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1st report on the Delphi study

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| Hans Spada, Malte Jansen, Christine Plesch. 1st report on the Delphi study. 2010. hal-00722856

HAL Id: hal-00722856

<https://telearn.hal.science/hal-00722856>

Submitted on 5 Aug 2012

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D1.3

1st report on the Delphi study

Edited by
Hans Spada, Malte Jansen,
and Christine Plesch

A graphic of a stylized star or sun with a bright core and a glowing ring, surrounded by several smaller, semi-transparent circles of varying sizes and colors (grey, brown, blue).

STELLAR

Amendment History

Version	Date	Contributor(s)	Modification
0.1	May 21, 2010	Hans Spada, Anne Deiglmayr, Nikol Rummel, Dejana Diziol, Malte Jansen, Christine Plesch, Celia Kändler	First version
0.2	May 25, 2010	Ulrike Cress, Nina Heinze	Revision
0.3	May 27, 2010	Hans Spada, Anne Deiglmayr, Nikol Rummel, Dejana Diziol, Malte Jansen, Christine Plesch, Celia Kändler	Version for internal review
1.0	July 14, 2010	Hans Spada, Anne Deiglmayr, Nikol Rummel, Dejana Diziol, Malte Jansen, Christine Plesch, Celia Kändler	Final version

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WP1 | D1.3

1st report on the Delphi study

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public report	final	1.0	07/14/201	M16
audience & type	status	version	0	due date
			doc date	

Delphi study, TEL, research agenda, visions, fragmentation

keywords

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1 Executive Summary

The STELLAR Network of Excellence brings together European researchers from different professional backgrounds to promote research in the field of technology enhanced learning (TEL). A central objective of the STELLAR Network is to identify grand research challenges to be addressed by TEL in the near future. The STELLAR Delphi Study, which is conducted as part of Work Package 1, serves as an instrument to achieve this objective. By conducting several rounds of expert surveys, the STELLAR Delphi study consolidates the expertise of researchers and stakeholders from both within STELLAR and external to STELLAR and thus enables us to identify important research themes and trends within TEL. The insights gained through the Delphi study will enable STELLAR to formulate recommendations for future research programs and to assist in reducing the fragmentation in the multidisciplinary field of TEL.

For the 1st Delphi round, we conducted a STELLAR-internal online expert survey with a total of 41 participants. The survey aimed at getting a first overview of emerging trends in TEL that could be further evaluated in the 2nd Delphi round. The survey consisted of open-ended questions regarding important research topics and developments in the past few years, recommendations for future research programs, the experts' personal opinions on standards for TEL research and visionary statements about future learning scenarios. A qualitative data analysis was combined with a quantitative one.

Even though the primary goal of the 1st round was to prepare the 2nd Delphi round which involved a large sample of STELLAR-external experts, the expert answers already yielded many interesting results. The results provide an overview of topics that are currently important in the research field of TEL, e.g. *collaborative learning*, as well as topics that are likely to become more important in the future, e.g. *ubiquitous learning and technology*. This includes developments in both technology such as *Web 2.0* and education. Furthermore, the participating experts shared their opinions on standards for TEL research, i.e. the purpose of TEL research, characteristics of "good" TEL research and undesirable developments in TEL. Of special interest are experts' views on how technological developments in TEL and societal challenges, e.g. the *digital divide*, will change the future of learning. Thought provoking are visions about future learning scenarios like: "By 2025, learning to type-write will replace learning to hand-write in early education.", or "By 2025, virtual experiences will dominate education." The results from the 1st Delphi round are presented in detail in this report.

The goal of the 2nd round was to further deepen and generalize these insights by including the perspectives of a large sample of European and Non-European experts from outside of the STELLAR network. To reach this objective, we condensed the results of the 1st STELLAR Delphi into materials to be processed in the 2nd round. The 2nd STELLAR Delphi survey was carried out from February to April 2010 and employed 230 experts. The data analysis is part of the 3rd Delphi round and still in progress. This report concludes with an overview of the questionnaire of the 2nd Delphi round and describes the panel of expert participants. In Late 2010, we will add an annex to this report that will describe the results of the 2nd Delphi round in detail.

2 Introduction

The STELLAR Delphi study is an important instrument of WP1 for meeting the Grand Research Challenges (STELLAR, 2009). This report presents selected results of the 1st STELLAR Delphi round and an outlook on the 2nd STELLAR Delphi round. It is the first of two deliverables on the progress and the results of the STELLAR Delphi study within the activities of WP1.

First, we describe the design, procedure and goals of the STELLAR Delphi study, including the contribution of the STELLAR Delphi activities with regard to the overall goals of WP1. The following sections present the successfully completed 1st STELLAR Delphi round. Section 4 describes the methodology of the 1st STELLAR Delphi round, explaining the objectives and the procedure as well as presenting the panel of experts, the questionnaire design of the online survey and the data analysis. Sections 5 present the results of the 1st STELLAR Delphi round by illustrating important research topics, trends and developments in the field of TEL as well as visionary future statements and opinions on standards for TEL research.

The 1st STELLAR Delphi round lead the way towards the planning and execution of the 2nd STELLAR Delphi round. Section 6 describes the planning and implementation of the 2nd Delphi round: its objectives, its procedure, the panel of experts and the design of the online survey.

In the concluding section of this report we give a short outlook on the next steps of the STELLAR Delphi study.

3 STELLAR Delphi Study

3.1 Delphi studies

Delphi Studies in general aim at identifying emerging trends and future developments in a given field (Gordon & Helmer, 1964; Linstone & Turoff, 1975; Rowe & Wright, 1999). They involve several rounds of surveys among experts; the results of each round are analyzed, generalized and transferred into materials to be processed and evaluated by the survey participants in the subsequent round. For example, the Japanese National Institute of Science and Technology Policy (NISTEP, 2005) carried out a prominent large-scale Delphi study on scientific and technological developments. It has started in 1971 and completed its 8th cycle in 2005.

The Delphi method has several advantages compared to other expert-based methods of envisioning future scenarios. Due to the larger number of participants it is more representative compared to single expert interviews and due to the feedback process, experts are prompted to rethink and maybe also revise their answers. Additionally, the Delphi method avoids some flaws of expert group discussions such as unequal participation of the present experts, high status persons dominating the discussion or closure of the discussion session before a conclusion is reached. A review by Rowe and Wright (1999) found that the Delphi method leads to more accurate estimations and better decisions than group discussions.

In STELLAR, we implement the Delphi technique to involve a representative sample of researchers and experts from various disciplines in the iterative process of co-constructing a visionary agenda for future research in the field of TEL.

3.2 Goals of the STELLAR Delphi study

The STELLAR Delphi study is part of WP1 and thus is closely connected to the network's objective of formulating "Grand Research Challenges" for TEL. The goal of the STELLAR Delphi study is to identify the state of the art, the most relevant research issues, evolving trends as well as discontinuities and the most promising ideas in the field of TEL. The study is part of the subgroup of STELLAR activities that aims to reduce the fragmentation of the field by bringing together the experience and the views of disjoint communities and of multiple disciplines. New knowledge is built from conclusions based on complementary expertise and will provide valuable input to other STELLAR activities. This will be especially true for the integration of insights from the social and behavioural sciences with technical and professional perspectives and developments. In the long run, the condensed and integrated

perspectives on TEL may serve as a framework for future international research programs.

3.3 Plan of action

In order to achieve these goals, a 5-round Delphi process has been planned (see Figure 1). It consists of two large external survey-rounds among TEL experts from outside the STELLAR research network and three internal rounds that are conducted within the STELLAR network to prepare, analyse and discuss the external surveys and to integrate and distribute the results.

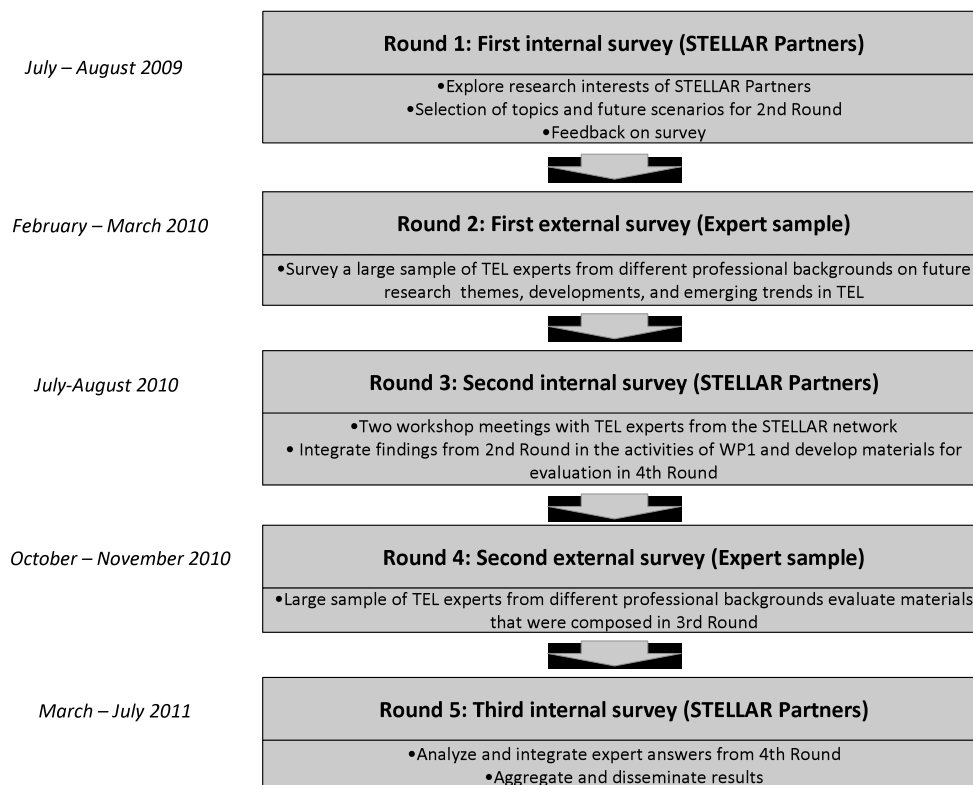


Figure 1. Agenda of the STELLAR Delphi study

This report focuses on results of Round 1 – an online survey among researchers from the STELLAR network. Furthermore, it gives an overview of the planning, implementation and the progress of Round 2, the first external survey which employed a larger sample of international TEL experts from outside the STELLAR network. Additionally, an outlook on the further Delphi rounds is given (see section 7).

3.4 Overview of STELLAR Delphi activities until April 2010

The Delphi project started in early 2009. As a first step, we defined the objectives for the Delphi study (see section 3.2), taking into account the specific requirements related to conducting a study within the STELLAR network of excellence, e.g. the

schedule, the networks' objectives and the availability of experts from the network. The objectives lead to the 5-round process described above (see section 3.3).

The fieldwork for the 1st Delphi round was carried out from mid-July to early September 2009. Based on the data from this round we prepared the materials for the 2nd Delphi round. The 2nd Delphi round took place from February to March 2010. Round 1 will be described in detail in section 4 and section 5 of this report; Round 2 will be described in section 6.

Figure 2 gives an overview of the main STELLAR Delphi activities until April 2010.

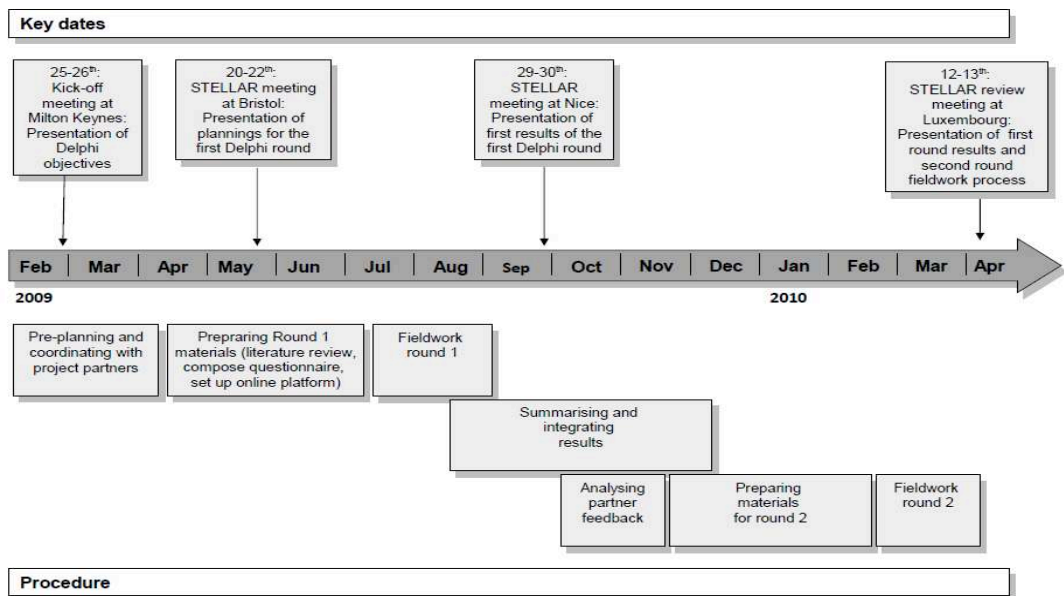


Figure 2. Overview of STELLAR Delphi activities till April 2010.

3.5 Role and function of the STELLAR Delphi study within the STELLAR network

The STELLAR Delphi study is one of three tasks in WP1 that aim at identifying and formulating the Grand Challenges for TEL (STELLAR, 2009). The first STELLAR Vision and Strategy Report (D1.1; Sutherland & Joubert, 2009) provided a unifying framework in form of three Grand Challenges for future research agendas in TEL:

- Connecting learners
- Orchestrating learning
- Contextualizing virtual learning environments and instrumentalizing learning contexts.

This study provided valuable input for the 1st Delphi round although only a draft version was available at the time of the planning of this study. The report on *Trends*

in Connecting Learners (Herder & Marenzi, 2010) was published parallel to the 2nd Delphi round. It will be very helpful to prepare the next round with external experts.

