Assess Inquiry in Science, Technology and Mathematics Education

Assessment Transformation Package

University of Copenhagen

Department of Science Education

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Assessment Transformation Package

> D6.5 Assessment Transformation Package: An Assessment Transformation Package with re-fined assessment methods and guidelines based on stakeholder feedback.

The Assessment Transformation Package (ATP) produced by ASSIST-ME will offer users examples of assessment guidelines and methods focusing on inquiry learning environments and accommodate differences in educational systems across Europe.

ASSIST-ME has produced a large body of research results from the classroom, but this is not readily usable for practitioners or for policymakers. The results need to be interpreted and transformed into a teacher context and into a discourse of policy in order to be used for changing teaching and for decision making. The purpose of the ATP is to promote and support transformation of the current national assessment system towards a more inquiry learning oriented system, i.e. a system focusing more on formative assessment and with summative assessments in alignment with this.

It is a fundamental understanding of the ASSIST-ME project that educational change must be initiated and carried through in a close collaboration between teachers, researchers, and policy makers. Thus, the ATP is designed to be used by three main target groups:

- By policy makers to inform decision making on curriculum design, teacher training and assessment strategies at institutional, regional and national levels taking into account relevant system characteristics and variables.
- By teachers and teacher educators to develop effective combinations of formative and summative assessment in daily practice in primary and secondary schools.
- By researchers to study formative and summative assessment methodologies and practices in different educational systems.

Summary

D6.5 is completely Web-based so that it is easily accessible to policy makers, practitioners and researchers. It provides entry points for each of these groups to aid them in using ASSIST-ME research results. In addition to overall suggestions for using formative and summative assessment methods, it contains eight country specific sections that interpret the overall suggestions for educational systems in each country. These country modules are written in the languages of the countries for easy access by nationals. Numerous links to appendices and project findings are provided throughout both the overall and country specific sections.

This deliverable provides the framework for all of these Web based materials in a 'screen/shot' format. Already the basic overall transformation materials are presented here and an example of a country specific module (Denmark) is in place. During the final six months of the project, partners will continue to populate this framework with materials from their national research. The completed Web site will be launched on the Internet at the final ASSIST-ME project conference on November 3rd, 2016. It is hosted on a University of Copenhagen server and will be available for at least five years after the conclusion of the project.

Overview of Website

Following is a graphical overview of the structure and content of the assessment transformation package. Each of the elements of the overview will be subsequently shared and described in this report.

Flow graphic for the
ASSIST-ME Transformation Web site

The opening screen (at the top) leads to three transformative perspectives. Teachers to the left, Researchers in the middle and Policy makers to the right

Most screens have links to Appendices where more details are found. Also, whereever there are country (flags) there are links to country pages where details relevant to each country are found, mostly in national languages.

Overall Transformative Suggestions for Teachers, Researchers and Policy Makers

The Web site will open with the following screen that offers an overall project video with interviews with project leaders and researchers. It then provides three user entry areas: Teachers, Researchers and Policy Makers. These are linked to screens which provide relevant project outcome suggestions.

This site, produced by ASSIST-ME offers examples of assessment guidelines and methods focusing on inquiry learning environments and accommodating differences in educational systems across Europe. This video provides an overview of the project through its researchers.

Introduction to the project

Assessment guidelines and methods are gathered into three perspectives. Each of three entries will lead you to results from the eight partners which reflect the educational systems of their countries.

TEACHERS Teachers and teacher educators can develop effective combinations of formative and summative assessment in daily practice in primary and secondary schools.

RESEARCHERS Researchers can study formative and summative assessment methodologies and practices in different educational systems.

POLICY MAKERS Policy makers can make informed decisions on curriculum design, teacher training and assessment strategies at institutional, regional and national levels taking into account relevant system characteristics and variables

Teachers

The Teachers opening screen gives teachers a choice of finding out more about four kinds of assessment that they currently may use. The idea is for them to learn from project results what steps they can take to transform their current methods.

TEACHERS

Teachers and teacher educators can develop effective combinations of formative and summative assessment in daily practice in primary and secondary schools.

ASSIST-ME research results provide suggestions for transforming common teacher formative and summative assessment practices into methods which provide greater feedback on progress for both teachers and students.

Select a commonly used assessment method below to see what the project results for each of eight European countries suggests for transforming your current methods for greater feedback.

