

WP 3.02 - ALOA model with integration of e-assessment practices

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Contents

Assessment methods and e-assessment	3
Multiple Choice Questions (MCQ)	3
E-assessment implementation of MCQ	4
Essays	5
E-assessment implementation of essays.....	5
Problem solving.....	7
E-assessment implementation of problem solving.....	7
Practical work	8
E-assessment implementation of practicals	8
Short-answer questions (SAQ).....	11
E-assessment implementation of short answer questions.....	11
Reflective Practice Assignments.....	12
E-assessment implementation of reflective practice.....	12
Integration of e-assessment with TALOE webtool	14



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Assessment methods and e-assessment

The ALOA model includes a selection of six categories of general assessment. Each category is divided in more specific assessment methods. The final list of assessment methods was obtained from literature research. It was considered that the list includes most assessment methods but it is assumed that there are assessment tasks that might not easily be included in these categories. This output presents the assessment methods of the ALOA model and proposes different e-assessment tasks for each method.

Multiple Choice Questions (MCQ)

MCQ consists of a question followed by alternative answers from which the student has to choose the most correct alternative. The alternative answers may be of the binary type like true/false or include several alternative answers. Even though MCQ are commonly associated with assessing “Remember knowledge”, they may be used for assessing most cognitive processes and types of knowledge. However, writing complex items that are assessing what is intended is difficult and time demanding.

The ALOA model defines the following sub-categories for MCQ:

- Remember
 - Response requires recall or recognition of one item correct information
 - Question includes who, what, why, when, where, which, choose, find, how, define, label, show, spell, list, match, name, relate, tell, recall, select
- Understand
 - Response requires recall of more than one correct item of information, may involve a number of unconnected items
 - Test item asks to compare, contrast, demonstrate, interpret, explain, extend, illustrate, infer, outline, relate, rephrase, translate, summarize, show, classify
- Apply
 - Student discusses knowledge and consequences, but does not relate evidence to conclusion
 - Test item asks to apply, build, choose, construct, develop, interview, make use of, organize, experiment with, plan, select, solve, utilize model, identify
- Analyse
 - Student correlates and differentiates, is able to distinguish between options
 - Test item asks to discriminate, infer, outline, separate
- Evaluate
 - Student discusses knowledge and consequences and relates evidence to conclusion
 - Test item asks to award, choose, conclude, criticize, decide, defend, determine, dispute, evaluate, judge, justify, measure, compare, mark, rate, recommend, rule on, select, agree, interpret, explain, appraise, ...
- Create

- Response relates knowledge and consequences together to make a case and a connection to a related area of knowledge beyond the explicit demand of the question
- Test item asks to build, choose, combine, compose, construct, create, design, develop, estimate, formulate, imagine, invent, make up, originate, plan, predict, propose, solve, suppose, discuss, modify

E-assessment implementation of MCQ

Online and computer based testing are used extensively for diagnostic and formative purposes. Its use as summative assessment is also frequent and in, some sectors of Education and training, is already common practice. This type of testing has many advantages since it is very efficient. It allows testing large number of students with a large number of questions thus assessing a wide range of knowledge. It allows the inclusion of rich media files. There are still some issues that prevent the wider adoption in high stakes assessment:

- Designing good MCQ is a difficult task that usually requires training and practice
- Using technology raises several security issues, in particular in online tests
- The need to deal with logistical aspects: computers, connectivity, authentication, security
- The possibility that non controllable external issues will cause the failure of the test
- The need to use specific software and consequent training of teachers and students

Computer based test / online testing

Multiple choice questions are a usual component of tests and exams, used for formative and summative assessment. There are many software solutions available that can be used to implement a test using computers, most of them very sophisticated. They offer a range of options to configure the test to the needs of the assessment, from the design of the question and test to the delivery process, feedback and results.

Optical reading

Some teachers will use the software to create and manage question banks, to build tests but won't use it deliver test to students. Instead, they will print it and grade the paper version or they will use optical reading to transfer the results to a computer. Test analysis is also done using a computer.