The STELLAR Delphi study mainly aims at the second objective of WP1 which is:

to contribute to a common framework for TEL research by involving researchers from multiple domains ... aiming for an integration of perspectives on core issues in TEL.
(STELLAR, 2009; p 18)

The STELLAR Delphi study focuses on this objective of WP1; that is, conducting two large surveys with key TEL stakeholders (STELLAR, 2009). Furthermore, the STELLAR Delphi study incorporates and draws on the strategic and conceptual work that is done by other WP1 partners and provides input for many of the other activities in STELLAR.

According to the Description of Work, WP 1 is the scientific backbone of the STELLAR Network. The aim is to identify the grand research challenges and to disseminate the insights gained to other STELLAR events and instruments (e.g. Meeting of Minds, STELLAR Open Archive, Theme Teams, Alpine Rendez-Vous). During the preparation phase of the 1st STELLAR Delphi round we mainly drew upon the fundamental work reported in D1.1 and D7.1. We could incorporate the relevant issues and findings from other work packages by asking researchers to provide insights from their work in progress through answering the survey in this first round. In particular, the open-ended format of the questionnaire for the 1st Delphi round allowed the participating STELLAR partners to cover relevant issues identified in their work packages and thus enabled us to gain a broader view on important themes in TEL research.

We were in close contact with the other STELLAR partners throughout the planning and data analysis process of the 1st and the 2nd STELLAR Delphi round. Several presentations during STELLAR network meetings and short progress reports during the monthly general assemblies via flash meetings served to inform the other network partners on the progress of the Delphi Study and to disseminate the results within the STELLAR network. At the meetings in Bristol and Nice we presented the current state of the Delphi project. The review meeting in Luxemburg served to present the results of the 1st STELLAR Delphi round and to report on the current state of the 2nd Delphi round. At these meetings STELLAR experts also offered their feedback and thoughts on the STELLAR Delphi study. To name some examples for the fruitful collaboration and mutual influencing between the Delphi-Team and other WPs: Ulrike Cress and Nina Heinze (KRMC) conducted a pre-test on both questionnaires (1st and 2nd Delphi round) with a sample of researchers; Fridolin Wild (UKOU), one of the editors of the *Report on the state of the art in TEL* (D7.1; Wild & Scott, 2009), assisted us in validating the coding categories of Round 1 in two flash

meetings; Iassen Halatchliyski (KRMC) helped us to rephrase the coding categories for use in the questionnaire of the 2nd Delphi round.

For the 3rd Delphi round, we will organize two workshops in Freiburg to integrate the findings from Round 2. These workshops will be held in conjunction with the WP1 integration meetings. Several STELLAR members from WP1 and the other work packages will meet to discuss how the different instruments – the STELLAR Delphi study, the Research and Technology Scouting reports, and the Roadmapping activities – can provide valuable input to each other, and how their results can be integrated. The planned design of the 3rd Delphi round is described in detail in section 7.2 of this report.

In the larger framework of the STELLAR network, the STELLAR Delphi study aims to provide scientific input for other WPs, for instance for the future capacity building activities of WP3. The results of the 1st Delphi round were disseminated to the STELLAR partners in February 2010. While they could not be incorporated into the first call for Incubators and Theme Teams that was posted in November 2009, they will provide a valuable input for the calls in the second year.

Furthermore, the STELLAR Delphi study supports the community building efforts and facilitates the work of WP 5: By involving international experts in TEL research and asking them for their personal opinions and visions, the STELLAR Delphi study makes STELLAR and the results of this network visible in the European TEL community and beyond. On the other hand the Delphi study opens STELLAR for insights and opinions outside the network.

The next steps in the STELLAR Delphi study and the further dissemination of the results within and outside the STELLAR network will be described in the outlook section at the end of this report.

4 Methodology of the 1st STELLAR Delphi Round

4.1 Objectives

The goal of the 1st STELLAR Delphi round was to “set the stage” for the first external round by gaining deeper insights into TEL research within STELLAR and by identifying important topics and trends in European TEL research to be discussed and extended in the second, external survey round. The survey topics covered were developments in TEL research in the last few years, future trends in TEL research, opinions on standards for TEL research and visions of STELLAR members for the future of TEL.

4.2 Procedure overview

In April 2009, preparations for the 1st Delphi round started. We developed the questionnaire in a design process that included a literature review on Delphi studies and important TEL topics, input from the STELLAR deliverables D1.1 (Sutherland & Joubert, 2009) and D7.1 (Wild & Scott, 2009), development of suitable open-ended questions and the online implementation of the survey. We refined the online survey several times and conducted a pretest with a small sample of researchers. Section 4.4 describes the questionnaire in detail.

The fieldwork started on July 21st. During the fieldwork process, we constantly monitored the number and the quality of the answers and sent out several reminders in order to promote participation (see Figure 3). The fieldwork was completed on September 6th (see 4.3 for details on the expert sample).

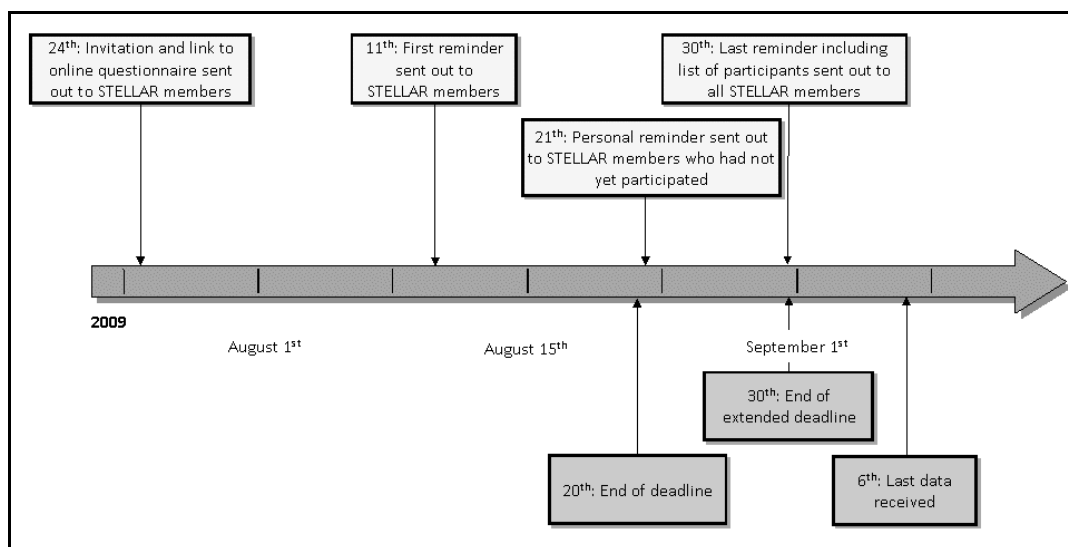


Figure 3. Timeline of the fieldwork process – 1st Delphi round.

After receiving a notable amount of answers we started the development of a framework for qualitative data analysis. The data analysis began simultaneously to the fieldwork and we analyzed the incoming answers continuously. Data analysis was completed by mid-November. Section 4.5 covers details on the data analysis.

4.3 Panel of experts

The expert panel was recruited by sending out an invitation email to the STELLAR mailing list. The list included 77 researchers from 16 research institutions across Europe. Based on the attendance of the STELLAR meetings in Milton Keynes and Bristol, a base of 30-40 people who actively work in the STELLAR project was identified. The other members of the mailing list were only peripherally involved in the project. Therefore, it was aimed for 30-40 experts to participate in the survey.

The final sample consisted of 41 STELLAR members. The sample included a diverse mix of gender, academic status, work location and professional background of the researchers. An overview of the sample characteristics can be found in *Table 1*.

20 participants were senior researchers in executive positions, such as full professors or directors of research institutions. The sample consisted of 21 participants with a social sciences background and 20 participants from disciplines that focus mostly on technological aspects.

A list of the names of all participants is provided in *Annex 9.1*.

Table 1: Samples characteristics (n=41)

Characteristic		N
Gender	Female	18
	Male	23
Academic Status	Doctoral student/Researcher without doctorate	9
	Post-doc researcher	12
	Full professor/Research director/Executive position	20
Country (based on working location)	Germany	11
	UK	10
	Netherlands	4
	Italy	4
	Austria	4
	France	3
	Switzerland	2
	Spain	2
	Belgium	1

Professional Background	Social/Educational Sciences	Psychology	10
		Educational Sciences	8
	Educational Technology/Computer Sciences	Computer Science	10
		Educational Technology	13

4.4 Questionnaire design

The online questionnaire was administered by the Unipark software. The survey covered developments in the last few years and expected future trends in TEL research, personal opinions on *standards of TEL research* (i.e. on the characteristics of “good” TEL research for example regarding methodology), and visions of STELLAR members regarding possible future TEL scenarios. Figure 4 shows the questions that were employed in the online survey.

- **Past and future of TEL research**
 - Looking at the whole field of TEL in the last couple of years:
Which have been 2-3 prominent research themes and promising results?
 - Which have been 2-3 important changes in education and advances in technology that have had an impact on TEL research?

Imagine a large international TEL research program to be carried out from 2014 till 2020 is planned:

 - What should be 2-3 central research themes and questions to be covered by this program?
 - What future key technical developments (e.g. increasing use of mobile devices) should be accounted for in the research program? (Please name 2-3)
 - What future key societal demands and challenges (e.g. aging society) should the research program live up to? (Please name 2-3)
- **Opinions on standards for TEL research**
 - What is the fundamental purpose of TEL research?
 - Which are the characteristics of “good” TEL research?
 - What developments in TEL research would be undesirable?
- **Visionary statements about future scenarios**

In this part of the questionnaire we would like to collect some general, visionary and maybe also controversial statements about the future of TEL such as:

“Some day, microchips in our brain will help us process information, solve problems and memorize facts.”

“Some day, computers will diagnose the mood of the user and display content adaptively”

“Some day, students will be allowed to use technological devices (including internet access etc.) in all exams”

“Some day informal learning will be more important than formal learning”

 - Please suggest two to three (or more...the more the better) interesting, visionary and/or controversial statements regarding future developments in TEL with a high potential impact.

Figure 4. Questions of the online survey for the 1st STELLAR Delphi round

The questions were open-ended, allowing for written answers in text fields. Due to the multidisciplinary nature and the current fragmentation of the field we expected a variety of views on current and future themes and developments in the field of TEL. The objective of the open-ended questions in the 1st Delphi round was to picture this variety in order to integrate different viewpoints and to reach a common understanding of the most relevant research challenges of TEL during the following Delphi rounds.

4.5 Data analysis

The experts' textual input to the open-ended questions resulted in a qualitative data set. Our approach for analyzing the qualitative data was a combination of an open coding process (bottom-up) and a categorization of the experts' answers (top-down). In the following, this process will be described in detail.

The objective of the data analysis was to develop topics and subtopics from the expert answers for each of the open-ended questions (i.e. all questions concerning the past and future of TEL research as well as opinions on standards for TEL research). These topics aimed to cover all important contents of the answers and to summarize and integrate them. The first step in the development of topics and subtopics was open coding of all answers based on the open coding approach that was developed as a part of Grounded Theory (Glaser, 1992; Glaser and Strauss, 1967; Strauss and Corbin, 1997). In other words, we did not employ a pre-structured category system, but developed codes and sub-codes solely based on the source data. This bottom-up approach fits the explorative nature of the 1st Delphi round. We did not choose the coding units based on sentences or entire expert answers but on units of meaning. For example, the following expert statement represented one single unit of meaning:

“Collaboration scripts for the support of CSCL”

We assigned the code “collaboration scripts in CSCL” to this unit of meaning. Later, we merged it with several other specific codes related to CSCL into a “CSCL”-topic. We divided the following statement into two units of meaning:

“Support to collaborative learning and communities of learners”

The codes assigned to these units of meaning were “collaborative learning” and “communities of learners”.

As shown in these examples we first assigned codes close to the actual wording of the answers and then merged them into larger topics and subtopics. This approach is similar to the guidelines offered by Mayring (2008). Two independent raters rated each question to ensure reliability and validity of the coding process, and each rater developed his or her own hierarchical system of topics and subtopics. Table 2 shows an example of a topic, two of its subtopics, and sample quotations that were assigned to these topics. For this first step of data analysis, we employed ATLAS.ti, a software tool specifically designed for qualitative data analysis.

Table 2: Extract from the category system developed for the open-ended question: **“Looking at the whole field of TEL in the last couple of years: Which have been 2-3 prominent research themes and promising results?”**

Topic	Subtopic	Sample quotation
Collaborative Learning	Collaborative Learning and CSCL	“Educational and psychological studies on CSCL”
	Learning in large Communities	“community-based learning”
	[...]	[...]

In a second step, coders integrated the topics and subtopics by comparing them and agreeing upon a new, integrated system of topics and subtopics that was further refined by discussions of the whole research team. In order to implement this final system the topics and subtopics were then rearranged and some answers had to be recoded, e.g. split into more coding units or assigned to another subtopic or topic. This step may be considered a top-down process as codes were adapted to fit into the integrated coding systems.

The integrated topics and subtopics that were identified for each question will be covered in the next section.

5 Results of the 1st STELLAR Delphi Round – Trends in TEL

This part of the report describes the results of the 1st Delphi round in detail. We present research themes that the STELLAR expert sample identified as particularly important regarding both the last few years of TEL research and its future and provide an overview on developments in technology, education and society that future research programs should take into account (see 5.1). Afterwards, opinions of the participants with regard to standards of quality TEL research will be laid out (see 5.2). Finally, we will present some creative, visionary and maybe also controversial future statements suggested by the participants (see 5.3).

In sections 5.1 and 5.2, which cover open-ended questions that we analyzed qualitatively (see 4.5), we will first show all topics and subtopics mentioned by the experts. Afterwards, we will present an integrative analysis summarizing the results and describing the most important trends.

5.1 Past and future of TEL research

5.1.1 Topics and subtopics mentioned by the panel of experts

5.1.1.1 *Important research themes and developments in the last few years*

We asked the members of the expert sample to name research themes and results in the last few years that they considered important. There are four prominent, broadly-focused topics that were perceived as important by many participating experts. These are *collaborative learning*, *ubiquitous and contextualized learning and technology*, *Web 2.0* and *instructional methods and frameworks*. Aside from these broadly focused themes there are a number of more specific research topics. These include technology-oriented topics, e.g. *adaptive support systems*, and pedagogy-oriented topics, e.g. *learner characteristics*. Table 3 displays all topics and subtopics that were mentioned.

