LEARNING ANALYTICS ENHANCED E-PORTFOLIOS FOR WORKPLACE BASED ASSESSMENT

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PLANNING

Introduction WatchMe project - Marieke van der Schaaf
The WatchMe student model explained – Jeroen Donkers
Demonstration – Denise Janssen and Martijn Holthuijsen
Practical – Jeroen Donkers
Plenary Discussion – Marieke van der Schaaf
INTRODUCTION WATCHME PROJECT

WORKPLACE-BASED E-ASSESSMENT TECHNOLOGY FOR
COMPETENCY-BASED HIGHER MULTI-PROFESSIONAL EDUCATION

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1. Utrecht University, NL
2. University Medical Centre Utrecht, NL
3. Szent Istvan University, Hungary
4. University of Tartu, Estonia
5. Universitätsmedizin Charité Berlin, Germany
6. University of California San Francisco, USA
7. Maastricht University, NL
8. Mateum, NL
9. University of Reading, UK
10. Jayway, Denmark
11. NetRom, Romania/NL
Develop complex competences
Integrated in context
Demands long learning trajectories in workplace
Deliberate practice: feedback and reflection
IMPROVE USE OF DATA IN E-PORTFOLIO WITH LEARNING ANALYTICS

Measurement, collection, analysis and reporting of data about trainees in their contexts, for the purpose of understanding, and optimising learning and the utilising of environments in which it occurs (Solar, 2013)

Application of probabilistic student models that enable feedback based on multi sorted assessments

Personalized feedback

Visualizing learners’ development
THREE WAYS OF PERSONALIZED FEEDBACK

• Regular e-portfolio feedback, e.g. assessment forms

Probabilistic, derived from data in the portfolio:
• Performance estimations, based on earlier scores or narratives
• Pedagogical estimations, e.g level of a student’s frustration, consistency
EPASS

Intuitive user interface

Monitoring of progress

Mobile web application for entering forms on smartphone or tablet
EXAMPLE DATA POINTS E-PORTFOLIO

Aggregation of data points

- Written or electronic test
- Skills test in simulation (OSCE)
- Workplace-based assessment (practice observation)
- Case-based discussion
- Multisource feedback
- Product evaluation
CHALLENGES AND PROGRESS

- Validation of an EPA based curriculum mapping procedure
- Definition of Workplace-based markers
- Development and implementation of the eportfolio architecture
- Specification of a student model
- Final specification of requirements
- Adaption of the architecture and configuration of EPASS
- Start implementation
- Development of test plans (integration of components)
- Start of evaluations
- Improve system
- Final evaluations
- Dissemination and exploitation of results
EPA 1. Sets learning goals for the whole curriculum and specific lessons

<table>
<thead>
<tr>
<th>Assessment and evaluation criteria</th>
<th>The teacher does/do not formulate (self formulated) learning goals in connection with specific subject content. The teacher does/do not make use of SMART (specific, measurable, acceptable, realistic and time related) formulated learning goals. The teacher does/do not take into consideration the starting situation of students when formulating learning goals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficiency levels</td>
<td>The teacher takes over the learning goals or course material from others. He/she incidentally considers the starting situation of the students and the connection with specific subject content. The teacher does not check if the learning goals are SMART formulated. <em>(starting)</em> The teacher regularly checks if the learning goals of others or the course material connect to specific subject content and the starting situation of the students. The teacher checks if the set learning goals are SMART formulated. <em>(sufficient)</em> The teacher formulates his/her own learning goals, which usually connect to the specific subject content and the starting situation of the students. These learning goals are partially SMART formulated. <em>(good)</em> The teacher formulates his/her own coherent learning goals, which connect to the specific subject content and the investigated starting situation of the students. The learning goals are SMART formulated. <em>(Excellent)</em></td>
</tr>
<tr>
<td>Assessment forms</td>
<td>Lesson plans/series of lessons and student placement evaluation form.</td>
</tr>
<tr>
<td>Assessor</td>
<td>Institute and internship supervisor.</td>
</tr>
</tbody>
</table>
PERSONALIZED FEEDBACK

Some users are motivated by competition? Others find competition demotivating.

Users want to know whether they are on track.

Users would like an overview of weekly, monthly and yearly goals.

Users want to be able to highlight and save useful feedback.
JIT Written feedback: supervisors’ feedback and rubric-based improvement advice.

VIZ Visualisations of students’ progress and development within competencies (e.g. graphs).

To create the interface(s) within the e-portfolio, in which information about development and progress will be shown to students.
WRITTEN FEEDBACK (JIT)

Appears in:
• Dashboard
• Assessment forms
• Pages with competencies

Feedback categories:
• Improvement feedback
• Supervisor feedback
**EXAMPLE**

**Just in Time feedback**

Carries out tasks which go beyond the lesson, class and subject.

All performance indicators are rated as sufficient. If you want to improve yourself, you should achieve a level three (good) or four (excellent) rubric rating for all performance indicators.

**Improvement feedback**

Your supervisor provided feedback on this task.

**Supervisor feedback**

Supervises the execution of learning activities.

There is room for improvement on this task. To meet the minimum requirements for this task you minimally need to achieve a sufficient rubric rating all performance indicators.

**Improvement feedback**

**Just in Time feedback**

Carries out tasks which go beyond the lesson, class and subject.