CAT: Computerized Adaptive Testing

In adaptive assessment [26] the test is built dynamically from a question database and includes pre-determined rules for selection of the questions that will be displayed to the student. The test will interpret the responses of the students and will make estimates of their ability. This estimate will then be used to select the next question or set of questions, in a iterative process. The process stops when the students reach the predetermined level of competence. CAT demands a large question

bank with and hierarchy of items. The validity of this type of testing depends on the quality of the items, the psychometric parameters of the item and the item selection process. More information about CAT may be found at the website C.A.T. Central [90], including recommended literature.

Essays

In an essay the student is expected to produce a structured text that responds to the question or challenge posed by the teacher. The nature of an essay may vary, determining different Learning Outcomes. Essays allow for assessing deep learning instead of rote learning. Essays promote understanding, analysis and evaluation as well as the integration of different types of knowledge and skills. Depending on how essays are designed, they may contribute to the acquisition and assessment of transversal skills like communication, working in teams, lifelong learning.

- Speculative essay
- Quote to discuss
- Assertion
- Write on
- Describe/explain
- Discuss
- Compare
- Evaluate
- Problem

E-assessment implementation of essays

File Upload

Assessment using essays is a traditional method that may be implemented online in a straightforward manner. Any tool that allows the student to send a single text file to the teacher may be used. This includes e-mail, assignment tools in LMS that allow the uploading of files. Using a LMS has advantages since it allows the automated control of the submission processes in a organized manner: number of submissions per student, size of the file, deadlines, etc.

Essay Question in online exam

Most LMS or online testing software includes a type of question that is “Essay” that allows the writing of text or the submission of a file.

Discussion Forum

Discussion forum allow the uploading of files but these will be available to a larger audience that may be controlled by the teacher. This is a good alternative if peer assessment is wanted and will contribute for the development of critical thinking and evaluation skills in both assessors and assessed students. However, the submission process won't be as controlled as described previously. Teacher may structure the discussion by assigning a specific work to be assessed by one specific student or group of students. The student that is being assessed may defend his work, initiating a



dialogue among students. This process can be supervised by the teacher.

Published media

The teacher may ask the student to publish the essay as a webpage that maybe shared with the teacher, with peers or with a larger audience. The advantages of using a webpage as the output format is that will contribute to the development of other skills and knowledge. For producing a webpage, students will have to address issues related with online communication that include:

- Technological issues during development: choosing the technology, producing results and others
- Awareness of the importance of web-design
- Structuring information in a non linear format using hyperlinks, tags and other navigation tools
- Using different types of media to enrich the message (image, audio, video, etc)

By having their work publicly available to a larger audience may increase responsibility of the students. Their accomplishments as well as their mistakes will be visible not only to the teacher but also other students and the general public.

Wiki

Wiki is a tool that may be used for group work since it allows students to work collaboratively in developing one or more documents. The great advantage is that it keeps records of the process of development by the students: “who” did “what” and “when”. However, some studies point to several difficulties of assessing collaboration since the use of the tool by the students may interfere with the results. As an example, it is customary for students working in group to develop the work offline and having only one student publishing the content in the wiki. To overcome these obstacles, it is necessary that the assessment criteria and process is very clear to the students.

Concept maps

Concept maps may be used to assess the early stages of writing an essay, organization and planning. There is software available that allows the online development of CM and in some cases it allows the collaborative development by different users.

Videoconferencing

Depending on the assignment design, an oral presentation of the essay by the student may be necessary. This can be done online using videoconferencing facilities. The presentation may be done in real time, allowing for feedback and interaction among the users. In other cases, the student may record a video presentation and send it to the teacher.

Chat

The chat tool may be used for discussion of the essay for assessment purposes. It may be done during the development process as formative assessment or at the end of the assessment with a summative purpose. One of the advantages of using chat is that the session is usually recorded in a

text file that can be accessed afterwards. Chat discussions may be used with assessment by the teacher or by peer although the latter may be more complex to implement.