- ❑ Written feedback to students on artefacts of their work
- ❑ Oral on-the-fly feedback to students as they work
- ❑ Student-to-student feedback on emerging artefacts
- ❑ Combining formative and summative assessment

If a teacher user selects 'Written feedback to students on artefacts of their work', they will next see the following screen which contains steps as well as links to examples of artefacts, a link to an example of a template and a link to an entire use of written feedback:

TEACHERS

❏ Written feedback to students on artefacts of their work

ASSIST-ME suggested steps to increase the quality of written feedback:
1. Students produce certain artefacts (lab reports, ideas for experiments, link to more examples of artefacts) associated with the competence
2. Teachers' give feedback focused on these artefacts. Feedback is given to individual students via paper or Web based platforms.
3. Teachers' feedback is supported through specially designed templates which provide a check-list of competences important for the lesson. (Link to template example)
4. Upon receiving comments from the teacher, each student revises the relevant artefact, taking into account the feedback received.

> **Link to**
> An example of a teaching plan for the competence of investigations in science
> Competence: Investigations in science
> Assessment Method: Marking (grading & written comments)
> Subject Area: Physics
> Educational Level: Upper Secondary (ages 15-17)

The next teacher's screen (below) provides links to deeper resources for written feedback as well as to the eight national research screens.

TEACHERS

Read more about the background for these research questions in the Description of Work (link (Appendix H)

ASSIST-ME project research approaches, data, results and examples are available for each of eight partners in their languages at the **links to these flags.**

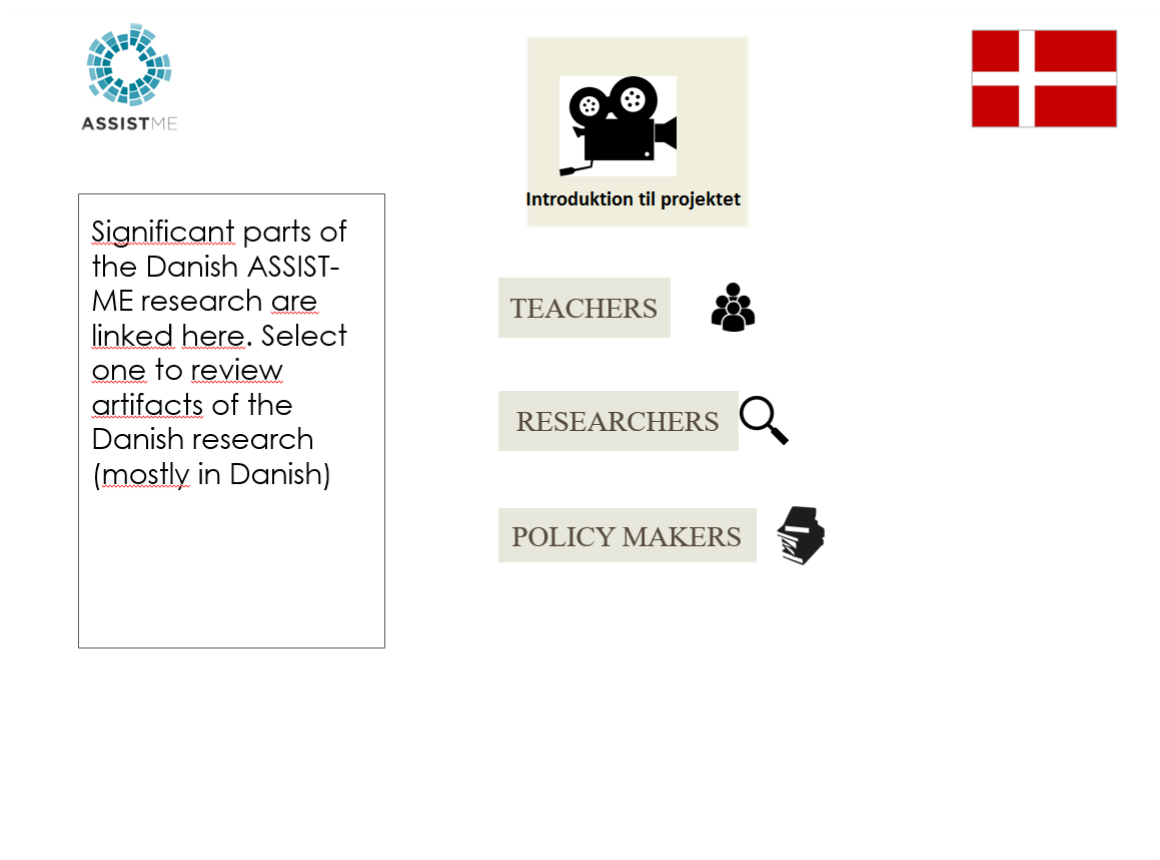These sites put project results into National educational contexts