Table 3: Topics and subtopics with regard to the open-ended question “Looking at the whole field of TEL in the last couple of years: Which have been 2-3 prominent research themes and promising results?”; number of coding units (n): 139

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Collaborative Learning	20	Collaborative Learning and CSCL	9
		Learning in large (online) communities	7
		Analyzing and assessing collaboration	4
Ubiquitous and contextualized learning and technology	20	Mobile learning	11
		Contextualised learning and Location-based Learning	5
		Ubiquitous learning	4
Web 2.0 and Social Software	19	Web 2.0 applications and user generated content	11
		Social software	8
Instructional methods and frameworks	18	Instructional methods and applications	10
		Instructional objectives and frameworks	8
Adaptive support systems	8	Adaptive support process-level : Modelling and intelligent tutoring	5
		Adaptive support systems	3
Learner characteristics	8	Competences and Attitudes of the learner	3
		Learner participation	3
		Holistic view of the learner	2
Reusable learning objects	7	Repositories and search interfaces	4
		Metadata	3
Data analysis techniques	5	(Semantic) data analysis	3
		Social data analysis	2
(Mash Up) Personal Learning Environments	5	/	/
Open access to information resources and tools	5	/	/

Connection between Learning and Working	3	/	/
Learning design	3	/	/
Knowledge management and knowledge sharing in groups	3	/	/
Recommender Systems and Social Navigation	2	/	/
Further development of evaluation methods in TEL research	2	/	/
Informal learning	2	/	/
Further Statements	8	/	/

In addition to research themes and results in the research field of TEL we also asked the experts to name developments in education and technology that had an impact on TEL research. We identified new advances in software towards a *Web 2.0* and the *spread of technological hardware* (including mobile devices) and as the two key developments in technology in the last few years. Table 4 provides an overview of the topics and subtopics that were mentioned.

Table 4: Topics and subtopics with regard to the open-ended question “Looking at the whole field of TEL in the last couple of years: Which have been 2-3 important changes in education and advances in technology that have had an impact on TEL research?”; number of coding units (n):

106

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Web 2.0 and social software	24	Web 2.0 and user generated content	14
		Social Software/Social Networks	8
		Social media	2
Technology Spread	21	Cheaper ICT Devices	5
		Spread of Internet Access	5
		Spread of personally owned ICT devices	4
		Increasing usage of and familiarity with ICT among various groups of people	4
		Increasing ICT usage in school and university education	2
		Further statements	1
Ubiquitous and contextualized learning and technology	11	Mobile devices	8
		Ubiquitous technology/computing	3
Instructional methods and frameworks	10	Instructional methods and applications	5
		Instructional objectives and frameworks	5
Open Access to information resource and tools	9	Open access/Open educational resources	4
		Shift to culture of openness	3
		Availability of extensive internet resources	2
Societal and political changes and developments	9	Developments in society, population and every-day life	5
		(Political) changes and developments in educational systems	4
Informal Learning	6	Decreasing importance of formal learning	4
		Blending of formal and informal	2
More “powerful” devices	4	/	/

Tools and sensors for data analysis	4	/	/
Communication	3	/	/
Knowledge Sharing and knowledge building in large groups	3	/	/
Lack of significant changes in educational practices to account for new technologies	2	/	/
Lifelong learning and Workplace learning	3	/	/
Social Justice regarding TEL opportunities	2	/	/
Further statements	5	/	/

5.1.1.2 Recommendations for a future research program

In addition to identifying important topics and developments in TEL in the last few years the survey also included three open-ended questions concerning a possible future research program.

First, we asked the experts to name important research questions and topics that they would include in a future research program running from 2014 till 2020. However, the expert answers did not just focus on research topics. Overall the experts' statements constituted a mixture between important research topics for the research program, e.g. *ubiquitous and contextualized learning and technology*, and research themes that may also be viewed as objectives, e.g. *improve formal education*, and *characteristics of the research program* itself (e.g. valid methodology). Regarding the learning settings to be investigated, formal education, which is not only reflected in *improve formal education* but can also be connected to *instructional methods and frameworks*, is still in the focus. However, *Informal learning* and *lifelong learning* seem to be of increasing importance. Table 5 shows all topics and subtopics that were mentioned.

Table 5: Topics and subtopics with regard to the open-ended question “Imagine a large international TEL research program to be carried out from 2014 till 2020 is planned: What should be 2-3 central research themes and questions to be covered by this program?”; number of coding units (n): 130

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Ubiquitous and contextualized learning and technology	19	Contextualized learning and Location-based learning/Context-aware applications	8
		Ubiquitous technology/learning	7
		Mobile technology/learning	4
Improve formal education	18	Improve formal education practice and formal education systems	9
		Integrating technology into formal education	4
		Teacher training	3
		Teaching of “TEL-Skills”	2
Characteristics of the research program (connected to TEL as a research field)	15	Theoretical frameworks and objectives	6
		Methodology	6
		Connecting Researchers	3
Instructional methods and frameworks	11	Instructional objectives and frameworks	7
		Instructional methods and applications	4
Collaborative Learning	9	Analysis of cognitive processes on group level	3
		Collaborative learning	3
		Collective Intelligence/Wisdom of the crowds	3
Informal learning	8	Connection between formal and informal learning	5
		Informal learning	3

Personalization/Individualization	7	Personalization/Individualization	5
		Personal Learning Environments	2
Social Justice	7	Addressing the needs of all learners	2
		Addressing the digital divide	2
		Have third world countries benefit from TEL	2
		Further Statements	1
Lifelong learning and Workplace learning	5	/	/
Emotional and motivational aspects	4	/	/
Social Software	4	/	/
Adaptive/Intelligent learning support systems	3	/	/
Competence Assessment Techniques	3	/	/
Open access to information resources and tools	3	/	/
Recommender Systems	3	/	/
Interoperability and the Integration of different devices and applications	2	/	/
Further statements	10	/	/

The second question concerning possible future research programs focused on future technological developments. The answers included both developments in the area of TEL and general developments in information communication technology (ICT) whose impact on TEL can only be speculated about. Overall, the central trend regarding future technological developments seems to be seamless technology that is integrated into most aspects of every-day life and will be used naturally by the majority of people. This trend is inherent in both topics that were mentioned most frequently, *ubiquitous and contextualized learning and technology* and *new ways of human-computer interaction*. Table 6 gives an overview of all mentioned topics and subtopics.

Table 6: Topics and subtopics with regard to the open-ended question “Imagine a large international TEL research program to be carried out from 2014 till 2020 is planned: What key future technological developments should be accounted for? (please name 2-3)”; number of coding units (n): 92

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Ubiquitous and contextualized learning and technology	29	Mobile devices and ubiquitous computing	13
		Contextualisation, location-awareness and context-aware applications	7
		Ubiquitous mobile connectivity	5
		Mobile learning	4
New ways of human-computer interaction and ambient computing	18	Ambient intelligence/computing and sensor technology	9
		“Intelligent” objects/furniture	5
		New, more intuitive Interfaces	4
Interoperability and the Integration of different devices and applications	9	Interoperability	5
		Integration of different devices and applications	4
Web 2.0 and Social software	8	Web 2.0 applications and user generated content	5
		Social Software	3
Augmented and virtual reality	6	Augmented/Mixed reality	4

		Virtual reality and Web 3D	2
Future of the Web	6	Web 3.0/Semantic web	3
		Further statements	3
Technology in education/Educational Technology	6	/	/
Collaboration and Communication tools	4	Collaboration and Communication tools	3
		Further statements	1
Technology Spread	4	/	/
Cloud computing	3	/	/
Further statements	9	/	/

The last open-ended question concerning future TEL research focused on key future societal developments and societal demands that a TEL research program should live up to. Therefore the expert answers were not only concerned with how societal developments influence TEL but also how TEL can benefit society. Whereas some experts concentrated on just naming developments such as the *digital divide*, other experts focused on how these developments could be addressed. Overall, the participants identified two major societal challenges that a TEL research program should live up to. The first challenge is promoting *social justice* by providing access to TEL tools for as many and as diverse people as possible. The second challenge is to *improve formal education* to account for changes brought along by the knowledge society. The participants also emphasized the possible impact of general developments in *demography* and *global politics* on TEL research. All topics and subtopics that were mentioned are shown in Table 7.

Table 7: Topics and subtopics with regard to the open-ended question “Imagine a large international TEL research program to be carried out from 2014 till 2020 is planned: What future key societal demands and challenges (e.g. aging society) should the research program live up to? (Please name 2-3)”; number of coding units (n): 101

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Social Justice	16	TEL for the inclusion of diverse groups of people	7
		(reducing the) Digital Divide	6
		Further statements	3
Knowledge society and its demands for education	15	Adapt to new generations of students	5
		Adjust education to the “knowledge society”	4
		Teach Media/Information literacy	2
		Quick/dynamic changes of knowledge	2
		Information society	2
Demographic developments	14	Aging society	7
		Job market changes	3
		Gap between young and old people	2
		Further statements	2
Improve formal education	12	Adapt education to individual needs	3
		Teacher Training	3
		Further Statements	6
Lifelong learning and Workplace learning	11	Lifelong learning	5
		Connection between learning and working	3
		Learning on demand	2
		Further statements	1
Global political challenges	7	Environmental challenges	4

		Financial crisis	2
		Further statements	1
Globalization of business and education	6	Globalization of Education	4
		Further Statements	2
Informal Learning	5	Connection between formal and informal learning	3
		Accreditation of informal learning	2
Ubiquitous technology	3	/	/
Change in societal values	3	/	/
Political usage of new media	2	/	/
Privacy on the internet	2	/	/
Further statements	6	/	/

5.1.2 Summary

This section aims at illustrating expert answers from all five open-ended questions concerning past and future TEL research (see 5.1.1) in an integrative way. We will first describe main topics and developments that were both identified as important in current TEL research and in future TEL research. Encouragingly, these topics were mentioned frequently by both researchers with a social sciences background and researchers with a technological background. Thus, there seems to be an overall agreement within the STELLAR network with regard to what the main research topics should be. This finding indicates that a common mind-set is present among STELLAR researchers and relates to the networks' objective of reducing the fragmentation of TEL research.

In addition we will discuss a selection of the less often mentioned topics. These include topics that are not yet prominent in TEL research, but are likely to become more important in the future.

For the main topics, we will also point out their relation to other topics that were mentioned, as well as their relation to the three STELLAR Grand Research Challenges (STELLAR, 2009):

- *Connecting learners*
- *Orchestrating learning*
- *Contextualizing virtual learning environments and instrumentalizing learning contexts*

Figure 5 gives an overview of how the future research topics identified in the 1st Delphi round map on the Grand Challenges.

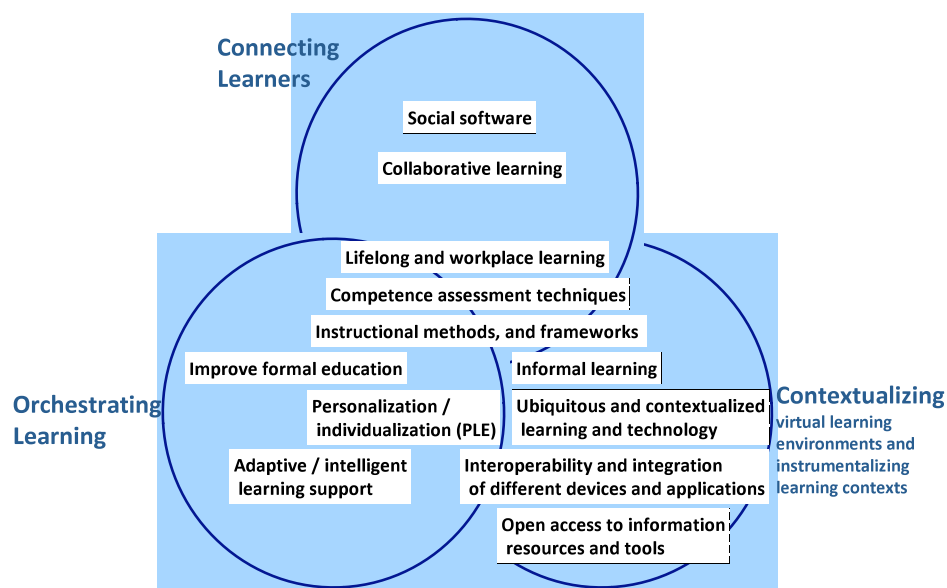


Figure 5. Mapping of future research topics identified in the 1st Delphi Round on STELLAR Grand Challenges

5.1.2.1 *Ubiquitous and Contextualized Learning and Technology*

Considering all questions related to research themes and developments in the last few years and in the future, *ubiquitous and contextualized learning and technology* is the topic that was mentioned most often by the STELLAR partners who answered the survey of the 1st Delphi round. This includes *mobile learning*, *contextualized learning* (and accordingly, *context-aware applications and devices*) as well as the general idea of *ubiquitous access to learning resources and tools*. As a possible future scenario concerning ubiquitous and contextualized learning, the experts envisioned that in the future, learners will be equipped with a single handheld device that allows them to access learning resources, connect with study partners and track their learning process.

According to the STELLAR expert sample, *ubiquitous and contextualized learning and technology* has been an important research theme in the last few years and will also be a central theme of future research programs. Comparing the expert answers to the questions on technological developments, it seems that the development of devices that can actually be used for *ubiquitous and contextualized learning and technology* has only just started and that future devices will be even “smarter” and easier to use.

The importance of this research theme can also be seen in the light of the societal challenge of the *knowledge society and its demands for formal education*. Ubiquitous technology satisfies the need for permanent access to the latest information in a time where knowledge is the most valuable resource and where knowledge is, as one expert pointed out, changing quickly and dynamically. Ubiquitous technology provides the possibility to access information and tools on the fly. For example, the combination of mobile and location-based learning offers the possibility to instantly equip the learner with context-related information such as information about the architect of the cathedral he or she is looking at. Even further, mobile devices bear the potential to *improve formal learning* by bridging *informal learning* settings, such as a visit to the zoo, with formal learning settings, such as a biology class.