Problem solving

Problem solving is a response to a question that requires thought and/or planned action. Plants et al. describe it as the student will combine ideas to produce an answer to a previously unanswered question. Problems vary in complexity and openness and, consequently, assessing problems also varies in complexity. In a closed problem the teacher knows the method and the solution; the answer is constructed and convergent. These problems are easy to assess but as the problems become more open and complexity increases, assessment has to become more flexible and it is more difficult to be reliable and valid. The same applies to assessing large numbers of students. For simple closed ended problems it is easy but for other types it is time demanding being difficult to implement.

- **Routines**
- **Diagnosis**
- **Strategy**
- **Interpretation**
- **Generation**

E-assessment implementation of problem solving

The implementation of e-assessment strategies for problem solving may depend on the type of the problem and on what type of information the assessor wants to obtain.

Computer based test / online testing

Online testing may be used for the assessment of problem solving. MCQs or SAQs with automated correction and feed-back may be implemented when the student is solving an exercise with a known answer. If it is necessary to register the solving process, the test will have to include an open answer question type that allows the insertion of special notations.

File upload

The student may be asked to submit a file that shows the process used to solve the problem. This type of tools allows students to submit files from specific software that was used to implement the problem.

Chat

An online discussion may be used to promote collaborative problem solving among students or to discuss the chosen approach with a single student.



Concept maps and Diagrams

In open-ended enquiry and in projects, students may be asked to build a diagram or concept map of the procedure they will implement. This type of tool may be useful to assess student's planning of the solution to problem.

Simulation

Computer based simulations play an important role in authentic assessment of problem solving. Simulations may vary in nature and complexity but they usually allow students to manipulate data, examine consequences. Simulations may have a strong graphical component, representing a physical system that can be manipulated, or may be text/numerical based representing a conceptual model. Students will need to manipulate the software to produce the solution to a given problem.

Scenario-based activity

Scenarios are suitable for complex problem-solving and situations that require making decisions in an authentic context. Usually it requires the use of software. However, in some cases it may be implemented using a discussion forum to develop the interaction between the different roles of the simulated situation.

Practical work

Practical work as referred by Brown is related to work developed in laboratories or equivalent environments. Practical work plays an important role in Engineering and other areas of Education and is generally understood that students will learn more effectively when they are engaged in practical tasks.

ALOA model uses the following classification of practical work:

0. Demonstration
1. Exercise
2. Structured enquiry
3. Open enquiry
4. Project

E-assessment implementation of practicals

Assessing practical work is traditionally done by analysing reports of practicals, tests and observation and testing of performance. When using computers for assessing practicals, the report analysis and testing are straightforward to implement. For the reports the teacher may use any tool that allows uploading a file, like e-mail, forum or assignment upload. To assess knowledge and understanding about practical work, a Computer Based testing software may be used. For the



hands-on component, other strategies may be used.

File upload

These tools may be used for uploading reports and other type of files. The main advantage in relation with traditional printed reports is the possibility of incorporating different types of media like audio and video.

Computer based tests/Online testing

To test knowledge and understanding of the factual, conceptual and procedural knowledge related with the topic. CBT has the advantage of allowing the use of rich media for illustrating procedures that may be used for structuring the questions. This is an important feature that allows authentic assessment.

Video file, animations and sequence of images

Video is a powerful tool to use in the assessment of practical work. For the Demonstration type of practical, the student is exposed to an experiment performed by the teacher or other experts recorded previously and made available to students as a single file or integrated in a structured learning object, complemented with other types of content, including online tests. The great advantage is that this type of file may be reused. Also, with the help of a video expert is possible to use techniques to highlight parts of the procedure that are more important or difficult.

For the other types of practicals described above, video files may be produced by students to demonstrate their performance that can then be assessed by the teacher or their peers. It is a powerful tool for self assessment because it allows the student to review his own performance. Some types of phenomena or procedures may be difficult to capture in video. In these cases, the teacher may produce an animation to demonstrate a procedure. It requires technical skills to develop but it has great reuse potential

An alternative to video for demonstration purposes or assessment of skills is using a sequence of images. It has the advantage of being easier to produce than video.

