Program Development Report and Recommendations
to the Faculty of Behavioral, Management & Social Sciences
University of Twente

Interdisciplinary Learning Sciences and Technology Research (ILLUSTRATE)
Program development report and recommendations to the faculty

LEARNING: BMS Research Theme Development
February 19, 2018

The activities described in this report were carried out by the Learning Working Group (LWG), the Learning Advisory Board (LAB) and/or the SEP staff (other researchers at BMS who, together, constitute the learning group that SEP would visit). This report was written by the LWG, with constructive feedback from the LAB.

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Executive Summary

In 2017, the Faculty of Behavioral, Management and Social Sciences (BMS) at the University of Twente (UT) launched several new programs of research. Based on broad interest and an outstanding track record, the theme of learning was selected as one of the programs to be elaborated. To leverage recent changes in the organizational structures within the faculty, and to ensure that the new research program would meet the criteria established in the current national evaluation protocol, the investigation described in this report was undertaken. This document provides transparency into the investigation process, as well as recommendations for moving forward.

Based on analysis of the current context, the goal of the investigation was to identify the core characteristics of a plan for developing a robust learning research program within BMS at the UT. Learning was defined in a broad sense, and relationships between learning research the university's mission were articulated. This yielded a rich variety of aspects being studied, including variety in learners, learning pathways and learning environments, as well as variety in learning contexts, learning disciplines, and types of learning goals.

The investigation blended top-down/bottom-up and rational/exploratory approaches to identify which focal areas the program should target, which assets can be leveraged and which needs must be met, and core design requirements for the program. Data were collected through three consecutive staff survey approaches (questionnaire, interview and focus groups) as well as analysis of documents (funding records, publications, and requests for proposals). In addition, workshops held with BMS learning researchers as well as external experts and local stakeholders provided valuable insights.

From this investigation, four thematic areas were identified as salient to current and prospective BMS work, and as high-leverage for a robust research program. These are: Depth/Quality, Inclusion/Equity, Adaptability/Flexibility, and Differentiation/ Personalization. Assets and needs were identified in relation to human, material, and structural resources. Design requirements were articulated in relation to the themes as well as collaboration, organization, and resources.

Learning is the cornerstone of societal development. Focusing on the four themes identified can support the development of individuals, groups and systems that carry our heritage forth, enrich our existing experiences, create new and better ways to care for our environment and one another, and provide structures to enable social, economic and political reform. BMS learning research can accomplish this through scientific contributions which are theoretical as well as methodological. It can also impact society at large by directly influencing three interacting layers: learners, learning environments, and the systems to which these are connected.

To realize the vision described above, targeted investments are needed to develop the human, material and structural aspects of infrastructure that can enable this work to thrive. Short term priorities should focus on institutionalization, community building, and (capacity for) scientific quality. In addition, developing outreach capacity establishing long-term partnerships will support the team's ability to yield relevant and meaningful societal impact.

NB: For readers seeking information relevant to the Part 5 of the Standard Evaluation Protocol mid-term review, this is given in chapter 6, Recommended contours for the BMS learning research program (p. 33).

Contents

1. Background and context

Launching the development of new research programs

In 2017, the University of Twente's faculty of Behavioural, Management and Social sciences (BMS) begin to establish new lines of research, which would leverage existing strengths and support innovation by crossing disciplinary boundaries. This was prompted by the university's decision to adopt new evaluation protocols, as well as the inherent desire to bolster existing quality. Since then, multiple lines of research have been under development (including health, industry, and resilience). This report portrays the work undertaken to develop a research program on the theme of learning, and offers recommendations for moving forward.

Standard Evaluation Protocol

Standard Evaluation Protocol (SEP) describes the methods used to assess publically-funded research (e.g. at Dutch universities) every six years. The present SEP has been endorsed by the Association of Universities in the Netherlands (VSNU), the Netherlands Organisation for Scientific Research (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW). This means that these organizations have agreed to assess all their research between 2015 and 2021 in accordance with the current SEP, available here: http://www.vsnu.nl/sep.

According to SEP, the following conditions apply to assessing research units:

1. The research unit must have its own clearly defined strategy and be sufficiently large in size, i.e. at least ten research FTEs among its permanent academic staff, including staff with tenure-track positions and not including PhD candidates and post-docs. This merely indicates the minimum number, however; larger units are preferable.
2. The research unit subject to assessment should have been established at least three years previously. If groups of a more recent date are to be assessed, their self-assessment should indicate their stage of development so that the assessment committee can take this into account when considering the "viability" criterion.
3. The research unit should be known as such both within and outside the institution and should be capable of proposing a suitable benchmark in its self-assessment. The benchmark would preferably be an international one.

To facilitate a successful evaluation, these conditions have been taken into consideration throughout the work described in this document.