A different field of application for *ubiquitous and contextualized learning and technology* can be seen in mastering the societal challenge of *lifelong and workplace learning*, which is especially important for an *aging society*. Learning on the job is literally possible and opens new horizons for continuing education in organizations and thereby contributes to the higher goal of organizational learning. Due to contextualized learning designs, learning events can be embedded in the daily working routine.

Ubiquitous and contextualized learning and technology may also be connected to *collaborative learning*. Mobile all-in-one learning devices could be used to communicate with learning partners, exchange learning materials, collaboratively work on documents or log into online learning communities. However, the experts pointed out that *interoperability* of TEL devices (hardware) and TEL tools (software) is a key technological challenge that needs to be met in order to make this possible. The following expert statement is connected to this idea:

“[...] - increasing use of mobile devices - but with it, a need to make these devices talk to each other and use/develop common standards/protocols.”

With regard to the STELLAR grand challenges, the topic *Ubiquitous and Contextualized Learning and Technology* is closely connected to *contextualizing virtual learning environments* but also includes aspects of *connecting learners*, e.g. due to always-online mobile devices.

5.1.2.2 Collaborative Learning

The experts identified *collaborative learning* as one of the most important research themes in the last few years. The topic includes the analysis of interaction and collaboration processes in groups of varying size, ranging from dyads to large communities and the development of tools to support these processes. Maybe surprisingly, this topic is not mentioned as often as a topic that should be accounted for in future research programs although the experts expect improved communication and collaboration tools to be important future technological developments. A possible explanation why the expert sample did not mention collaborative learning explicitly as a central future research theme could be that collaborative learning is already well established as an important research theme in a variety of research areas within TEL. However, whether collaborative learning is established as a pedagogical practice in educational settings remains debatable. Experts who mentioned *collaborative learning* as a research theme in the past also mentioned *Web 2.0/social software* as a technological development in the last couple of years. This connection indicates that the researchers in the field of collaborative learning are well aware of the technological developments and their potential in enhancing the pedagogical method. Some of the synergetic effects of mutual research advances from computer and social sciences are reported in the Trends in Connecting Learners report (D1.2; Herder & Marenzi, 2010)).

This topic *collaborative learning* is strongly connected to the Grand Challenge *connecting learners* as well as to one key aspect of *orchestrating learning* – designing collaborative learning models with innovative technology (STELLAR, 2009)

5.1.2.3 Learning in the classroom: Instructional Methods and Frameworks to Improve Formal Education

This key theme integrates two related topics that are frequently mentioned in nearly all questions regarding past and future developments, *improve formal education* and *instructional methods and frameworks*. Both topics include statements on educational practices, but with a slightly different focus.

Improve formal education includes a large cluster of statements focused on improving educational practices and education systems, as shown in this statement:

“Having more impact on the formal school system: classroom orchestration, core curriculum contents. “

Improve formal education is only mentioned as a future research topic and a future societal demand, but not among the answers to the two questions on past topics and developments. This is probably because it is not only a research theme but rather a research objective and therefore inherently oriented to the future.

Instructional methods and frameworks in general, on the other hand, is an important research theme with regard to both past and future. Both topics include a variety of quite heterogeneous statements; nevertheless some trends can be observed.

The topic *improvement of formal education* is further specified by the subtopics *teacher training* and *teaching of TEL-skills*, i.e. fostering students' digital literacy. An expert statement illustrating the latter subtopic was:

“Teaching of TEL-skills, e.g. computer-literacy, collaboration skills, learning skills, reading skills, information evaluation skills...: What skills are needed, how do they influence each other? How can they best be taught?”

Within the goal of *improving formal education and instruction* a key challenge is to adapt teaching, technology use and curricula to account for the changes brought about by the *knowledge society*, as this statement suggests:

“Teaching new generations how to work in a fast changing world: Providing up-to-date and tailored on-line training in continuing education.”

According to the experts, this may include teaching media literacy and information literacy as well as adapting to new generations of students, i.e. digital natives who grew up with ICTs as part of their daily life. To meet these challenges successfully, TEL tools need to be integrated in formal education, as suggested in this research question proposed by an expert:

“How to best integrate computer-based/computer-supported learning activities with regular face-to-face, teacher-to-students learning arrangements, in school and universities settings, but also in adult learning settings (e.g. vocational education, training on the job)?”

This statement also points out that, according to the experts, future educational challenges may not only be met by adapting formal education as we know it, e.g. school systems and universities. Rather, the connection between formal education and *informal learning* as well as *lifelong and workplace learning* will need to be redefined. Some experts suggested that TEL research should develop methods for assessing and accrediting *informal learning*. TEL tools that record the personal learning history (“lifelong learning organizers” as mentioned by one expert) may be helpful in this accreditation process and may also make individual recommendations on what to learn next, similar to an intelligent tutoring system but on a more general level.

With regard to pedagogic methods no specific methods were frequently mentioned. However, a trend towards active and participative learning approaches such as inquiry-based learning, game-based learning, or the situated learning framework is evident, e.g. as mentioned in this statement:

“Development of active and collaborative learning paradigms (following the economy push for soft skills and innovation-oriented workers).“

Overall, it can be concluded that the experts still see formal education as a very important – probably the most important - field of application for TEL even though the importance of informal learning is starting to increase.

5.1.2.4 Learning outside the Classroom Setting: Lifelong Learning and Informal Learning

Another key theme that was mentioned frequently is learning outside the traditional, formal educational settings, i.e. school classrooms and universities. The main topics referring to this key theme are *lifelong learning* and *informal learning*. While both topics are related, they refer to different concepts. *Lifelong learning* concerns intentional competence development after formal education. This is closely connected to the scenario of a knowledge society in which the competencies needed by white-collar workers change rapidly. In contrast, the term *informal learning* refers to learning that takes place unintentionally, e.g. while surfing on the internet or visiting a museum. Both topics are envisioned to become much more important in the future, both in their function as research themes of TEL and in their function as societal developments influencing TEL. The increasing importance of learning outside of formal education also leads to a challenge for education that needs to be met – the accreditation of lifelong and informal learning activities by educational institutions.

Lifelong learning and informal learning cannot be mapped exclusively on one Grand Challenge but encompass aspects of all three Grand Research Challenges. For example, lifelong learning can be supported by *connecting learners* in learning communities or communities of practice. Adapting assessment practices to account for informal learning relates to *orchestrating learning*, and *contextualized learning environments* create new opportunities for lifelong learning on the job.

5.1.2.5 The Individualization of Learning: A Future Scenario

The individualization of learning is a general trend identified by the STELLAR experts that relates to aspects of several topics. It includes *personalized and adaptive learning environments*, but also the availability of extensive learning resources for all learners due to *open access* and the possibility to choose individual learning paths in formal education. In future scenarios envisioned by the expert sample learners will have a wide range of possibilities what they can learn, where they can learn it and how they can learn it. *Adaptive and personalized learning applications*

will support learners in their self-directed learning by recommending interesting and efficient further learning resources. Competencies that learners will acquire this way will be accredited by educational institutions and added to their personal competence profile that is managed by their personal, mobile learning device.

This topic is most closely connected to the Grand Research Challenge of *orchestrating learning*. The challenge includes a redefinition of the roles of the teacher and the learner in formal education (STELLAR; 2009) and thus may emphasize the importance of individualizing learning.

5.1.2.6 Social Justice

The future societal demand most often mentioned by the experts is *social justice*. This topic reflects the idea that all learners (i.e. learners from different cultural and socio-economical backgrounds) should benefit from TEL. *Social justice* in TEL also includes dealing with the *digital divide*. The *digital divide* refers to the divide between media-literate and non-media-literate people in industrial countries, which may increase due to the *aging society*. The experts suggest that TEL research may help to reduce this divide by developing easy-to-use TEL tools for elderly people:

“Handling of technological devices has to become easier, performance more reliable, and purchase cheaper to allow young children and old adults but also people outside western countries to really benefit from TEL.”

According to the experts, social justice also includes addressing the technological and educational divide between industrial and developing nations, as mentioned in these two statements:

“I am less concerned about the old in rich places than the big young populations of less-rich, emerging places! The big issue is global Higher Education, for a smarter world. Most of our world cannot afford conventional Higher Education. But neither can the planet afford NOT to leverage the work and learning power of emerging economies. The global power of these new markets and peoples will be a significant new social driver to newer interaction models.”

“Social justice with a particular focus on countries in Sub-Saharan Africa -- Questions to include: How do we ensure access to technical resources is supported by access to human resources?”

The experts who mentioned the societal demand for *social justice* also mentioned *ubiquitous & contextualized technology* and *new ways of human-computer-interaction & ambient computing* as technological developments. The connection between those topics provides further insights in possibilities for promoting social justice. The ubiquity and mobility of technology seems to be an important step towards enabling access to technology for a variety of people and thereby helps

reduce the digital divide. Additionally, more intuitive interfaces and ways to communicate with technology might close the gap between digital natives and people who are less digitally literate. The experts who mentioned *social justice* also mentioned the research topic *improve formal education* as a future research theme, indicating that the significance of social justice should not be neglected when analyzing and enhancing formal educational practices.

The STELLAR Grand Challenges do not yet capture social justice as a main research theme; however its relevance in research advances due to the scientific community's duty to society is highly recognized. Other developments mentioned by the experts that might promote social justice could be the *Open Access movement* and the *spread of cheap technological devices*.

5.1.2.7 New ways of human-computer-interaction and ambient computing

This topic is a key future technological development that was mentioned by many experts. It includes *ambient intelligence*, *intelligent objects/furniture* and *more intuitive interfaces*. These subtopics share the common idea that people will be able to interact with computers in other ways than by pressing buttons and that computer technology will be seamlessly integrated into the environment. This includes micro-chips and sensors in buildings that can track people or items moving through the building and, for example, adjust room temperature accordingly or grant access to specific areas of the building. Closely connected to this is *intelligent furniture* that can gather data from the environment and make decisions based on the data, such as a refrigerator that keeps a record of the food stored in it and orders new food accordingly. In order to interact with this intelligent environment, *more intuitive interfaces* such as speech detection are needed. Whereas this topic is a common future scenario – the idea of talking to ones apartment draws a quite illustrative picture of future living – its connection to learning is not quite clear. One expert suggested intelligent classroom furniture in formal education as one way of applying these technological developments to promote learning.

5.1.2.8 Further Emerging Topics

Aside from these main themes and trends that were derived from the expert answers on past and future topics and developments there are also some significant, although less frequently mentioned, topics.

Most of these topics relate to advances in technology. One topic already mentioned earlier is the *interoperability* of devices, applications and services. Addressing this topic would enable further important technological developments such as the integration of different communication channels and collaboration tools. However, the experts also pointed out some specific technological developments that might strongly influence future developments of the society and thereby challenge TEL.

These technological developments include *virtual and augmented reality*, *intelligent objects* and *ambient intelligence*.

Another interesting topic that is not yet in the focus of TEL research but is likely to become more important concerns *emotional and motivational states of the learner*. This development has both technological and educational aspects. A creative technological idea is to develop technological devices or applications that can detect the mood of the user via sensor technology and that can adapt accordingly, e.g. by displaying different content. An important educational aspect envisioned by the expert sample is a trend to analyse and promote cognitive aspects together and in interaction with motivational and emotional states of the learner in educational theories and frameworks.

Some experts also mentioned *global political and societal challenges* such as climate change that TEL research needs to take into account. One idea is the use of distance collaboration and communication environments to reduce the need for air travels and thereby reduce energy consumption as well as CO²-emissions. At the same time, the energy consumption of TEL devices and applications could be reduced to a minimum due to new seamless technological devices (as in ambient intelligence).

5.2 Opinions on standards for TEL research

5.2.1 Topics and subtopics mentioned by the experts

We did not only ask the experts to provide input with regard to important trends and developments but also to share their personal opinions with regard to the fundamental purpose of TEL research, the characteristics of “good” TEL research and developments in TEL that would be undesirable.

5.2.1.1 The fundamental purpose of TEL research

Three main objectives of TEL research can be identified. These are *expanding scientific knowledge*, *designing tools*, and implementing the results into practice to *improve learning* in general and *formal education* in particular. Table 8 gives an overview of all topics and subtopics named by the experts.

Table 8: Topics and subtopics with regard to the open-ended question “Please share your personal opinions and visions on TEL research: What is the fundamental purpose of TEL Research?”; number of coding units (n): 83

Topic	n	Subtopics	n
Design and Development	13	Develop technological devices and tools	6
		Statements with focus on designing and developing in general	4
		Develop (pedagogical) learning methods	3
Expand scientific knowledge	13	Understanding TEL	8
		Explore Conditions under which Learning is successful	3
		Further Statements	2
Improve Learning	11	Support learning with technological advances	4
		Effectiveness and Efficiency	4
		Make learning more attractive	2
		Further statements	1
Demands regarding TEL as a research field	10	Connection between researchers/Interdisciplinarity	4
		Focus on Learning rather than Technology	2
		Connect to basic research	2
		Further Statements	2
Improve formal education	9	Improve educational practices	7
		Ensure the adoption of TEL methods in practice	2
Investigate which TEL methods/tools are effective	7	/	/
Evaluate (new) technologies	5	/	/

Inform and advise Stakeholders	4	/	/
Impacts on Society	3	/	/
Augmenting cognition and communication	3		
Provide easy access to educational resources	3	/	/
Social Justice	2		/

5.2.1.2 Characteristics of “good” TEL research

Whereas the last question focused on what TEL research should do, the open-ended question covered in this section is focused on how it should be done. It asks for characteristics of “good” TEL research. From the expert answers five main characteristics of “good” TEL research can be identified. “Good” TEL research should be *methodologically valid, practically relevant, theory based, user inspired* and *innovative*. Table 9 provides an overview of all topics and subtopics that were mentioned

Table 9: Topics and subtopics with regard to the open-ended question “**Please share your personal opinions and visions on TEL research: What is the fundamental purpose of TEL Research?**”; number of coding units (n): 121

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Valid methodology	33	Empiric validation	8
		Clearly defined and “good” research goals/questions	4
		Experimental studies	4
		Multimethodal studies	4
		Sound interpretation and reporting of results	4
		Reproduceable studies	3
		Rigorous methodology	2
		Accurate methodology	2
		Long-term studies	2

(Practical) Relevance and Implementation	21	Research validated in authentic settings/practice	7
		Fulfil needs of the society	3
		Relation to the “real world”	3
		Results are implemented in practice	3
		Dissemination of results	2
		Scalability	2
		Further Statements	1
Theory based research	16	Theory based research	9
		Relate to basic research	3
		Integrating theories/approaches	2
		Theory based development of tools and methods	2
User Orientation	13	Fulfilling needs of the learner/user	9
		Taking into account stakeholder needs	4
Innovation	9	Challenging conventions	2
		Innovative research	2
		New tools and methods are developed	2
		Usage of innovative technologies	2
		Further statements	1
Interdisciplinary research	4	/	/
Balance between learning and technology focus	3	/	/
Ethical research	3		
Initiating further TEL research	3	/	/

Visibility	2	/	/
Independent research	2	/	/
Further statements	11	/	/

5.2.1.3 Developments in TEL that would be undesirable

Finally, we asked the experts to identify developments in TEL research and TEL in general that would be undesirable. Overall, the most important undesirable development identified by the experts would be a *lack of synergy between learning sciences and technology-oriented research*. Another undesirable development that is frequently mentioned is *lobbyism*. Aside from these two topics there are many further interesting undesirable scenarios mentioned by the experts, often related to a particular research method that they perceived to be flawed. An overview of all topics and subtopics mentioned by the experts is shown in table 10.