App I   App J   App K   App L
App M   App N   App O   App P

Link to (Appendix Q)
Summary of the overall project outcomes

Link to For each of the assessment methods you can find the research designs through the links below:
- Written feedback (Appendix R)
- Oral on-the-fly feedback (Appendix S)
- Student-to-student feedback (Appendix T)
- Combining formative and summative assessment (Appendix U)

The Danish national ASSIST-ME opening screen leads to project examples including a Danish relevant video, cases, templates and teaching plans in Danish.

Significant parts of the Danish ASSIST-ME research are linked here. Select one to review artifacts of the Danish research (mostly in Danish)

Introduktion til projektet

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Each of the other seven ASSIST-ME partner countries has a similar site with research results useful to teachers in transforming their current assessment practices. Most of this site information will be in national languages since these additional transformation ideas are idiosyncratic to the educational systems and curricula of each country.

If a teacher user selects 'Oral on-the-fly feedback to students as they work', they will next see the following screens which contain steps as well as links to examples of artefacts, a link to an example of a template and a link to an entire use of on-the-fly feedback:

❑ Oral on-the-fly feedback to students as they work

ASSIST-ME suggested steps to increase the quality of oral on-the-fly feedback to small groups of students:

1. Teacher suggests an activity in order to investigate a hypothesis that emerged during a discussion.
2. Teacher poses a question that is intended to promote students' thinking about the topic being discussed
3. Teacher poses clarification questions to help students further articulate a seemingly valid contribution they made
4. Teacher takes the opportunity to use what the students said in order to conclude/provide feedback
5. Students express several ideas that allow the teacher to ask them to compare the ideas
6. Teacher gets a contribution from the students and asks for further explanation with the intent to help them evaluate and adjust their reasoning

ESRU scheme (Ruiz-Pinto & Furtak, 2006)

❑ Oral on-the-fly feedback to students as they work

Link to
 Examples of the major challenges faced by teachers in giving on-the-fly feedback to
working groups with sample dialogues and several content areas.

As with written feedback, teachers can proceed to more background and transformation aids .

ASSISTME   TEACHERS

Read more about the background for these research questions in the Description of Work (link (Appendix H)

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These sites put project results into National educational contexts

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And also as with written feedback, teachers can then go to country specific experience and suggestions from country portal screens like this one for Denmark:

ASSISTME

Introduktion til projektet

Significant parts of the Danish ASSIST-ME research are linked here. Select one to review artifacts of the Danish research (mostly in Danish)

TEACHERS

RESEARCHERS

POLICY MAKERS

If a teacher user selects 'Student-to-student feedback on emerging artefacts', they will next see the following screens which contain steps as well as links to examples of artefacts, a link to an example of a template and a link to an entire use of student-to-student feedback:

❏ Student-to-student feedback on emerging artefacts

ASSIST-ME suggested steps to increase the quality of student-to-student (peer-to-peer) feedback:

1. Develop teaching and learning materials targeting relevant competencies
2. Before the implementation the students should be introduced to the roles of the peer-assessor and the peer-assessee. During the implementation, students alternate between the two roles
3. As part of the teaching and learning materials, student(s) submit to their peer(s) certain artefacts they produce, associated with the competence under emphasis. These artefacts could be produced either by individual students or by groups of students.
4. The student(s) provide feedback to their peer(s). The process of exchanging peer-feedback is supported through specially designed templates, which encompass criteria for assessing the specific artefacts. These tools are developed by the teacher.

