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

MARIEKE VAN DER SCHAAF

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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
WATCHME’S AIM

Improve efficiency and quality of workplace-based feedback and assessment by means of a mobile electronic portfolio system, that is enhanced:

*Conceptually* with the concept of Entrustable Professional Activities

*Technically* through Learning Analytics:
  - Student models that *monitor* the learners’ development and *inform* learners and supervisors (based on data of students, supervisors and peers - probabilistic algorithms that learn from new incoming data)
  - Personalized feedback and visualization of development.
Develop complex competences
Integrated in context
Demands long learning trajectories in workplace
Deliberate practice: feedback and reflection
UNFORTUNATELY, HOW MANY DAILY FEEDBACK PRACTICES LOOK LIKE

“Well done!”
“Pleasure to supervise!”
“Reliable candidate”
“Poor fund of content knowledge”
“Needs lots of supervision”
WHAT IS NEEDED

Personalized Feedback that gives (Sadler, 1989; 2010):

- insight into performance
- ability to evaluate and monitor own process
- suggestions to fill gap between expected norm and performance

That feeds into learners’ major feedback questions (Hattie & Timperley, 2007):

- Where am I going? (goals, feedup)
- How am I going? (feedback)
- Where to next? (feedforward)
FROM 90S ONWARDS: ELECTRONIC PORTFOLIOS

Portfolios contain selected evidence of performance and products accompanied by reflections.

- Reflective ‘log’ of trainee over longer time span
- Repository of evidence regarding performance etc
- Different instruments and methods
Example Digital portfolio, example veterinary education

Aggregation of data points
- Mini-CEX (clinical evaluation exerc.)
- Multisource feedback
- Case reports
- Knowledge tests
- Personal development plan
ELECTRONIC PORTFOLIOS MIXED SUCCESS

Underuse of potential data and not very well tailored to worksituations (not timely).

Drawbacks:

• Authentic, personal unique character of evidence, difficults scoring.
• Full standardization impossible, asks for interpretation of assessor (no golden standard or external criterion).
• Impacts reliability and validity of the assessment.
• Limited impact on learning
• Low motivation of students
CRITICS COMPETENCY-BASED ASSESSMENT
MOST CRITICS COME DOWN TO THE ANALYTIC APPROACH (E.G. CANMEDS)

- Medical expert
- Collaborator
- Communicator
- Manager
- Health advocate
- Scholar
- Professional

Source: Ten Cate
THE ANALYTIC APPROACH

- Medical expert
  - With nursing staff
- Collaborator
  - With family
- Communicator
  - With patients
- Manager
  - With colleagues
- Health advocate
  - With trainees
- Scholar
- Professional
  - ...

Source: Ten Cate
THE ANALYTIC APPROACH

Medical expert
- With nursing staff

Collaborator
- With family

Communicator
- With patients

Manager
- With colleagues

Health advocate
- With trainees

Scholar

Professional

Consultation
- With elderly

Breaking bad news
- With children

Explain medication

Source: Ten Cate
THE SYNTHETIC FRAMEWORK APPROACH

Medical expert
Collaborator
Communicator
Manager
Health advocate
Scholar
Professional

Source: Ten Cate
ENTRUSTABLE PROFESSIONAL ACTIVITY

Task based instead of construct based approach

Crucial question: would I entrust this learner unsupervised with this task? (with my sick mother, animal or teach my daughter/son…)

An EPA is a task that an individual can be trusted to perform unsupervised, in a given professional context, once sufficient competence has been demonstrated.

International Competency-Based Medical Education Collaborators, March 18, 2014
EXAMPLES ENTRUSTABLE PROFESSIONAL ACTIVITY (EPA)

Conducting patient hand-overs
Anesthetic management a patient
Conducting a normal, low risk delivery
Interviewing adolescents regarding high risk health behavior
# EXAMPLE EPA

<table>
<thead>
<tr>
<th>Title of EPA</th>
<th>EPA x Routine check-up of the stable adult patient</th>
</tr>
</thead>
</table>
| Specification and limitations | This EPA includes no more and no less than  
1. Measuring vital parameters: heart rate, respiratory rate, temperature, blood pressure, saturation  
2. Explaining all actions to the patient  
3. Reporting results to the health care team including interpretation, orally and/or written  
Context: ambulatory and inpatient setting  
**Targeted transition:** first fulltime clinical clerkship to next clerkship  
**Limitations:** only with circulatory stable patients of 18 year and older |
| Most relevant domains of competence | X Medical Expert  
X Communicator  
X Collaborator  
□ Manager  
□ Health Advocate  
□ Scholar  
□ Professional |
## EXAMPLE EPA