Videoconferencing

A videoconferencing system may be used by the teacher for demonstrating a procedure in real time to students that are in a different location. It may be used to assess the performance of students in practical work. Videoconferencing has the advantage of being interactive and creating opportunities for feed-back. However, technical issues may interfere with the effectiveness of the process.

Diagrams

Software for producing diagrams is a good tool to assess some components of practical work. In open-ended enquiry and in projects, students may be asked to build a diagram of the procedure they will implement. Diagrams may be used to ask the student to replicate the physical setting of an experiment they followed (Remember) or that they executed (Apply). Students may be asked to use a diagram to interpret and explain the processes of an experiment (relating procedures with concepts).

Publish media or wiki

Students may be asked to publish the report of their work in a website instead of using a standard text processing tool. A wiki may be an interesting way of recording the process of more complex

practical work, individual or in groups.

Chat and discussion forum

Online communication tools may be used in assessing practical work by the teacher or peers. It is particularly useful for evaluation, to discuss decisions taken by the students and the results obtained.

Virtual Labs and Remote Labs

Remote Labs are real laboratories that can be manipulated by the students at a distance. Virtual labs are simulated labs that allow students to explore equipment and procedures, to seek their own solutions.

Simulation

Computer based simulations play an important role in authentic assessment of practical work. Even though they do not replace the real physical interactions that occur in a lab or equivalent environment, they may replicate several of the processes that occur. Simulation may vary in nature and complexity but they usually allow students to manipulate data and examine consequences. Simulations may have a strong graphical component, representing a physical system that can be manipulated, or may be text/numerical based representing a conceptual model.

De Jong and Van Joolingen [91] define computer simulations as *programs that contain a model of a system (natural or artificial, e.g., equipment), or a process*. They divide them in:

- Simulations containing a conceptual model include principles, concepts and facts related to the system that is represented. These are used for discovery learning and may be qualitative/quantitative, continuous/discrete or static/dynamic
- Simulations containing an operational model include sequences of cognitive and non cognitive procedures that can be applied to the system, used for experiential learning

The complexity of existing simulations varies considerably in relation to the sophistication of the model and the degree of manipulation of the system that it allows. In most simulations the student is asked to change values of input variables and then observe the results.

The paper by Thomas et al. [92] defines three ways of integrating simulations in the assessment process:

1. As part of the assessment question, providing different scenarios to be studied
2. As the answer mechanism (the student has to use the simulation as the response)
3. As the feedback provider to the student, important in formative assessment

Scenario-based activity

Scenarios are suitable for complex problem-solving and situations that require making decisions in an authentic context. Usually intends to model expert performance and decision making, based on a non-linear paradigm. It works on tacit knowledge and behaviours associated with a subject.



Game based learning

Games principles are similar to a constructive approach to learning. Crisp [26] presents a table that matches game design principles with learning design. Games may be used for authentic assessment activities with frequent rewards. Feedback is provided in response to actions of the game and student is rewarded when achieves goals. Mistakes will be made and corrected. The main goals of gaming and learning are different. In gaming students have to win. In learning students have to learn and apply. In gaming, sometimes students don't master the necessary skills but are still able to win. To assess this type of task it is necessary to clarify what are the expected LOs. Another problem is that games are difficult to develop specially if they have a strong programming and design component, like in videogames. Some games may be simpler in terms of technology. Quizzes or discussion forum may be used to implement the game and corresponding assessment. A game has a goal and tasks that have to be completed to achieve the goal and these may constitute the assessment criteria. What is assessed, the product or the process? If it is the process, then the game must allow tracking the process. This can be very complex and difficult to implement.

Short-answer questions (SAQ)

Short answer questions are questions that demand a short response from the student. Answers may be in text, graphic or numerical formats. Short answer questions have potential to assess an extended range of LOs. SAQs usually demand constructed response that may be convergent or divergent.