☐ Student-to-student feedback on emerging artefacts

ASSIST-ME example of student-to-student (peer-to-peer) feedback with a teacher created template:

Model Assessment	
1. Name of model:	Group 9
2. Modeler's group name:	Group 9
3. Date:	24/07/2015
4. Phenomenon represented by your model:	It represents plant growth
5. Criteria 1,2,3,4 : representation of phenomenon To what extent does the model incorporates all necessary components associated with the operation of the target phenomenon (Criterion 1: objects, Criterion 2: variables, Criterion 3: relationships and Criterion 4: processes)? Specifically identify missing components.	It includes some objects like plant but some other are missing such glucose and conduits (CRITERION 1). Variables like water, sun, CO2 (CRITERION 2) and relationships like water-roots, sun – tree leaves, CO2- leaves, are existed (CRITERION 3). But it does not provide information about the processes. (CRITERION 4)
6. Criterion 5: Explanatory power of the model To what extent does your peers' model includes a mechanism that can help one account for operation of the target phenomenon? Justify your response and if you think that it does include such a mechanism offer a brief description of the mechanism.	The model provides a partial explanation. It provides only few pieces of information. (CRITERION 5)
7. Criterion 6: Predictive Power To what extent can your peers' model be used by someone to predict the operation of the phenomenon under specified (not previously observed) conditions? If yes, formulate a prediction and justify how it can be derived from your peers' model	Even though the plant is already developed, it still needs specific amounts of sun and water. if The plant is irrigated with less amount of water it can't product glucose for its needs. (CRITERION 6)
8. How would you suggest your peers to revise/change their model so as to make it more powerful in terms of the six criteria?	They should place the various elements of the model in an appropriate sequence. Specifically, we mean that they have to draw the developments stages of the plan (small, big, bigger) in order to show the size of the plant (CRITERION 2) They should also use more colors and be clearer and more explicit in the information they are providing.

As with all four types of feedback, teachers can proceed to more background and transformation aids including country specific information from the following screens:

Read more about the background for these research questions in the Description of Work (link (Appendix H)

ASSIST-ME project research approaches, data, results and examples are available for each of eight partners in their languages at the links to these flags.

These sites put project results into National educational contexts

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Significant parts of the Danish ASSIST-ME research are linked here. Select one to review artifacts of the Danish research (mostly in Danish)

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POLICY MAKERS

If a teacher user selects 'Structured Assessment Dialogue', they will next see the following screens which contain steps as well as links to examples of artefacts, a link to an example of a template and a link to an entire use of structured assessment dialogue feedback:

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TEACHERS

□ **Combining formative and summative assessment through a 'structured assessment dialogue'**

ASSIST-ME suggested steps to increase the quality of 'structured assessment dialogic' feedback:

1. Teachers develop teaching and learning materials targeting a competency
2. The teaching plan includes a ritualized conversation (5 minutes) between one student (the student in focus) and a teacher based on the student's preparation and the teacher's filled-in template mirroring the demands for the competence to be assessed.
3. This is followed by a peer-feedback phase where the student in focus discusses the dialogue with a group of feedback students.
4. During these two interactions, the rest of the class observes and reflects on their own understanding.
5. In the end, all students write down reflections about their perceived level of competence and future learning path using a reflection tool.

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□ **Combining formative and summative assessment through a 'structured assessment dialogue'**

Link to
 The various types of contributions which teachers and students make in a Structured Assessment Dialogue. Some statements are used by both students and teachers to formatively assess current student progress. Other statements are used for formative assessment.

As with all four types of feedback, teachers can proceed to more background and transformation aids including country specific information from the following screens:

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TEACHERS

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RESEARCHERS

POLICY MAKERS

Researchers

If from the opening screen, users select 'Researchers' the opening screen gives them details about the main research questions of the project as well as leads into more specific research user results including country specific materials (Denmark here is one of eight examples).

RESEARCHERS

The ASSIST-ME project has four main research questions that sought to investigate how summative and formative assessment can be combined across various European educational contexts:

1. What are the main challenges related to the uptake of formative assessment in the daily practices in science, technology and mathematics in primary and secondary schools in different European educational systems?
   1.1 In their efforts to enact innovative inquiry-based teaching-learning sequences, how do teachers approach the need to monitor student learning as it develops? To what extent does they use structured formative assessment and in what formats?
   1.2 What systemic support measures and what tools do teachers need in order to integrate formative assessment of student learning in their classroom practice?

2. What changes are needed in summative assessment practices?
   2.1 To bring them into consistency with the learning aims of IBE in STM?
   2.2 To ensure that they support and do not inhibit the practice of formative assessment?