<table>
<thead>
<tr>
<th>Title of EPA</th>
<th>EPA x Routine check-up of the stable adult patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required experience, knowledge, skills, attitude and behavior</td>
<td>Knowledge:</td>
</tr>
<tr>
<td></td>
<td>- basic knowledge of anatomy including relevant arteries</td>
</tr>
<tr>
<td></td>
<td>- normal values of vital parameters</td>
</tr>
<tr>
<td>Skill:</td>
<td>Skill:</td>
</tr>
<tr>
<td></td>
<td>- skill in using necessary devices to measure vital parameters</td>
</tr>
<tr>
<td></td>
<td>- recognition of stable and unstable patients</td>
</tr>
<tr>
<td>Attitude and behavior:</td>
<td>Attitude and behavior:</td>
</tr>
<tr>
<td></td>
<td>- professional communication with the patient</td>
</tr>
<tr>
<td></td>
<td>- proactive alertness in case of adverse events</td>
</tr>
<tr>
<td></td>
<td>- willingness to ask for help if needed</td>
</tr>
<tr>
<td>Experience:</td>
<td>Experience:</td>
</tr>
<tr>
<td></td>
<td>- all measurements done at least 5 times</td>
</tr>
<tr>
<td>Assessment: information sources to assess progress and ground a structural entrustment decision</td>
<td>Observation: satisfactory observation of all measurements at least fully twice by experienced health care professionals (nurse, physician or other)</td>
</tr>
<tr>
<td></td>
<td>Case-based discussions: one CBD with an qualified health care professional</td>
</tr>
<tr>
<td>Entrustment for which level of supervision is to be reached at which stage of training?</td>
<td>Indirect supervision (level 3) ultimately before the transition to the second full time clinical clerkship</td>
</tr>
</tbody>
</table>
# COMBINING THE COMPETENCY-FRAMEWORK WITH ENTRUSTABLE PROFESSIONAL ACTIVITIES

<table>
<thead>
<tr>
<th>Role</th>
<th>EPA1</th>
<th>EPA2</th>
<th>EPA3</th>
<th>EPA4</th>
<th>EPA5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical expert</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Collaborator</td>
<td>+</td>
<td></td>
<td>+</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Communicator</td>
<td>+</td>
<td>++</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Manager</td>
<td></td>
<td></td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Health advocate</td>
<td>+</td>
<td></td>
<td>++</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Scholar</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Professional</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Assessment: Ten Cate
GROWTH OF ENTRUSTABILITY OVER TIME

- expert
- proficient
- competent
- advanced
- novice

training  deliberate professional practice
CURVES OF ONE TRAINEE

Compe-
thres-

Justified entrustment decisions

tence

hold

EPA5

EPA3

EPA1

EPA2

EPA4

training
deliberate professional practice
ANOTHER TRAINEE

Competence threshold

EPA1
EPA2
EPA3
EPA4
EPA5

Justified entrustment decisions

Training

deliberate professional practice
COMBINE EPA APPROACH 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
ELECTRONIC PORTFOLIO

Personal data
Name: demo student
Department: Diakonessenhuis Undergraduate Medical Education Utrecht
E-mail address:
Phone number: -
Total attachments: 0MB / 50MB

Edit information

JIT Feedback
EPA 1: History taking, general impressions and general examination
There is room for improvement on this EPA.

Click to see improvement Feedback

Your Supervisor added a few comments on this EPA.

Click to see Supervisor Feedback

You currently have a trend of decreasing scores for this EPA

Click to see Trend Feedback

My competencies
Medical Expert (2)
Communicator (2)
Collaborator (2)
Professional (2)
Manager (2)
EPASS

Intuitive user interface

Monitoring of progress

Mobile web application for entering forms on smartphone or tablet
PRINCIPLES OF GOOD FEEDBACK
(NICOL AND MACFARLANE-DICK, 2006)

1. Helps clarify what good performance is
2. Facilitates the development of self-assessment in learning
3. Delivers high quality information to learners about their learning
4. Encourages teacher and peer dialogue around learning
5. Encourages positive motivational beliefs and self-esteem
6. Provides opportunities to close the gap between current and desired performance.
7. Provides information to supervisors
ASSESSMENT ARGUMENTS (MISLEVY, 2006)