Table 10: Topics and subtopics with regard to the open-ended question “**Please share your personal opinions and visions on TEL research: What developments in TEL would be undesirable?**”; number of coding units (n): 72

<u>Topic</u>	<u>n</u>	<u>Subtopics</u>	<u>n</u>
Lack of synergy between learning sciences and technology	18	Technology or pedagogy dominating the field	6
		Too much focus on (specific) technologic devices	6
		Segregation of the research field	5
		Further statements	1
Flawed research methodology	12	Invalid methods	8
		Unclear research objectives	2
		Further statements	2
Undesirable societal developments	9	Developments of tools that endanger privacy	3
		Elitist target group of TEL users	2
		Further statements	4

Lobbyism	8	Business/Commercial control over TEL education	4
		Politically motivated/influenced research	3
		Further statements	1
Non-cumulative research	6	/	/
Conservatism in Education	4	/	/
“Misguided” assumptions/premises	4	/	/
Lack of implementation in practice	3	/	/
Lack of user orientation	3	/	/
Further statements	5	/	/

5.2.2 Summary

In order to integrate experts’ opinions on standards for TEL research we will sketch out a research process. We will summarize the expert answers regarding phases of the research process from the first planning of a program to the dissemination of its results respectively.

5.2.2.1 Research Objectives and Planning of Research Programs

One characteristic of “good” TEL research, which was frequently named by the experts, is addressing “real world” problems. The experts also emphasized that the needs of the users, i.e. learners and educators, should be taken into account when thinking about research objectives. Some experts suggested that the whole research process should be user-inspired. Other experts pointed out that parts of European TEL research are still conducted with “fuzzy”, unclear research goals. When converting broad research objectives into specific research goals a clear definition of the research goals, which was frequently mentioned by the experts as a characteristic of methodologically valid research, is crucial. This includes the development of criteria to measure whether these proposed goals have been reached and also a clear output orientation.

5.2.2.2 Collaboration within the Scientific Community

An often mentioned vision for European TEL research is fruitful collaboration within the scientific community of TEL researchers. This was mentioned by many participants and is consistent with the STELLAR objective to reduce the fragmentation of TEL as a research field.

The experts pointed out several aspects of fruitful collaboration. First of all, TEL research should be interdisciplinary. This especially refers to a synergy between learning sciences and technology-oriented sciences such as computer science and engineering. One of these disciplines dominating the field or a segregation of researchers from the different disciplines were seen as undesirable scenarios by many experts. Some experts suggested that researchers from different professional backgrounds working in the area of TEL should also keep track of new developments in basic research in their respective field and try to include some of these findings in the interdisciplinary research field of TEL.

In addition to being interdisciplinary, TEL research should also be cumulative, i.e. based on developments, findings or theories by other researchers. Many experts saw the development of new tools or methods without taking a look at what tools or methods already exist as a problem.

5.2.2.3 Theoretical Perspectives and Frameworks

With regard to theoretical frameworks underlying TEL research, the experts emphasized above all that “good” research should be theory-based, i.e. that the development of methods or tools should be based on assumptions about learning processes that have already shown empirical validity or are derived from a valid theory.

Taking into account the objective of reducing the fragmentation of TEL as a research field, some experts also stressed the importance of using integrative theoretical frameworks. Ideally, such frameworks should be based on insights from the learning sciences as well as from the technology-oriented disciplines related to TEL.

5.2.2.4 Methodology

The single most frequently named characteristic of “good” TEL research is that the research should be methodologically valid. The experts pointed out several aspects that promote validity. First of all, tools or methods should be tested for effectiveness in empirical studies. Second, empirical evidence should not only be obtained using case studies but also using controlled experimental studies. According to the experts, TEL research should be as methodologically rich as possible, e.g. combining case studies with experimental studies or even including long-term studies.

Regarding the context of studies, several experts warned against carrying out TEL research solely in laboratory settings. Related to the objective of addressing “real world problems”, the aim should be to carry out at least part of the planned studies in practice settings such as classrooms.

5.2.2.5 Dissemination and Implementation of Results

Regarding the dissemination of results there is one important objective shared by most members of the expert sample: The results of TEL research should be implemented in practice settings. An undesirable development mentioned by many experts was the flawed dissemination of research results: Tools or methods are not always properly disseminated and the development is often stopped before the tools or methods are ready to be implemented in practice settings. Because of this lack of dissemination other researchers cannot base their research on such tools even if they would like to.

However, some experts warned against using developed tools and methods mostly for commercial purposes – selling learning tools may not be the major research objective.

5.3 Visionary statements about future scenarios

In addition to naming important research themes and trends in TEL research we also asked the participating experts to think of visionary but maybe also controversial statements about future scenarios in TEL.

Overall, we collected 134 statements (see Annex 9.2). Some statements are related to general societal developments, e.g.:

“Middle- and upper-class kids will attend mostly private schools throughout Europe.”

Others are quite specific, e.g. with regard to particular developments in educational technology:

“In the future, learning will be done in ‘the Cloud’ of reusable learning objects that exist on the global WWW.”

Few statements also focus on future developments regarding instructional methods:

“Some day, schools will be designed to support social constructivist and inquiry learning.”

Some statements pictured positive future scenarios. Others pointed out possible negative side-effects and risks of future societal and technological developments. For instance, the following two expert statements show a tension between two possible future scenarios:

“Some day, personalised learning will ensure the right education is provided at the right time at the right place.”

“In a world with cameras everywhere and online tracking of what we do, genuine security becomes impossible and we will have to "give away" everything we do!”

While the data collection of an individual’s learning history enables the development of personalized and adaptive learning environments, it also reduces the privacy of the learner and may provide others - e.g. teachers, prospective employers, and companies distributing learning software - access to sensible information.

Another tension can be identified between the availability of portable ICT devices that allow for instant communication with learning partners, colleagues or friends and the disruptiveness of continuous alerts:

“Some day, all of us will have one mobile device, which includes all functions you need (phoning, mailing, web, learning devices, gaming, scanning, information gathering).”

“Some day, it will be recognized that continuous alerts (news, email, chat, twitter) are disruptive; the zap generation will (re-)learn to concentrate on one thing at a time.”

The main purpose of collecting these statements from the STELLAR-internal experts was to create visionary statements to be evaluated by the STELLAR-external panel of experts in the 2nd Delphi round. In the selection process we sorted the 134 visionary statements into categories, e.g. *assessment, lifelong and informal learning, individualization of learning, ubiquitous and contextualized learning and technology or formal education*. The categories were created on the basis of the main research topics identified in the 1st Delphi round (see section 5.1.2). Then researchers of the Freiburg Delphi team evaluated whether the statements would be suitable for the envisioned format and could be rated on two dimensions (desirability and probability to become reality in the future) by the participants of the 2nd Delphi round. In this internal evaluation process we selected the 16 scenarios to be evaluated by the STELLAR-external experts in the 2nd Delphi round (see Figure 6).

For these 16 visionary scenarios we adjusted the wording to standardize the format. Section 6.4.2 explains the format of the visionary statements employed in the 2nd Delphi round.

1. By 2025, virtual experiences will dominate education.
2. By 2025, formal education of long running mass programmes will become irrelevant in favour of networked and digitally supported personal learning trajectories.
3. By 2025, learning to type-write will replace learning to hand-write in early education.
4. By 2025, recognizing prior learning will be standard and technology plays a vital role in supporting both learners and assessors in accrediting what has been informally learnt.
5. By 2025, no content needs to be memorized because wearable context-aware devices will provide the relevant information.
6. By 2025, our learning history will be recorded resulting in a track record (including video) for example for evaluation purposes.
7. By 2025, key developments in TEL will mainly come from the gaming and entertainment industry.
8. By 2025, learners will no longer use a mouse or keyboard, but will interact with their computer only using eyes, hands and their brain.
9. By 2025, learners will be empowered to design their own think tools.
10. By 2025, intelligent software will support learners to filter information for quality and importance.
11. By 2025, inexpensiveness and ease of use of technology will enable diverse groups of people to access educational resources.
12. By 2025, students will start their school day by switching on their computer and logging in to "school" (from wherever they are at that time).
13. By 2025, microchips in our brain and drugs will allow us to control our mood, our motivation for learning and many other emotional aspects.
14. By 2025, students' report cards will include assessment of domain-general skills, such as computer-literacy, collaboration skills, mastery of reading and learning strategies....
15. By 2025, the boundary between formal and informal learning will have been blurred.
16. By 2025, students will be allowed to use technological devices in exams that are designed to assess students' abilities and knowledge while taking into account what the technological devices can do (e.g. draw graphs...).

Figure 6. 16 visionary future scenarios that are based on the expert answers in the 1st Delphi round and that were employed in the questionnaire of the 2nd STELLAR Delphi round.

6 Planning and Implementation of the 2nd STELLAR Delphi Round

6.1 Objectives

By involving STELLAR-external TEL experts, the 2nd STELLAR Delphi survey aimed at:

- exploring the most important future developments (i.e. societal and technological) and emerging research trends for the time until 2025 and beyond
- exploring the goals and visions for TEL research and practice held by different groups of STELLAR-external experts.

6.2 Procedure overview

Preparations for the 2nd STELLAR Delphi round started in December 2009 (see Figure 7). We applied a two-fold recruiting process: In December 2009 we sent a request to the STELLAR partners to provide expert nominations; furthermore, we conducted an online search to identify experts based on their membership in the program committee of TEL-related conferences (for details see next section). We developed the survey for the 2nd Delphi round based on the results from the 1st Delphi round. On February 23rd 2010 the survey of the 2nd STELLAR Delphi round went online and we invited STELLAR-external experts to participate in the survey. The time frame for answering the online questionnaire ended in late March. Currently we are analyzing the data.

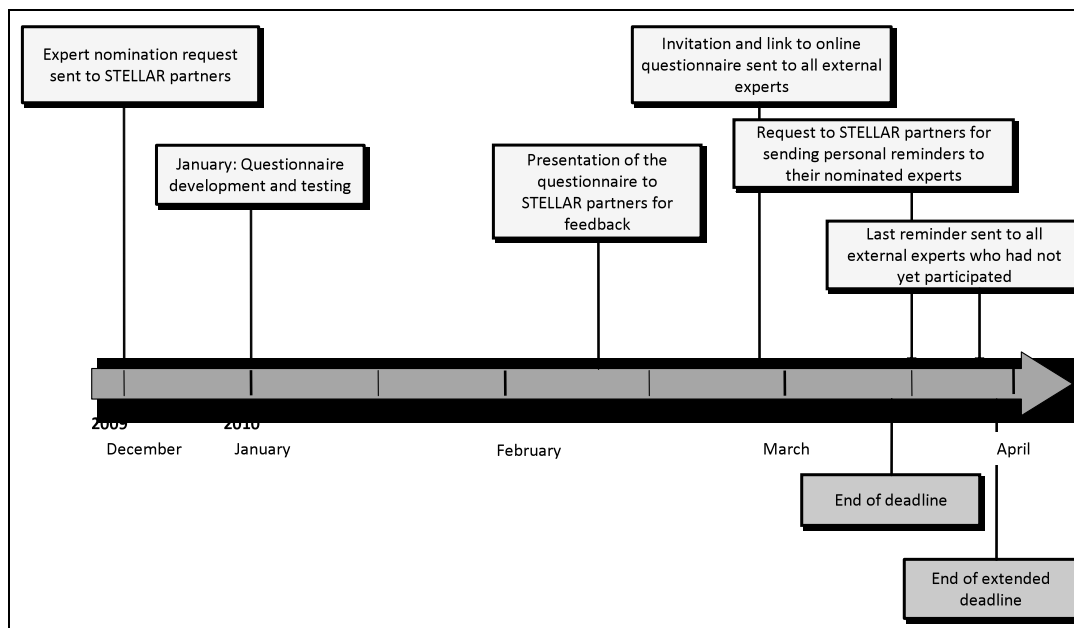


Figure 7. Timeline of the fieldwork – 2nd Delphi round.

6.3 Panel of experts

We aimed at a target sample size of about 230 European/Non-European experts. The specific groups we were looking for were researchers, developers, business people and policy makers in the field of TEL. Expert status was based either on nomination by one of the STELLAR partners or on membership in the program committee of the following TEL related conferences: EC-TEL 2008/2009, AiED 2009, IST 2010, CSCL 2009, ICCE 2009/2010.

6.3.1 Recruiting

The recruiting process started in December 2009 with a STELLAR-internal call for expert nominations that was sent out to all 16 STELLAR partners (see Figure 7). Every member was expected to contribute to the success of the survey by suggesting 15-20 experts till the end of January 2010 and motivating them to participate in the survey.

We received a total of 363 expert nominations from nearly all of the STELLAR partner institutions.

