td>0.419* (p=0.000)</td>
<td>-0.259* (p=0.000)</td>
<td>-0.155* (p=0.008)</td>
<td>0.491* (p=0.000)</td>
</tr>
<tr>
<td>Exercise abandonment:</td>
<td>Follow recommendations:</td>
<td>-0.002 (p=0.972)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional activities:</td>
<td>Hint abuse:</td>
<td>0.089 (p=0.131)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hint avoider:</td>
<td>0.053 (p=0.370)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unreflective user:</td>
<td>0.039 (p=0.507)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video avoider:</td>
<td>-0.051 (p=0.384)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proficient exercises sig. (2-tailed) N = 291</th>
<th>Optional activities:</th>
<th>Goal:</th>
<th>Feedback:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.553* (p=0.000)</td>
<td>0.384* (p=0.000)</td>
<td>0.205* (p=0.000)</td>
</tr>
<tr>
<td>Vote:</td>
<td>0.243* (p=0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avatar:</td>
<td>0.415* (p=0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display badges:</td>
<td>0.418* (p=0.000)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Clustering depending on effectiveness

Grouping types of students
Prediction models

Learning gains = 25.489 - 0.604 * pre_test + 6.112 * avg_attempts + 0.017 * total_time + 0.084 * proficient_exercises

Pedro J. Muñoz-Merino, José A. Ruipérez-Valiente, Carlos Delgado Kloos, Maria A. Auger, Susana Briz, Vanessa de Castro, Silvia N. Santalla, “Flipping the classroom to improve learning with MOOC technology: A case study with engineering students using the Khan Academy platform”, Submitted for publication
LA for Google Course Builder:

- Links

Source code: https://github.com/roderickfanou/Learning_analytics_on_GCB

Video: http://www.youtube.com/watch?v=b5vOoWHgmqg

Visualization of emotions

- Time-based visualizations
  - Timeline for the level of each emotion.

- Contextualized visualizations
  - Daily average of emotion by day.
  - Emotion levels vs use of tools.
  - Emotion levels vs student grades.

ANALYSE: LA support for open edX

● General information and Github
  ➢ http://www.it.uc3m.es/pedmume/ANALYSE/
  ➢ https://github.com/jruiperezv/ANALYSE

● Evaluation

● Demos
  ➢ https://www.youtube.com/watch?v=3L5R7BvwlDM&feature=youtu.be

Héctor Pijeira, Javier Santofimia, José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos, Demo ANALYSE, EC-TEL 2015
MOOC of maths

- MOOC of maths:
  - Available at: http://ela.gast.it.uc3m.es
  - Topics: Units of measurement, algebra, geometry
  - High school education for adults
  - Generation of educational materials: CEPA Sierra Norte de Torrelaguna: Diego Redondo Martínez
  - 28 videos, 32 exercises
  - Configuration, support and personalization of the MOOC platform at Univ. Carlos III de Madrid
  - Open for everyone
  - Flipped the classroom methodology
ANALYSE in the MOOC of maths

- Uses of ANALYSE in the experience
  - Self-reflection for students
  - Support for the flipped classroom
  - Evaluation of educational materials
  - Evaluation of students
  - Evaluation of the course
Example I: Self-reflection
Example II: Evaluation of students

Students Grades
This visualization shows the average grade in each category of resource in the course. You can filter by all the students, each student individually or by students’ groups (by grades). Click on a bar in order to see the results decomposed in each item within the category.

Options
- Select student
- Student A

Grade categories
- Proficiency
- OK
- Fail

Course Accesses
This visualization shows the number of accesses in each chapter of the course. Click in one chapter in order to decompose these accesses into their respective subsections. You can filter by all the students, each student individually or by students’ groups (by grades).

Options
- Select student
- Student A

Chapters accesses
- Introducción
- Unidades de Medida
- Álgebra
- Geometría

Chapter Time
This visualization shows the time elapsed in each chapter of the course. Click in one section in order to divide it in graded, ungraded and chapter time. You can filter by all the students, each student individually or by students’ groups (by grades).