- What EPAs should be assessed and how does the learner develop during the curriculum?
- What performance indicators should be used to gain insight into a learner’s competence?
- What instruments should be used to assess the EPAs?
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.
1. HELPS CLARIFY WHAT GOOD PERFORMANCE IS (RUBRICS)

<table>
<thead>
<tr>
<th>Assessment and evaluation criteria</th>
<th>The teacher does/does not formulate (self formulated) learning goals in connection with specific subject content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The teacher does/does not make use of SMART (specific, measurable, acceptable, realistic and time related) formulated learning goals.</td>
</tr>
<tr>
<td></td>
<td>The teacher does/does not take into consideration the starting situation of students when formulating learning goals.</td>
</tr>
<tr>
<td><strong>Proficiency levels</strong></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. ((\text{starting}))</td>
</tr>
<tr>
<td></td>
<td>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. ((\text{sufficient}))</td>
</tr>
<tr>
<td></td>
<td>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. ((\text{good}))</td>
</tr>
<tr>
<td></td>
<td>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. ((\text{Excellent}))</td>
</tr>
<tr>
<td><strong>Assessment forms</strong></td>
<td>Lesson plans/series of lessons and student placement evaluation form.</td>
</tr>
<tr>
<td><strong>Assessor</strong></td>
<td>Institute and internship supervisor.</td>
</tr>
</tbody>
</table>
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
TYPES OF FEEDBACK

1. MATCH TO STANDARDS
2. GROUP COMPARISON
3. DEVELOPMENTAL TREND
4. PERSONALIZED RECOMMENDATIONS
5. NARRATIVE FEEDBACK
MATCH TO STANDARDS - SUPERVISION LEVELS

Ten Cate, Chen, Hoff, Peters, Bok & Van der Schaaf, 2015
GROUP COMPARISON WITHIN EPASS

My competences

- Medical Expert (2)
- Communicator (2)
- Collaborator (2)
- Manager (2)
- Professional (2)

more
DEVELOPMENT TREND
# PERSONALIZED RECOMMENDATIONS

<table>
<thead>
<tr>
<th>EPA “XX”</th>
<th>Below expectations</th>
<th>Expected level</th>
<th>Exceeds expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Expert</td>
<td>You show some lack of knowledge or skill, try to read and practice about the aspects you feel least secure in</td>
<td>For this EPA, your knowledge and skill seems sufficient. You can be confident</td>
<td>Your knowledge or skills exceeds the expectation at this stage of training. Compliment! Think of how to even further build these</td>
</tr>
<tr>
<td>Communicator</td>
<td>You need to work on your communication skills for this EPA</td>
<td>Your communication skill is adequate for the level of permission to execute this EPA</td>
<td>Your communication skills for this EPA are great, above and beyond what is needed</td>
</tr>
<tr>
<td>Collaborator</td>
<td>Your collaboration skills and behaviour related to this EPA can be improved</td>
<td>Your collaboration skills and behaviour are adequate for the level of permission to execute this EPA</td>
<td>Your collaboration skills and behaviour related to this EPA are great and exceed what is minimally needed</td>
</tr>
<tr>
<td>Manager</td>
<td>You need to work on your organizational and leadership skills related to this EPA</td>
<td>Your organizational and leadership skills are adequate for the level of permission to execute this EPA</td>
<td>Your organizational and leadership skills related to this EPA are great; above and beyond what is needed or the level of permission to execute this EPA</td>
</tr>
<tr>
<td>Health Advocate</td>
<td>You need to attend a bit more to the more general aspects of health care related to the EPA</td>
<td>You have shown to be sufficiently aware and knowledgeable about the more general aspects of health care related to the EPA</td>
<td>Your awareness and knowledge about the more general aspects of health care related to the EPA extend above and beyond what is needed for this EPA</td>
</tr>
<tr>
<td>Scholar</td>
<td>The scholar competency role is not applicable for this EPA</td>
<td>The scholar competency role is not applicable for this EPA</td>
<td>The scholar competency role is not applicable for this EPA</td>
</tr>
<tr>
<td>Professional</td>
<td>You need to work on your skills and attitude concerning professional behaviour related to this EPA</td>
<td>Your skills and attitude concerning professional behaviour related to this EPA are adequate</td>
<td>You have shown superb skills and attitude concerning professional behaviour related to this EPA</td>
</tr>
</tbody>
</table>

Role feedback related to EPA “XX”

- Medical Expert
- Communicator
- Collaborator
- Manager
- Health Advocate
- Scholar
- Professional
MOCK-UP PERSONALIZED FEEDBACK

JIT Feedback

EPA 1: History taking, general impressions and general examination

There is room for improvement on this EPA.