6.3.2 Reaching the experts and motivating them to participate

First, we sent out invitations to all the experts stressing their qualification as an expert in the field of TEL: either the nomination by one of the STELLAR partner representatives or their membership in one of the program committees:

“...We would like to invite you to participate in the STELLAR expert-survey on Technology-Enhanced Learning (TEL). You were personally nominated by *the research group of ...*”

“We would like to invite you to participate in the STELLAR expert-survey on Technology-Enhanced Learning. As a member of the ... *Program Committee*, you were nominated to participate in the STELLAR expert-survey on Technology-Enhanced Learning (TEL).”

We set the initial deadline for mid march; however the participation rate was not high enough at that time and consequently, we extended the deadline till the end of March. We monitored the participation of the nominated experts and sent out reminders before the initial and the extended deadline (see Figure 7). Additionally, we asked the STELLAR partners to send out personal reminders to *their* experts who had not yet participated after the initial deadline expired.

In the 1st Delphi round we successfully motivated STELLAR researchers to participate in the survey by implementing strategies inspired by social psychology such as taking descriptive norms into account when reminding the experts to participate in the survey. We built on this strategy in the 2nd Delphi round as well when sending out the final reminder to all the experts who had not yet participated. For the 2nd Delphi round, we extended the recruiting strategy by mobilizing existing

personal networks of STELLAR partners; in consequence, a high participation rate for the 2nd Delphi round was achieved.

6.3.3 Characteristics of the final panel of experts

The final sample of 511 experts that were invited to participate in the survey consists of 363 nominated international TEL experts and 148 TEL experts from the members of the program committees.

From the 511 TEL experts who received the survey invitation, 230 participated in the questionnaire. 172 work in European countries, 52 experts work outside Europe and 6 experts did not provide information about the country they work in (see Figure 8).

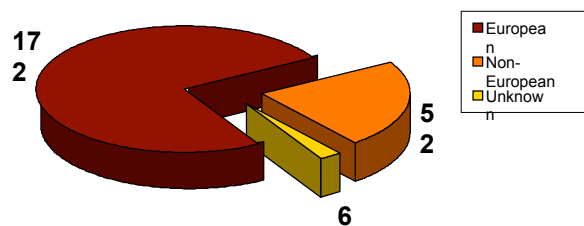


Figure 8. Sample characteristics – European and Non-European distribution.

Figure 9 shows the distribution of the experts with regard to countries. All in all, we reached experts in Asia, North and South America, Australia, and Europe; however, the experts participating in the 2nd STELLAR Delphi round were not distributed equally between the continents and countries. For example, there were more experts from UK and Germany compared to other European countries and more from the USA compared to other countries from Non-European continents.

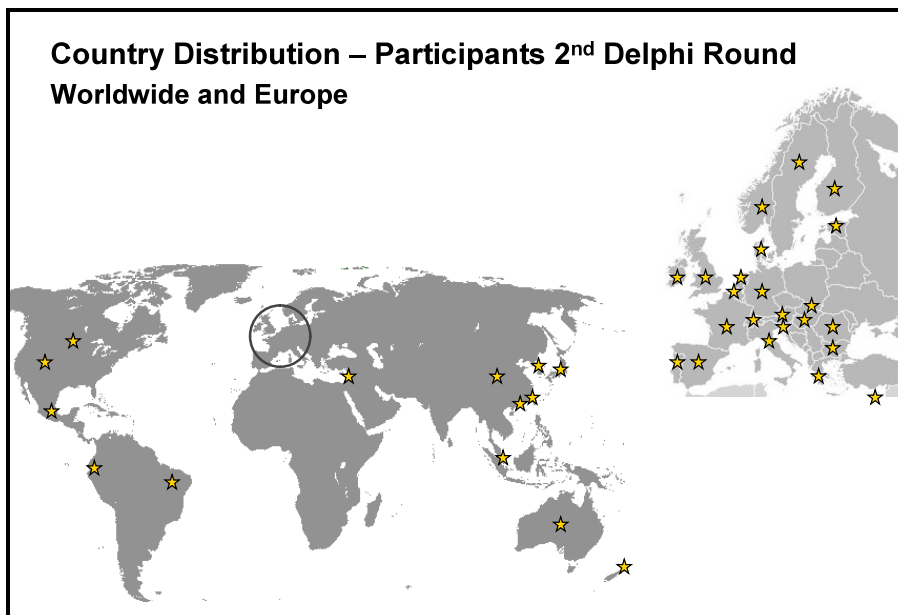


Figure 9. Sample characteristics – Country distribution.

The experts have varying academic backgrounds ranging from a Bachelor degree as the lowest educational degree to status of a professor. More than half of the experts have a doctoral degree (PhD or Dr.) and many are professors (see Figure10).

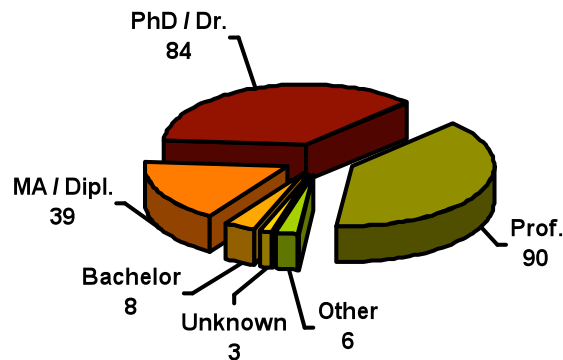


Figure 10. Sample characteristics – Academic background.

With regard to the professional background the participants in the 2nd Delphi round could choose from a list of options: researcher, developer, policy maker, business people, other (an opportunity to clarify their specific professional background was given). As expected, most participants belong to the group of *researchers* (see Figure 11), followed by developers. Since multiple answers were possible some of the experts chose more than one category; therefore the total number of options selected exceeds 230.

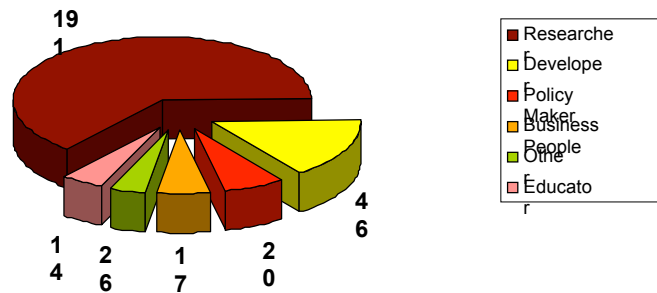


Figure 11. Sample characteristics – Professional background.

6.4 Questionnaire

The questionnaire of the 2nd STELLAR Delphi round is presented in Annex 9.3. In the next sections we will illustrate the rationale behind the development of this questionnaire.

6.4.1 Characteristics of the final questionnaire

The survey encompassed both closed and open-ended questions. The closed questions represented the rephrased research subtopics and a selection of visions identified in the 1st STELLAR Delphi round. We asked the external experts to rate the importance of each research topic. For the visionary statements they rated on a five-point Likert scale the desirability of each scenario and the likeliness that it will become reality within the next 15 years (see Figure 12 for examples and Annex 9.3 for the questionnaire). As the results from the 1st round only provide the opinions of representatives of STELLAR partners on important TEL topics and themes, the external experts of the 2nd survey were encouraged to provide additional input based on their specific expertise.

6.4.2 Use of results from the 1st Delphi round in the development of the questionnaire for the 2nd round

Future of TEL research: Coding categories – topics and subtopics

The development of the online questionnaire was based on the consolidated results of the 1st STELLAR Delphi round. The coding categories provided insights into the most important research themes and results concerning past and future research in TEL; we therefore chose to transform the labels of the coding categories into rating items for the 2nd survey (see Figure 12). We chose to use the subtopics and not the topics for the rating items because the goal of the 2nd Delphi round is to receive an evaluation of the trends, visions and opinions on a more fine-grained level. In the process of transforming the subtopics we rephrased the labels giving special attention to the comprehensibility of the resulting items. This was especially important since the panel of expert was comprised of international participants from various backgrounds.

Part 3: Future TEL Research Themes					
Imagine a large international research program on Technology-Enhanced Learning to be carried out from 2015 till 2020:					
What should be central research themes in this program? (research themes presented in random order)					
	not important			very important	
Development of / research on instructional objectives & frameworks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teacher training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 9. Questionnaire of the 2nd STELLAR Delphi round –
format of the subtopic rating items.

Opinions on standards for TEL research: Open-ended questions

In order to keep the time it would take to complete the survey as short as possible we had to downsize the length of the survey. Therefore, we decided to employ only two of the three questions on opinions on standards for TEL research that were used in the 1st round. We decided for the questions asking for the STELLAR-external experts' perspective on the purpose of TEL research and on undesirable developments in the research field of TEL because these two questions had yielded the most interesting results in the 1st Delphi round.

Visionary Statements

Out of the 134 Visionary Statements produced by the STELLAR members in the 1st Delphi round, we selected Visionary Statements that were mentioned frequently to be evaluated by the STELLAR external panel of experts in the 2nd Delphi round. We sorted the Visionary Statements which were created by STELLAR members in the 1st Delphi round in categories, for example *assessment* or *transformation of formal education*. These categories were inspired by the main themes identified in the 1st Delphi round (see section 5.1.2). Next, members of the Freiburg research team evaluated whether the statements would be assessable on the two intended rating scales, that is, whether the statement will become reality and whether it is desirable. Through the internal evaluation process and mutual discussions between the evaluators, we selected 16 prototypical statements out of the 134 statements for being evaluated by the international experts in the 2nd Delphi round (see Figure 6, p. 47).

For the selected 16 Visionary Statements, we adjusted the wording to standardize the format and employed the two aforementioned rating scales for the evaluation of these future statements. For instance, the statement

“Virtual experiences will dominate the future of education.”

was rephrased to

“By 2025, virtual experiences will dominate education.”

We asked the experts to rate a) the likelihood of the future statement to become reality by 2025 and b) to rate whether they considered the statement to be desirable (see Figure 13).

By 2025, virtual experiences will dominate education.						
unrealistic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	realistic
undesirable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	desirable
By 2025, students' report cards will include assessment of domain-general skills, such as computer-literacy, collaboration skills, mastery of reading and learning strategies....						
unrealistic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	realistic
undesirable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	desirable

Figure 13. Questionnaire of the 2nd STELLAR Delphi round – format of the visionary statements.

7 Outlook

We want to start this section with a short summary of the achievements in the process of the STELLAR Delphi study (see Figure 1, p.10) :

- The 1st STELLAR Delphi round yielded important results that were processed for evaluation in the 2nd Delphi round. Furthermore, we disseminated the results in a preliminary report to all the STELLAR partners in February 2010; thereby the results could be taken into account for other STELLAR activities.
- For the 2nd STELLAR Delphi round we reached the goal of recruiting a large sample of international experts in TEL from a number of different professional backgrounds and successfully completed data collection by the end of March 2010.

7.1 Next steps for the 2nd Delphi round

The next steps of the STELLAR Delphi study are the qualitative and quantitative analysis of the data of the 2nd Delphi round. The results will be disseminated inside the STELLAR network as input to the goal for building leadership in the reflection of the research field of TEL. Dissemination outside STELLAR will include presentation at TEL conferences, communicating with different groups of stakeholders, and of course the next external Delphi round (Round 4) with another large sample of experts.

7.2 The 3rd STELLAR Delphi round

The 3rd STELLAR Delphi round is a STELLAR-internal round and serves to:

- reflect the results on the background of the complementary competence of the STELLAR partners,
- coordinate the work on the Delphi study with the various activities of WP1 and the other WPs, and
- prepare the next and final external round (4th Delphi round).

Not only for this purpose but with these goals in mind, two workshops will take place in Freiburg in cooperation with the Bristol research team in July and August 2010. STELLAR members from all WP1 instruments and representatives from other STELLAR work packages will come to Freiburg to participate. The workshops will be held in conjunction with the WP1 integration meetings that aim at coordinating the various WP1 activities, coordinate the relation with the other WPs, and help to optimize the input in and output of the Delphi study. In the preparation of the

second external round (4th round), the results of of the previous rounds will be processed (see Figure 1, p. 10).

7.3 The 4th STELLAR Delphi round

The 4th STELLAR Delphi round will be the last external round. We will ask a large international panel of experts to evaluate the material we generated from the results of the previous rounds. In contrast to the 2nd Delphi round, we plan on receiving more concise evaluations by the STELLAR-external experts by applying a more competitive approach. For instance, the experts will be asked to evaluate research core areas by stating clear priorities and by providing input in form of short sketches for potential future projects. In addition, the experts will be asked to reflect on areas of future tensions in TEL, e.g. the tension between positive effects of tracking learning records such as the potential to personalize learning, and negative effects such as loss of data privacy, and to provide recommendations of how to meet these challenges.

7.4 The 5th STELLAR Delphi round

The last STELLAR Delphi round will be a round for discussing and disseminating the results of the entire study. With the help of the STELLAR partners, we will integrate the results of all the Delphi rounds and process them e.g. into executive briefings. The main goal of this round will be to disseminate the results as widely and successfully as possible to different groups of stakeholders.