Options
- Select student
- Student A

Chapters spent time
- Introducción
- Unidades de Medida
- Álgebra
- Geometría
Example III: Flipped classroom, evaluation of materials
Example IV: Evaluation of the course

This visualization shows in dark blue the percentage of different video watched (it does not count if the same parts are watched several times, the max. is the 100% of the video) and in light blue the percentage of total video watched (total amount of time spent compared to the length of the video in percentage). You can filter by all the students or each student individually.

Options
All students

Videos which belong to the "Area calculation" sub-section
Present and future work in ANALYSE

- Design and implementation of higher level learning indicators and their correspondent visualizations
- Scalability. Work with a big amount of users
- Recommender based on previous data analysis we have performed on other experiences -> clustering, prediction, relationship mining
- Integration with Insights
ANALYSE in the Spanish TV

- Part of the mapaTIC project:
  - ANALYSE and the MOOC of maths: 5:30-7:11
### Problem data:

- **Title:** Lenguaje Java
- **Problem max. score:** 1.0
- **Type:** choiceMultiple

### Problem:

Select the correct answers about Java:

- It is an object oriented programming language
- It is a portable programming language
- Generate code that depends on the architecture
- It is a **script** language, this is the origin of JavaScript
- None of the previous answers
Adaptation (I): ISCARE

Application variables

- Max. session inactive interval: 60 min (you’ll have to re-login to take effect)
- Percentage of random problems: 70 % (other will be selected according to its difficulty and students rank)
- SMTP Configuration:
  - SMTP Server: smtp.uc3m.es
  - From field: ISCARE PFC <no-reply@iscare.com>
  - Subject field: User registration
- Max. size for bulk uploads: 5 Mb
- Behavior with 1 student pairings:
  - They’ll take all the collective score, no matter what they do.
  - They’ll be faced with a fictional student who get individual score of 0.
- Default pairing algorithm:
  - Edmonds algorithm
  - Brute force algorithm
  - Improved brute force algorithm
  - Round robin algorithm
  - Voracious algorithm

Update

Back
ISCARE competition tool

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Select the correct answers about Java:
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- It is a script language, this is the origin of JavaScript
- None of the previous answers

My information:
- NIA: 800000084
- Name: 800000084
- Average score: 0.0%
- Tournament Points: 0.0 / 2.0
- Round points: 0.0 / 7.0
- Resolving: 1st problem

Opponent information:
- NIA: 800000085
- Name: 800000085
- Average score: 0.0%
- Tournament Points: 0.0 / 2.0
- Round points: 1.0 / 7.0
- Resolving: 4th problem

Time left: 8 min, 3 sec
ISCARE: Publications


Problemas diferentes aprobados por más compañeros ‘más coincidentes y menos diferentes’: $p_7 = 4$  
$p_8 = 4$
Adaptation (III): Document recommendation based on emotions

- Learner profile is augmented with affective information (AI).

Implementation in the ROLE Personal Learning Environment.
Adaptation (V): FEST Tutor

Se está analizando el error:
argumento de tipo inválido de ‘->’ (se tiene ‘Lista’),
ocurrido en la línea 15:15 del fichero lista.c

CAUSA: El error se ha producido porque el nombre que va precedido al operador -> no es de un puntero a una estructura o unión.

SOLUCIÓN: Comprueba que el nombre del puntero es correcto en todas sus apariciones ó realice una correcta declaración del puntero.

Marca esta casilla si prefieres que los enlaces sean a páginas en inglés (si están disponibles)

A continuación se muestran enlaces a Teoría y Ejercicios relacionados con el error

Teoría:
pointers_indirection_with_pointers
pointers_structure_indirection
pointers_indirection
dynamic_memory_examples
pointers_structures_as_parameters

Ejercicios:
pointers_indirection_use_evaluation
pointers_indirection_evaluation
pointers_assignment_pointers_assignment_evaluation

Mostrar más enlaces
Adaptation (V): FEST Tutor

Master Thesis: Belén del Campo
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