3. How can formative and summative assessment methods including use of ICT be used together to promote learning in inquiry-based STM?

4. How can research-based strategies for the use of formative/summative assessment be adapted to various European educational traditions to ensure their use and avoid hindrances?
   4.1 How can the diverse roles of summative and formative assessment be clearly delineated for teachers and what strategies can help them make appropriate use of both, each to fit its own purposes?
   4.2 How can relevant stakeholders be invited to take co-ownership to the research results and how can a partnership between researchers, policy makers, and teachers be established in order to secure relevant actions following implementation guidelines?

RESEARCHERS 🔍

Read more about the background for these research questions in the Description of Work (link (Appendix H)

ASSIST-ME project research approaches, data, results and examples are available for each of eight partners in their languages at the **links to these flags**

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RESEARCHERS 🔍

Significant parts of the Danish ASSIST-ME research are linked in the four categories here. Select one to review artifacts of the Danish research.

Danish research **approaches** for the four assessment methods (Appendix V)

Danish research **data** for the four assessment methods (Appendix W)

Danish research **results** for the four assessment methods (Appendix X)

Danish research **examples** for the four assessment methods (Appendix Y)

The majority of the research methods and findings are reported in a book having Jens Dolin and Robert Evans as editors-in-chief. A contract has been signed between Springer Publishers and AS-SIST-ME researchers and the book, titled Transforming assessment – through an interplay between practice, research and policy, will be for sale at the ESERA2017 conference in Dublin.

The book has the following content:

Editors
Jens Dolin, Robert Evans, Christine Harrison, Florence Le Hebel, Monika Holmeier, Pasi Nieminen, , Mathias Ropohl and Silke Rönnebeck

Introduction. **The problems and affordances with implementing and assessing competences in a test-oriented educational system**.
Authors: Jens Dolin, Editorial Board

Section I   Background

Chapter 1. **The concept of competence and its releveance for science, technology and mathematics education**
Authors: Mathias Ropohl, Xenia Danos, Jan Alexis Nielsen, Christopher Olley, Silke Rönnebeck

Chapter 2. **Teaching and assessing competences in the context of scientific inquiry, engineering design, and problem solving**
Authors: Silke Rönnebeck, Xenia Danos, Jan Alexis Nielsen, Christopher Olley, Mathias Ropohl

Chapter 3. **Combining formative and summative assessment**
Authors: Jens Dolin, Paul Black, Wynne Harlen, Andrée Tiberghien

Section II   Practice

Chapter 4. **On-the-Fly assessment**
Authors: Chris Harrison, Pasi Nieminen, Catarina Correia, Natasha Serret, Nikos Papadouris, André Tiberghien, Micheal Grangeat, Ellie

Chapter 5. **Structured assessment dialogue**
Authors: Jens Dolin, Jesper Bruun, Catarina F. Correia, Chris Harrison, Sofie Birch Jensen, Sanne Schnell Nielsen, Pasi Niemienen

Chapter 6. **Peer assessment**
Authors: Florence Le Hebel, Costas Constantinous, , Regula Grob, Monika Holmeier, Alena Hospesova, Pascale Montpied, Marianne Moulin, Jan Petr, Lukas Rokos, Iva Stuchlikova, Andrée Tiberghien, Olia Tsivitanidou, Iva Zlabkova.

Chapter 7. **Teacher written feedback**
Authors: Monika Holmeier, Regula Grob, Jan Alexis Nielsen, Mathias Ropohl, Silke Rönnebeck

Section III   General Reflections

Chapter 8. **European perspectives on formative and summative assessment**
Authors: Robert Evans, Michel Grangeat, Lima Laurent, Nakhili Nadia, Elie Rached, Mathias Ropohl, Silke Rönnebeck,

Chapter 9. **Teacher perspectives about using formative assessment with Inquiry Based Science Education**
Authors: Robert Evans, Rose Clesham, Jens Dolin, Alena Hošpesová, Sofie Birch Jensen, Jan Alexis Nielsen, Iva Stuchlíková, Iva Žlábková

Chapter 10. **Policy aspects – how to change practice**
Authors: Jens Dolin, Paul Black, Jesper Bruun, Costas Constantinou, Justin Dillon, Doris Jorde, Olaf Köller

Chapter 11. **A research perspective with recommendations for further research**
Authors: Jan Alexis Nielsen, Editorial Board

Policy Makers

If from the opening screen, users select 'Policy Makers' then the opening screens gives them details about the main research questions of the project as well as leads into more specific policy maker results including country specific materials.