All performance indicators are rated as sufficient. If you want to improve yourself, you should achieve a level three (good) or four (excellent) rubric rating for all performance indicators.

You are at level 2 (Sufficient) on "Shows initiatives to carry out new tasks.". In order to achieve the next level, you should: "regularly represent the school professionally and contribute to the execution of the vision and/or profiling of the school.".
VISUALISATION

• Appears in:
  • Dashboard
  • Competency pages
  • Visualisations

• Visualisations
  • Timeline
  • Current Performance
  • General Overview
  • Supervisor View
EXAMPLE - TIMELINE

How am I developing?

What competencies need my attention?
How am I doing right now?

What are my strengths and weaknesses?
How are my students progressing?

Which of my students require special attention?
THE WATCHME STUDENT MODEL EXPLAINED

JEROEN DONKERS, MAASTRICHT UNIVERSITY

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THE WATCHME STUDENT MODEL

• Student Model = A representation of the variables and their relations that play a role in a (workplace-based) learner (e.g., performance level, motivation, consistency).

• We use a Bayesian network for this representation. It is grounded in classical probability theory and allows us to predict the inner state of a student on the basis of observed evidence.

• The type of Bayesian network we apply is called Multi-Entity Bayesian Network, which makes it possible to take the student’s particular context into account, and allows a more clear way of defining the model.
THE WATCHME STUDENT MODEL

• As input, our model uses e-portfolio content (e.g., assessments, scores), or findings generated from the content (e.g. a sudden drop in scores)

• The output are posterior probability tables for the variables, given the observed. (e.g., p(motivation=high)=0.7, p(motivation=low)=0.3)

• This output is used for presenting appropriate messages to students or their supervisors. (e.g., if p(motivation=low) > 0.5 display: “Please contact your mentor to talk about your study progress”)
THE WATCHME STUDENT MODEL

• In WATCHME we produced two different student models that are used in parallel:

• The PERFORMANCE MODEL takes the assessment scores directly from the portfolio and tries to estimate the true present level of performance. It does this per EPA and per performance indicator in the EPAs. It also takes a few narrative feedback fields into account, that are translated in a sentiment level.

• The PEDAGOGICAL MODEL concentrates more on the behavioural and meta-cognitive aspects. In this presentation, we will concentrate on this second model.
DESIGNING THE MODEL

• Before building the pedagogical model, we needed to decide on what variables to include in the model.

• We interviewed 12 scholars involved in workplace-based learning on what educational theories and concepts that are linked to this area.

• From the interviews, a mind-map was created that interlinks all terms and theories mentioned in the interviews.
Mind map of concepts in workplace-based learning
DESIGNING THE MODEL

- From this mind-map, we selected 5 themes, which we judged to be feasible to implement into the student model on the basis of e-portfolio content.

- The five selected themes are:
  - Feedback seeking behaviour
  - “Frustration alert”
  - Completeness of information
  - Portfolio consistency
  - Need for feedback (currently not implemented)

- We discussed the themes with representatives from each of the three WATCHME application domains for further details and refinement
BUILDING THE MODEL

• In a Multi-Entity Bayesian Network, each of the themes is represented by what is called a “knowledge fragment”. Such a fragment contains the variables that are important in that theme and defines the probabilistic relations between them.

• Each knowledge fragment contains input variables that either are fed with evidence from the portfolio, or that can come from other knowledge fragments.

• Each knowledge fragment contains output variables.

• Intermediate variables can be used to define more complicated relations between input and output.

• A fragment also has parameters that dictate when and how and how often the fragment is applied.

• The tool UnBBayes was used to build and run the model.
BUILDING THE MODEL

Each variable has a probability function connected to it:

The knowledge fragment for “Frustration alert”
After adding evidence to the model, the model can be queried, e.g.

“what is the level of frustration at time T2?”

A Bayesian network will then be created that answers the query:
GETTING THE EVIDENCE

• To fill variables like “scoreHasDropped(t)” we need to extract this information from the e-portfolio

• We created a series of statistical functions that take the assessments from the portfolio (with the time points of the assessment) and determine for each of the time if, for instance, a drop in score can be detected

T-statistic
TUNING THE MODEL

• The model and the finding-generating functions contain many parameters that need to be tuned.

• Some parameters can be deduced from literature, but most of them need to be fine-tuned to the application domain.

• We took a set of anonymized historical portfolio data to tune the WATCHME model. It did not include EPAs, so competencies were used instead.

• First, the parameters for the finding-generating functions were tuned so that not too many but also not too little findings where detected.

• Then we ran the student model for all portfolio’s in the set for all points in time and inspected the model output.

• This resulted in some changes in probability functions.
Findings generated for a fictive student
Model output for a fictive student
THE PROOF OF THE PUDDING…

- Tuning the model and the parameters on the basis of historical data is necessary, but only the starting point
- The field-experiments in WATCHME are about to start
- Retuning of parameters might be needed along the ride

- **Research questions:**
  - Exact phrasing and timing of feedback-messages is important and context dependent. What is the best for this situation? What other communication is possible, e.g. what visualisations could be used?
  - Will students change their behaviour on the basis of output generated by the model?
  - What other elements can be included in the model?
  - In what contexts and circumstances does such a model work best?
DEMONSTRATION WATCHME PROJECT

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SWOT-ANALYSIS

Strengths

Weaknesses

Opportunities

Threats