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9 Annexes

9.1 1st STELLAR Delphi round – panel of experts

- Balacheff, Nicolas (Université Joseph Fourier, Grenoble, France)
- Börner, Dirk (Open University of the Netherlands, Heerlen, Netherlands)
- Bottino, Rosa Maria (Istituto Tecnologie Didattiche, Genova, Italy)
- Brown, Elizabeth (University of Nottingham, Nottingham, United Kingdom)
- Burgos, Daniel (Atos Origin s.a.e ES, Madrid, Spain)
- Cress, Ulrike (Knowledge Media Research Centre, Tübingen, Germany)
- Desmoulins, Cyrille (Université Joseph Fourier, Grenoble, France)
- Dillenbourg, Pierre (Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland)
- Duval, Erik (Katholieke Universiteit Leuven, Leuven, Belgium)
- Fischer, Frank (Ludwig-Maximilians-Universität, Munich, Germany)
- Gillet, Denis (Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland)
- Glahn, Christian (Open University of the Netherlands, Heerlen, Netherlands)
- Heinze, Nina (Knowledge Media Research Centre, Tübingen, Germany)
- Herder, Eelco (L3S Research Center - Leibniz Universität. Hannover, Germany)
- Hesse, Friedrich W. (Knowledge Media Research Centre, Tübingen, Germany)
- Hofer, Margit (Centre for Social Innovation, Vienna, Austria)
- Hofmann, Lena (Ludwig-Maximilians-Universität, Munich, Germany)
- Joubert, Marie (University of Bristol, Bristol, United Kingdom)
- Kravcik, Milos (Open University of the Netherlands, Heerlen, Netherlands)
- Kieslinger, Barbara (Centre for Social Innovation, Vienna, Austria)
- Ley, Tobias (Know Center, Graz, Austria)
- Lindstaedt, Stefanie (Know Center, Graz, Austria)
- McAndrew, Patrick (The Open University, Milton Keynes, United Kingdom)
- Meier, Anne (Albert-Ludwigs-Universität, Freiburg, Germany)
- Montadon, Lydia (Atos Origin s.a.e ES, Madrid, Spain)
- Moskaliuk, Johannes (Knowledge Media Research Centre, Tübingen, Germany)
- Nejd, Wolfgang (L3S Research Center - Leibniz Universität. Hannover, Germany)
- Ney, Muriel (Université Joseph Fourier, Grenoble, France)
- Persico, Donatella (Istituto Tecnologie Didattiche, Genova, Italy)
- Pozzi, Francesca (Istituto Tecnologie Didattiche, Genova, Italy)

- Rummel, Nikol (Albert-Ludwigs-Universität, Freiburg, Germany)
- Sarti, Luigi (Istituto Tecnologie Didattiche, Genova, Italy)
- Scanlon, Eileen (The Open University, Milton Keynes, United Kingdom)
- Scott, Peter (The Open University, Milton Keynes, United Kingdom)
- Sharples, Mike (University of Nottingham, Nottingham, United Kingdom)
- Spada, Hans (Albert-Ludwigs-Universität, Freiburg, Germany)
- Specht, Marcus (Open University of the Netherlands, Heerlen, Netherlands)
- Sutherland, Rosamund (University of Bristol, Bristol, United Kingdom)
- Weller, Martin (The Open University, Milton Keynes, United Kingdom)
- Wild, Fridolin (The Open University, Milton Keynes, United Kingdom)
- Wishart, Jocelyn (University of Bristol, Bristol, United Kingdom)

9.2 134 visionary future statements from 1st Delphi round

1. Middle-and upper-class kids will attend mostly private schools throughout Europe
2. Part of their time, students will be taught in virtual classrooms that assemble students interested in "niche" topics (e.g. a specific foreign language), from various schools
3. Some (very few) schools will ban the use of technological devices (from computers to any more recent developments) completely for ideological reasons
4. Students' report cards will include assessment of domain-general skills, such as computer-literacy, collaboration skills, mastery of reading and learning strategies....
5. Someday, people will stop trying to control the brain of others
6. Someday, everyone will be recognized as a teacher and a learner at the same time
7. Some day, the use of networked devices will be not questioned in education anymore
8. In the near future, formal education of long running mass programmes will become irrelevant in favour of networked and digitally supported personal learning trajectories.
9. Personal mobile devices will soon loosen up the boundary between different learning experiences and educational services.
10. Soon, children will learn basic social skills and cultural values from commercial computer and video games rather than in families or at school.
11. Some day, people could keep and access the whole amount of educational documents (textbooks, exercises, experiments, ...) he has ever used on a small portable device.
12. Every single aspect of our daily life, learning included, will be monitored and managed by a single PDA or table device
13. Learning will take 100% in practice in a company, with no more than a formal connection to a college. Learning from practice, no more useless content storing
14. Some day, only 20% of the population will produce 80% of the goods and knowledge, the others will have to be entertained
15. Some day, only students will speak in the few remaining classrooms
16. Some day, competences will be assessed on demand by universities being only accreditation bodies

17. Some day, the unemployed knowledgeable people will get state funding to help disfavored children online
18. Informal learning is already more important than formal learning.
19. Formal learning should teach people how to make use of all available information, rather than restrict the access to this information.
20. People need more information navigation skills.
21. Informal learning is already more important than formal learning from the point of view of individuals. It is from the point of view of society that formal learning is important. Society needs formal learning as a means to achieve average standards and guidelines.
22. Technology is rising the quantities in education, but not the qualities. For the qualities, the human element will always be indispensable.
23. Some day, universities will not exist any more. Adult learners will choose their academic career from a wide range of opportunities provided by a unique learning centre serving the whole country.
24. Some day, it will be recognized that continuous alerts (news, email, chat, twitter) are disruptive; the zap generation will (re-)learn to concentrate on one thing at a time
25. Ubiquitous computing devices will be more like tools that support interaction in the real world than devices with keyboard that demand attention
26. Key developments in TEL will not come from researchers, but from the gaming and entertainment industry
27. The original meaning of 'school' (in Greek) is 'leisure': informal learning with TEL technologies will make learning more enjoyable and appealing
28. Formal assessments, certificates and degrees will become far less relevant, in exchange for proofs of abilities and skills that are specific for a job, either to be provided on the spot or to be distilled from track records (which will become more public than ever)
29. Cost will be the key determinant of future access to educational resources
30. Virtual experiences will dominate the future of education
31. The future of conventional higher education is unclear
32. Some day, personalised learning will ensure the right education is provided at the right time at the right place
33. Location-aware mobile devices will completely change the face of informal learning
34. In the future, learning will be done in "the Cloud" of reusable learning objects that exist on the global WWW

35. One day there will only be 3 universities: Microsoft, Amazon and Google (this statement should be credited to colleagues from the STELLAR Bristol meet)
36. Some day, most 18 year olds will still consider learning as much fun as when they were 6 year olds.
37. Some day, everybody will have immediate access to all the learning support she needs.
38. Some day, we will really understand how learning works.
39. Some day each student will be equipped with her own laptop (or mobile) in class
40. Some day the school system will open to the external worlds and the new methods
41. Some day computer interfaces will become completely "transparent" to the user
42. Teachers will be supported by technology in helping individuals and small groups to learn
43. There will be hopefully great collections of multimedia cases and videos completely indexed and flexibly used for formal and informal learning
44. One day, TEL will include the design of the physical environment as well - the emergence of new learning spaces
45. Learning environments will be an outcome not an input of learning.
46. Media literate learners will be empowered to design their own think tools.
47. Recognising prior learning will be standard and technology plays a vital role in supporting both learners and assessors in accrediting what has been informally learnt.
48. New technological developments require new media literacies and constant innovation in achieving both is the key to move society forward.
49. One day, my mobile phone will chat into my pub talk with a friend, uttering the remark that from hearing what I just said, it might be advised to read the according wikipedia entry -- and my friend and me will laugh and switch it off, (cont'd f.abv.) ... knowing both that the last time I got it in consultation mode about my daily traces it had spotted a weakness in my competence profile which -- after fixing it -- raised my salary to the level we were just now celebrating in that pub.
50. Some day, everyone has access to implicit knowledge in such a way as to not lose knowledge any longer
51. Some day, the Open Access development will make it possible for all to get scientific information for free, but only for few to provide it.
52. Some day the quality and inexpensiveness of net-based communication will have the effect that most of the communication will be net-based.

53. Some day microchips in our brain and drugs will allow us to control our mood, our motivation for learning and many other emotional aspects.
54. computers will be wearable and provide context specific knowledge and information so that no content needs to be memorised
55. There will be no need to bring pupils together in schools for education
56. We will confirm that the wi-fi cloud in which we are bathed causes brain cancer
57. New technologies with video will record all aspects of our learning and training so there will be no need for summative assessment as employers and admissions tutors can be shown clips of students' successes
58. the concept of separate work and personal lives or school and home lives will disappear
59. Some day, objects in the real world and in an virtual world will interact smoothly.
60. Some day, lawmakers will launch a fundamental right for free internet access for citizens.
61. Some day, we will interact with our computers only using eyes, hands and our brain, but no mouse or keyboard.
62. Some day, there will be no longer a formal education system.
63. Some day, old people will no longer be excluded from large part of society due to their usage of technological devices (including internet access etc.)
64. The distinction between informal and formal learning is going to blur
65. Robotic devices will pervade our lives, also with respect to learning processes
66. Some day, it will be easy for grand-parents to teach things to their grand-children using technology, and learn as well
67. Some day, informal learning will count as aquired skills and will play a role when looking for a job
68. Some day, learning will get over geographical and physical barriers
69. context aware devices will form the future learning landscape
70. content federation and integration is the basis for personalisation
71. creating something personal is essential for learning
72. research on context is at the core of learning research
73. Some day, all of us will have one mobile device, which includes all functions you need (phoning, mailing, web, learning devices, gaming, scanning, information gathering,)
74. Some day, f2f teaching will be fostered again in our schools, our learning approaches and our life since it has become too dominant in our learning.

75. Some day, the computer will tell me what LO I shall immediately open in case I have difficulties with a task.
76. Some day, school children will all have mobile phones (with Internet access and some computing functionality) in schools
77. Some day, school curricula and assessment will change to take into account what computers can do (e.g. draw graphs in mathematics)
78. Some day, school teachers will not be afraid of allowing students online access in all classrooms
79. Some day, all learning will be personalised
80. Some day, the exam will be redundant as students create multi-media artefacts
81. Some day, people will have lifelong learning organisers
82. Some day, people will be able to capture, recall, and share a lifetime of rich media memories
83. Some day, people will be able to explore immersive re-creations of historical settings and events
84. Some day, schools will be designed to support social constructivist and inquiry learning
85. Students will be allowed to use technological devices in properly designed exams.
86. Informal learning should be equally important than formal learning.
87. People will be advised which competences to develop, based on their talent, interest, and a general demand.
88. People will learn how to benefit from the abundance of choices, instead of being confused.
89. Learning will be more fun.
90. the computer will be considered as a familiar means of expression, just as a pen
91. any educational or cultural content will be open access
92. we will understand that learning is learning something, and that epistemic knowledge is the core of TEL design
93. epistemic feedback is a critical concept for TEL design
94. Some day, learning to type-write will replace learning to hand-write.
95. Some day, a school day will begin simply by the student switching on his or her computer.
96. Some day, every learner will receive instructional support and feedback adaptively, tailored exactly to his or her needs, from an intelligent computer tutor.

97. where and how to find information will be a higher rated competency than actual knowledge
98. social media will help us communicate and collaborate on a qualitatively higher level
99. media-use will increase the number of people we know and have contact with, but interactions will mostly be shallow
100. personal information online will lead to an increase in personal problems (eg in our jobs in regards to reputation, in our relationships due to jealousy issues, with our kids due to an increase of monitoring possibilities)
101. knowledgemanagement and community management will be key aspects of functioning networks in education and business
102. There will soon be no need for universities.
103. Opinions are becoming more important than facts.
104. Humans need to be technology augmented to learn and work.
105. Protecting rights is in conflict with the operation of the Internet.
106. In future, there will be an 'open marketplace' online in useful people who can help you learn.
107. In a world with cameras everywhere and online tracking of what we do, genuine security becomes impossible and we will have to "give away" everything we do! Working and learning in the open and public!
108. Eventually, we will figure out how to make all assessments ones which are communal not fixed upon one individual. We work and learn in teams; so must be assessed so..
109. Online assessment is the key to the future online learning.
110. The future of interaction analysis is below the semantic level, at the signal level
111. To have an impact on the educational system, we must first have an impact on the assessment methods.
112. Our social duty is to improve formal duty, this is way tax payers support our research; informal learning is an escape from the difficulty of facing schools.
113. TEL has to become teacher-centric: the teacher is the most important actor in the classroom.
114. Learning is not virtual, it is physical.
115. Technology cannot be used as a substitute for personal hard work and commitment
116. Information problem solving should be considered as a key capacity

117. Inclusive education should be considered as a serious goal that cannot be faced only at the superficial level but understanding the various individual, group and cultural differences.
118. We should study the technology related impact of the perceptual differences associated with gender, maturation and aging population
119. Some day people will appreciate that technology can transform their capabilities, but they have to learn how to do this
120. Some day we will be able to build knowledge collectively
121. Some day educational assessment will support creative learning in the classroom
122. some day, schools will increase the fun of learning instead of killing it in the young students
123. some day, working will be fun (without all the dreary routine stuff)
124. some day, I will know which information is important/of high quality without having to search around
125. some day, we all will have more time to think
126. TEL will be interdisciplinary
127. Some day, the internet will break down.
128. Some day, everyone will always be online and connected and any knowledge will be freely available and just a blink (or thought) away
129. intelligent technology will help people to filter the most important information
130. technology will make people more rational in their decisions
131. technology will enhance the divide between first and third world
132. the internet will make school learning more embedded in the everyday life
133. Ambient intelligence devices will blend the real world with the world of information
134. Almost all information needed is available on the Web, the problem is to find the relevant information and to put it into (one's own) context, in order to make it useful.

9.3 2nd STELLAR Delphi round – questionnaire

[PAGE 1]

Dear participant,

Thank you for participating in the STELLAR Delphi study. **STELLAR** is a European Network of Excellence on Technology-Enhanced Learning (TEL) with the goal to foster multidisciplinary research in the field of TEL (www.stellarnet.eu). The STELLAR Delphi study encompasses a series of questionnaire rounds for identifying and exploring experts' opinions and visions about future trends in TEL and TEL research. The 1st STELLAR Delphi round was an internal survey that was answered by the STELLAR participants; the 2nd round aims at integrating perspectives of TEL experts beyond the STELLAR network.

You were personally nominated as an expert for the 2nd STELLAR Delphi round by one of the STELLAR representatives (www.stellarnet.eu/partners). **The statements you will be asked to rate reflect the summarized answers of the 1st STELLAR Delphi round. In addition, we encourage you to share your expert knowledge by providing your input wherever you feel that important points are missing.**

You can find additional information about the STELLAR Delphi study on the **STELLAR Delphi homepage**.