The ASSIST-ME project has four main research questions to investigate how summative and formative assessment can be used across various European educational contexts:

1. What are the main challenges related to the uptake of formative assessment in the daily practices in science, technology and mathematics in primary and secondary schools in different European educational systems?
   1.1 In their efforts to enact innovative inquiry-based teaching-learning sequences, how do teachers approach the need to monitor student learning as it develops? To what extent does they use structured formative assessment and in what formats?
   1.2 What systemic support measures and what tools do teachers need in order to integrate formative assessment of student learning in their classroom practice?

2. What changes are needed in summative assessment practices?
   2.1 To bring them into consistency with the learning aims of IBE in STM?
   2.2 To ensure that they support and do not inhibit the practice of formative assessment?

The ASSIST-ME project has four main research questions to investigate how summative and formative assessment can be used across various European educational contexts:

3. How can formative and summative assessment methods including use of ICT be used together to promote learning in inquiry-based STM?

4. How can research-based strategies for the use of formative/summative assessment be adapted to various European educational traditions to ensure their use and avoid hindrances?
   4.1 How can the diverse roles of summative and formative assessment be clearly delineated for teachers and what strategies can help them make appropriate use of both, each to fit its own purposes?
   4.2 How can relevant stakeholders be invited to take co-ownership to the research results and how can a partnership between researchers, policy makers, and teachers be established in order to secure relevant actions following implementation guidelines?

Policy makers can find the summative National Stakeholder Panel conclusions from all eight partner countries with links to the following screen:

POLICY MAKERS

Choose by clicking on any of the following policy areas for overall ASSIST-ME based research suggestions

The main challenges related to the uptake of formative assessment in the daily practices in science, technology and mathematics in primary and secondary schools in different European educational systems (Appendix Z)

Changes needed in summative assessment practices (Appendix AA)

How can formative and summative assessment methods including use of ICT be used together to promote learning in inquiry-based STM (Appendix BB)

How can research-based strategies for the use of formative/summative assessment be adapted to various European educational traditions to ensure their use and avoid hindrances (Appendix CC)

They can also get more details from country National Stakeholder Panels from this screen:

To read recommendations for each of these policy areas from the partner countries, click on the country flag and go to the Policy Recommendations in the country language

ASSIST-ME project policy recommendations are available for each of eight partners in their languages at the **links to these flags**

These sites put project policy into National educational contexts

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Link to (Appendix Q)
Summary of the overall project outcomes

Supporting Transformation Materials linked to Web Screens

The ATP will summarize many of the ASSIST-ME results in the three target group categories: Policy makers, practitioners, researchers. For each category the messages, the justification of the messages, examples, national diversity etc. will be addressed, as illustrated in this table:

		Dimensions										
		Message			Justification							
		Our purpose	Recommendations	Guidelines	Type of examples	Type of results	Type of data	Way of addressing cultural aspects				
Target group	Policy makers											
	Practitioners											
	Researchers											

Much of the material in the ATP will be assessed through a link to the ASSIST-ME website. This website is under continuous construction as the results are collected and made readable. The following entries can serve as illustration of the variety of accessible material :

GRADING AND WRITTEN COMMENTS – EXAMPLES AND POTENTIALS AND CHALLENGES

INTERACTIONS ON-THE-FLY – EXAMPLES AND POTENTIALS AND CHALLENGES

SELF AND PEER FEEDBACK – EXAMPLES AND POTENTIALS AND CHALLENGES

STRUCTURED ASSESSMENT DIALOGUE – EXAMPLES AND POTENTIALS AND CHALLENGES

SYNTHESIS OF KEY FINDINGS

OVERALL RECOMMENDATIONS

EXAMPLES OF CODING FOR ASSESSMANT METHODS

NATIONAL APPROACHES

NATIONAL RESULTS

CHALLENGES TO USING FORMATIVE AND SUMMATIVE ASSESSMENTS

NATIONAL STAKEHOLDER PANEL DUSCUSSIONS

COMBINING FORMATIVE AND SUMMATIVE ASSESSMENTS