The ALOA model uses the following classification by Brown et al.:

- Select crucial evidence
- Explain methods, procedures and relationships
- Present arguments
- Describe limitations of data
- Formulate valid conclusions
- Identify assumptions
- Formulate hypothesis
- Formulate action plans

E-assessment implementation of short answer questions

SAQs are easy to implement using simple e-assessment tasks.

Computer based test / online testing

SAQs are a usual component of tests and exams, used for formative and summative assessment. There are many software solutions available that can be used to implement it using a computer. They offer a range of options to configure the question to the needs of the assessment, from the size of answer (single word or small text) to other types including fill-in-the blanks.

Chat or Forum

An online discussion tool may be used to deliver the SAQs to an individual student or group. This could be interesting to promote discussion around specific themes or to promote collaboration in finding the answer

Concept maps and Diagrams

Some SAQs may require an answer that includes illustrating a concept or a process using a diagram or a concept map.

Reflective Practice Assignments

Reflective practice is an approach to measure the capacity to analyse and evaluate experiences. Reflective practice assignments aim at motivating students to understand and critically think about their own learning and development.

ALOA model uses KOLB learning cycle to analyse this type of assessment:

- Concrete experience
- Reflective observation
- Abstract Conceptualisation
- Active Experimentation

E-assessment implementation of reflective practice

Portfolios

Portfolios may have different uses, as stated by Mason [93]: developmental, presentation and assessment. Also it may be applied with different scopes: course, programme, transversal. They allow for a holistic approach to education, integrating pedagogy of the course, the learning activities and assessment. Also it allows the development of meta-cognitive knowledge, important for lifelong learning.

Portfolios intend to provide rich information about the students' learning. [94] Other authors identify four types of evidence that may be collected in portfolios:

- Artefacts, produced during learning activities
- Reproductions, produced outside classroom
- Attestations, documents about progression of the student



- Productions, documents prepared specifically for the portfolio and that may include goal statements, reflective statements and captions. This is basically meta-information about the learning of the student

The first three types of documents may be linked explicitly to the fourth type.

E-portfolios are portfolios that use media to organize information and that allow the inclusion of different file types. There are five stages identified in portfolio production, as defined by Barrett:

- **Collection:** artefacts that represent the success are saved by the individual or institution
- **Selection:** artefacts are reviewed and evaluated to identify those that demonstrated achievement of what is intended
- **Reflection:** students reflect on their learning, the artefacts and the achievements. They will also identify gaps in their learning.
- **Projection:** They compare their reflections and performance with standards and will define learning goals for the future.
- **Presentation:** the portfolio is shared with other students.

To implement e-portfolios as an assessment tool it is important to have a structured approach.

Based on the Electronic Portfolio Development process proposed by Barrett, it is possible to adapt it to assessment.

1. **Context:** Define the context of the portfolio, including the purpose and LOs to be addressed. It is important to clarify the audience of the portfolio and how it will be presented. At this stage it is important to decide how it will be implemented and what resources will be needed.
2. **Selection:** Based on the previous stage, students may start collecting, selecting and documenting the artefacts that are related with the LOs.
3. **Reflection:** The student should describe the artefacts selected, explain why it was important and what was learned and finally analyse the performance against what was expected.
4. **Connect evidence:** The great advantage of e-portfolios in relation to a traditional assessment is that it allows connecting the evidence to the LOs, reflections and descriptions.



One single artefact may be connected with different LOs and reflections. Portfolios are important for self-assessment and for the lifelong learning context.

- 5. Presentation:** Presenting the portfolio to the audience is a strategy for implementing self and peer assessment, increasing the formative potential of the portfolio.

Another aspect of using e-portfolios is that may help the development of multimedia skills and communication skills. Concerning assessment, e-portfolios may be used for formative and summative assessment.

Integration of e-assessment with TALOE webtool

The webtool developed in TALOE is based on the ALOA model and includes general assessment methods. This document establishes a correspondence between each method and e-assessment practices. When the teacher uses the webtool, the results suggest general assessment methods that can be used for the Learning Outcomes inserted by the teacher. After the integration, the webtool will provide the general assessment methods and the corresponding suggestions of e-assessment practices.



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