The survey consists of five parts and will take about 20 minutes to complete. **You can move back and forth within the survey using the "back" and "next" buttons at the bottom of each screen; please solely use these buttons for navigation. From now on, you have 24 hours to complete the survey, if you want to resume the survey after 24 hours have elapsed, you will have to start over (from the beginning).** Please do not close the browser window while filling out the survey or your data will be lost. If you have any questions, please feel free to contact us (Christine.Plesch@psychologie.uni-freiburg.de).

Best regards,

The STELLAR Delphi Team

(University of Freiburg: Hans Spada, Nikol Rummel, Dejana Diziol, Anne Deiglmayr, Christine Plesch, Malte Jansen & Celia Kändler; Knowledge Media Research Center Tübingen: Ulrike Cress, Nina Heinze, Katrin Wodzicki)

[PAGE 2]

Information about your professional background

For a sample analysis we would like to collect a brief description of each participant's background. Your answers will be analyzed anonymously; however we would be happy to receive your name for a list of experts who participated in the survey.

Name: _____

Institution/Organization/Business: _____

Country: _____

Academic title/highest degree of education:

- Bachelor
- Master/Dipl.
- PhD/Dr.
- Prof.
- Other: _____

Which of the following groups do you belong to?
(Multiple answers possible)

- Researchers
- Developers
- Policy makers
- Business people
- Other: _____

[PAGE 3]

PART 1: Future Societal Demands & Challenges Influencing TEL

What key societal demands and challenges will Technology-Enhanced Learning have to respond to in the future? (presented in random order)

	not important				very important
Adapt education to new generations of students (e.g. "digital natives" that grew up with technology)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide teacher training in order to improve formal education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lifelong learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Political usage of new media	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Job market changes (e.g. job profiles and requirements)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Privacy issues on the internet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning on demand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teach media and information literacy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reducing the "digital divide" (accessibility to digital resources)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gap between young and old people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adjust education to the "knowledge/information society" (e.g. quick, dynamic changes of knowledge)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Aging society (different needs of older people)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental challenges (e.g. climat change)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Integrate diverse groups of people in the society and the educational system with the help of technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adapt education to individual needs to improve formal education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Globalization of education (both provision of education and global distribution of learners)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Connection between formal and informal learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accreditation of informal learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide additional future societal demands & challenges that you consider important but are missing above:

[PAGE 4]

PART 2: Future Technological Developments Affecting TEL

What key technological developments will have an impact on Technology-Enhanced Learning in the future? (presented in random order)

	no impact				high impact
Technology spread (smaller, cheaper, easier technological tools)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Augmented & virtual reality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile (portable) computing technologies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Semantic web (a web including the meaning of the information - not just links between webpages - making it possible to satisfy search requests on a higher level)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web 2.0 applications & user-generated content	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovative interfaces (e.g. more intuitive to interact with)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interoperability between technological devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ambient intelligence/computing (e.g. objects or environments of networked devices that recognize people and react to their presence)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collaboration & communication tools (e.g. increasing communication tools for distance learning/collaboration such as Google wave)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Sensor technology (e.g. sensors for biometrics)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web 3D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Context-aware technologies and applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide additional future technological developments that you think will have a high impact but are missing above:

[PAGE 5]

Part 3: Future TEL Research Themes

Imagine a large international research program on Technology-Enhanced Learning to be carried out from 2015 till 2020:

What should be central research themes in this program? (presented in random order)

	not important				very important
Development of/research on instructional objectives & frameworks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teacher training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recommender systems (e.g. based on a students previous learning experience a system recommends matching learning objects)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching of TEL-skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competence assessment techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lifelong learning & workplace learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ubiquitous & mobile technology/learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Connection between formal and informal learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adaptive/Intelligent learning support systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Integration of technology into formal education settings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Informal learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collective intelligence/wisdom of the crowds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Social justice/addressing the digital divide (accessibility to digital resources)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contextualized learning & context-aware applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Enabling third world countries to benefit from technology enhanced learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interoperability and the integration of different devices & applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Social software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Development of/research on instructional methods & applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personalization/individualization of learning (e.g. PLE)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Analysis of cognitive processes on the group level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open access to information resources and tools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How can the needs of all learners be addressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emotional and motivational aspects of learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improve practices of formal education & formal education systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collaborative learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

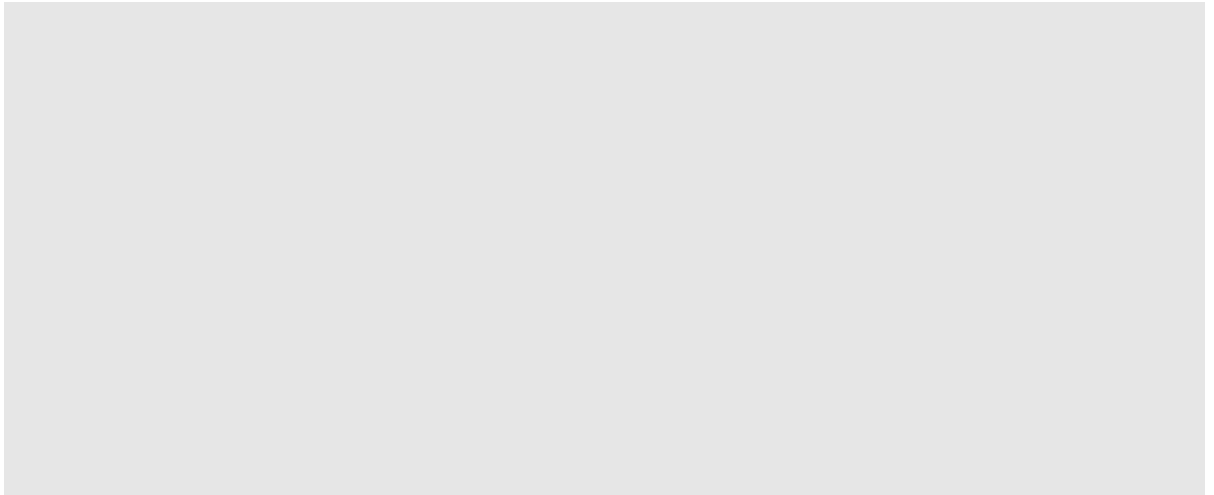
Please provide additional research themes that you consider important but are missing above:

[PAGE 6]

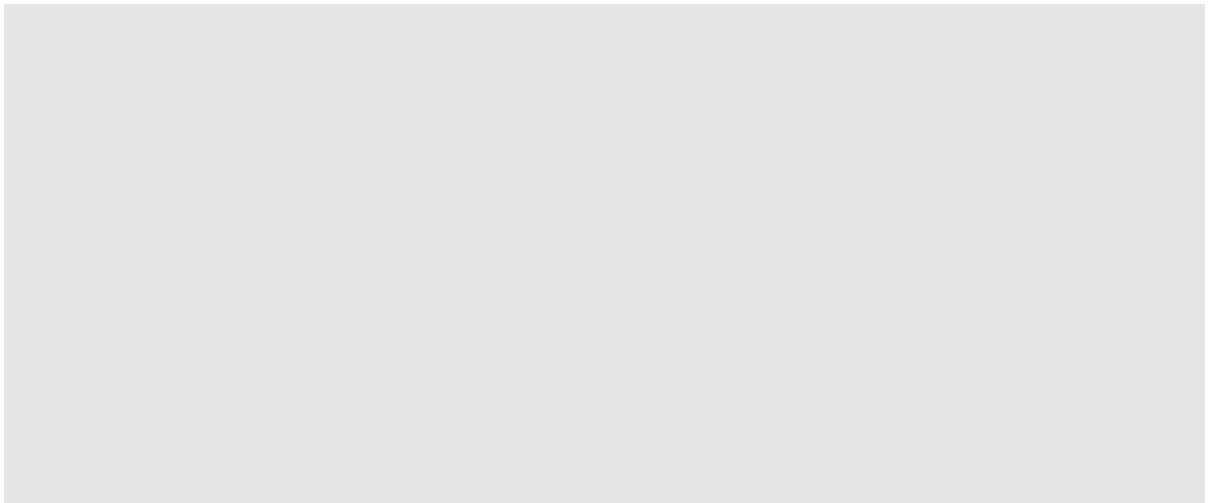
PART 4: Opinions and Visions on Technology-Enhanced Learning Research

One objective of STELLAR is to reduce the fragmentation of TEL research; therefore we would like to collect opinions and visions of TEL experts on TEL research for identifying common goals and visions.

From your perspective, what is the fundamental purpose of Technology-Enhanced Learning research?



From your perspective, what developments in Technology-Enhanced Learning research would be undesirable?



PART 5: Visionary Statements

In the last part of the survey, we would like you to rate visionary and/or controversial statements regarding future developments in TEL.

Please rate whether you think it is realistic that the scenario will be true by 2025 and whether you consider it to be desirable:

1. "By 2025, virtual experiences will dominate education."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

2. "By 2025, formal education of long running mass programmes will become irrelevant in favour of networked and digitally supported personal learning trajectories."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

3. "By 2025, learning to type-write will replace learning to hand-write in early education."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

4. "By 2025, recognising prior learning will be standard and technology plays a vital role in supporting both learners and assessors in accrediting what has been informally learnt."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

5. "By 2025, no content needs to be memorized because wearable context-aware devices will provide the relevant information."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

You can add a comment to the statements or your ratings

6. "By 2025, our learning history will be recorded resulting in a track record (including video) for example for evaluation purposes."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

7. "By 2025, key developments in TEL will mainly come from the gaming and entertainment industry."

unrealistic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	realistic
undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	desirable

8. "By 2025, learners will no longer use a mouse or keyboard, but will interact with their computer only using eyes, hands and their brain."

unrealistic **realistic**
undesirable **desirable**

9. "By 2025, learners will be empowered to design their own think tools."

unrealistic **realistic**
undesirable **desirable**

10. "By 2025, intelligent software will support learners to filter information for quality and importance."

unrealistic **realistic**
undesirable **desirable**

11. "By 2025, inexpensiveness and ease of use of technology will enable diverse groups of people to access educational resources."

unrealistic **realistic**
undesirable **desirable**

You can add a comment to the statements or your ratings

[PAGE 9]

12. "By 2025, students will start their school day by switching on their computer and logging in to "school" (from wherever they are at that time)."

unrealistic **realistic**
undesirable **desirable**

13. "By 2025, microchips in our brain and drugs will allow us to control our mood, our motivation for learning and many other emotional aspects."

unrealistic **realistic**
undesirable **desirable**

14. "By 2025, students' report cards will include assessment of domain-general skills, such as computer-literacy, collaboration skills, mastery of reading and learning strategies...."

unrealistic **realistic**
undesirable **desirable**

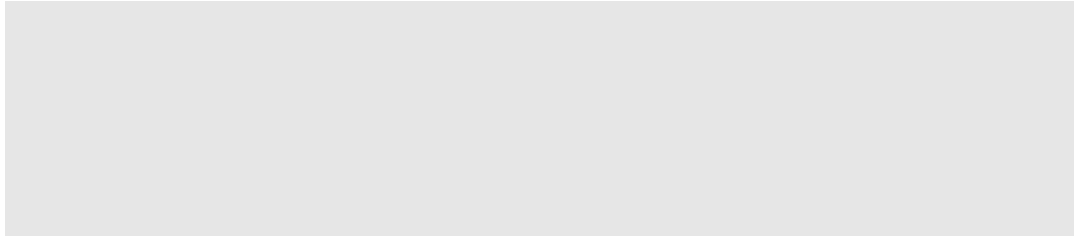
15. "By 2025, the boundary between formal and informal learning will have been blurred."

unrealistic **realistic**
undesirable **desirable**

16. "By 2025, students will be allowed to use technological devices in exams that are designed to assess students' abilities and knowledge while taking into account what the technological devices can do (e.g. draw graphs...)."

unrealistic **realistic**
undesirable **desirable**

You can add a comment to the statements or your ratings



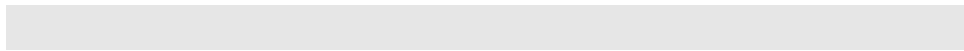
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Please provide 2 to 3 additional “visionary statements” regarding future developments in Technology-Enhanced Learning with a high potential impact.

By 2025,



By 2025,



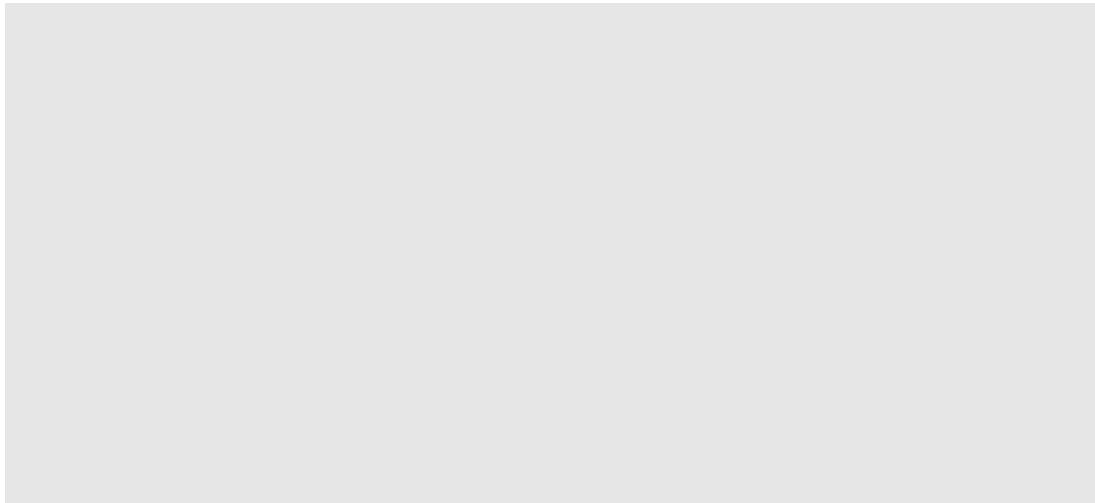
By 2025,



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General Feedback

Please feel free to give feedback to the survey:



You have completed the survey. You may still move back and edit answers. **By clicking on the "next" button you can submit your answers.** You won't be able to move back and change your answers after submitting.

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Thank you for participating in the STELLAR Delphi study!

We hope for further fruitful collaboration.

Best regards,
The Stellar Delphi Team



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