Click to see Improvement Feedback

Your Supervisor added a few comments on this EPA.

Click to see Supervisor Feedback

You currently have a trend of decreasing scores for this EPA.

Click to see Trend Feedback

JIT Feedback - Improvement Feedback

EPA 1: History taking, general impressions and general examination

There is room for improvement on this EPA.

You are level 2 on your Physical Examination Competency. To achieve the next level please check if:
• Research is reasonably completed and technically adequate
• Tempo is reasonable
• Overview and consistency are reasonably developed

You are level 1 on your Further Research and Approach Competency. To achieve the next level you should:
• Be partially capable, based on findings / DD, to formulate an appropriate policy
• Have reasonable knowledge
• Implement additional research technically.
# NARRATIVE FEEDBACK

<table>
<thead>
<tr>
<th>Recent EPA 1 JIT Feedback</th>
<th>Improvement feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>There is room for improvement for this EPA.</strong></td>
</tr>
<tr>
<td></td>
<td>You are level 2 on your Physical Examination Competency. To achieve the next level please check if: research reasonably complete and technically adequate, tempo is reasonable. <strong>Overview and consistency are reasonably developed.</strong></td>
</tr>
<tr>
<td></td>
<td>You are level 1 on your Further research and Approach Competency. To achieve the next level you should be partially capable, based on findings / DD to formulate an appropriate policy. Have reasonable knowledge, implementing additional research technically only partially adequate.</td>
</tr>
<tr>
<td></td>
<td><strong>Supervisor Feedback</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Your Supervisor added comments on this EPA.</strong></td>
</tr>
<tr>
<td></td>
<td>“You are performing well, but you can take more notes during the examination process.” (13/05/2015)</td>
</tr>
<tr>
<td></td>
<td>“You did really well on today’s pre-op preparation. Trust your own judgement and be more confident.” (08/05/2015)</td>
</tr>
<tr>
<td></td>
<td><strong>Trend Feedback</strong></td>
</tr>
<tr>
<td></td>
<td><strong>You currently have a trend of decreasing scores on this EPA.</strong></td>
</tr>
<tr>
<td></td>
<td>On the competency Physical Examination, your performance was previously on Level 3, but you have now declined to Level 2. To achieve the next level follow the guidelines:</td>
</tr>
<tr>
<td></td>
<td>- Your research must be reasonably complete and technically adequate</td>
</tr>
<tr>
<td></td>
<td>- Your tempo must be reasonable</td>
</tr>
<tr>
<td></td>
<td>- Your overview and consistency must be reasonably developed</td>
</tr>
</tbody>
</table>
2. FACILITATES THE DEVELOPMENT OF SELF-ASSESSMENT (REFLECTION) IN LEARNING

Timeline overview:

Detailed visualization:

Dora Van A. | Justine B. | Stefan Van H. | Teunis F. | Vanessa X.
DANK VOOR JE BELANGSTELLING

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BAYESIAN NETWORKS

1) CONSTRUCTION OF GRAPH REPRESENTING QUALITATIVE INFLUENCES OF SITUATION MODEL
2) ASSIGNMENT OF PROBABILITY TABLES TO EACH NODE IN GRAPH
Fig. 2. Sample graph.
ARCHITECTURE (ZOOMED OUT)

- Student Model Database
- Learning Analytics Engine - Online Learning
- Database
- Portfolio system (ePASS)
- GAME
- WPB Assessment
- EPA Matrix
- Just in time Feedback
- Mobile device
- Aggregated Visualisation

WATCHME
MULTI-ENTITY BAYESIAN NETWORKS
(LASKEY, 2008)

Mfrag as basis concept

Mfrag: parameterized Bayesian network fragment that represents uncertain relationships among a small collection of related hypotheses

Can be instantiated and combined to form complex graphical probability models

Learns from incoming data

http://unbbayes.sourceforge.net/

University of Brasil & George Mason University (Costa & Laskey)

Tool for constructing and querying MEBN and other extended Bayesian network formats