BMS learning research

The faculty has multiple graduate and undergraduate programs that relate to this theme (e.g. Educational Science and Technology, Learning Sciences, Preservice Teacher Education, Psychology). There are also groups housed within BMS that are responsible for providing learning support (e.g. The 4TU Center for Engineering Education, Assessment Center). The study of learning at BMS is tackled from multiple, complementary perspectives, which yields powerful variation such as, individuals and group learning, formal and informal contexts of learning, and neuro, cognitive, and social aspects of learning.

There are also both individual researchers and entire departments investigating learning, contexts in which it takes place, ways to support it, and so on. Among staff with fixed contracts, there are approximately 50 researchers who either already are conducting research relevant to the theme of learning, or have expressed their aspiration to do so in the coming short term. These are the individuals who would participate in a research program assessment following the current evaluation protocol.

The faculty of BMS has undergone organizational transitions recently. Several of the participating departments have been fused and reorganized, including the establishment of four organizational clusters, which are just taking the first steps toward becoming functional units. Many of the fixed staff with interest in learning research do not (yet) know each other, or their areas of work, very well. Thus, elements of this research unit have been together for much longer than three years, and other elements are quite new. While the research unit as a whole does not yet have a strong (inter-)national name, many of its sub-units do (e.g. educational researchers from this group are ranked 35th in the world in de QS World University Ranking, and have held 5th place in the *Learning and Instructional Sciences* for several years, according to recent editions of the Educational Media and Technology Yearbook.

Such a context naturally offers affordances and limitations for shaping the development of a new line of research. Together, these warranted investigation, before a plan for developing a robust program of research could be articulated. Specifically, the goal was to further analyze the current context, in order to understand how a learning research program could be developed at the faculty of BMS within the UT. The remainder of this document describes both the process and the outcomes. Specifically, chapter 2 offers key conceptual points of departure, chapter 3 describes the methods used, and chapter 4 presents the results. Building on these, chapter 5 discusses the key issues and chapter 6 offers core recommendations for moving forward.

2. Core ideas framing the present investigation

Principles guiding our work

While theoretical underpinnings for any research program are of course crucial, they are more the result than the starting point for this inquiry. However, we did articulate some key principles that shaped the research program development work described in this document. Specifically, the program development team felt it important that this work would be characterized by:

- *Inclusiveness*: Participation accessible to all interested BMS colleagues
- *Strategic alignment*: Focal areas support UT Vision 2020
- *Innovativeness*: Program stimulates ground-breaking R&D
- *SEP-enabling*: Ranks highly on research quality, relevance to society, viability

In addition, we used a systematic approach in which the inputs from each phase of exploration informed and shaped the subsequent one. We noted that teamwork (in the working group, and later throughout the learning strand) relies on shared vision, which can only grow from negotiation of meaning. We therefore prioritized starting with the meaning of "learning" and attempted to distill focal areas related to that.

Further, we saw value in blending top-down/bottom-up and rational/exploratory, approaches. We noted that individual and organizational benefits must be linked, and thus planned activities that help seek synergies. Starting in late August 2017, the team met every two weeks to progress on the core tasks, elaborated in Chapter 3.

Characteristics of research in the learning strand

What constitutes learning?

We agreed to use the term, learning, in the broadest sense. As such, we understand it to mean one or more of the following: acquisition of knowledge, skills and attitudes relevant to a specific discipline or across disciplines; engagement in practices of the discipline; or the process through which larger entities (e.g., groups, organizations, macro systems) develop their understanding, norms and values, policy and practice. Additionally, we noted that the learning outcomes can be manifested in individuals, teams, organizations, etc. as well as their practices, cultures, policies, etc. While most of the researchers in BMS focus on human learning, we agreed to explore (interest in) machine learning also.

Twente learning research

We considered what would characterize the research that is conducted at this university, whose motto is "high tech, human touch." First, we agreed that it should attend to a blend of technology (high tech) and human factors (human touch). Thus, we noted the following:

- Technology can be included in BMS learning research as:
    - An instrument for research (e.g. eye trackers, data analysis),
    - An object of research (i.e. dependent or independent variables),
    - A means for researching learning (i.e. treatment), or possibly also
    - A context for research (e.g. the learning of those who develop technology).
- Human touch is identified in BMS learning research in terms of (understanding or supporting) the
    - Learners (individuals or groups)
    - Learning processes, in which self-activity (active engagement with disciplinary content) is crucial for enabling learning.
    - Learning facilitators (teachers, coaches, leaders, etc.)
    - Learning environments and systems (schools, organisations, business, governments, etc.)

Second, we articulated a vision for how BMS learning research work should be undertaken. This vision aligns with the criteria of SEP, the university's mission, and our own convictions. Namely, we felt that BMS learning research should always:

- Tackle challenges which are both locally and internationally relevant;
- Leverage the strong collaborative culture on campus (within BMS and, where possible, with other faculties);
- Build (on) sustainable partnerships off-campus, from both new and existing affiliations (4TU, Novelty, ECIU, partner schools, museums, publishers, etc.);
- Strives to examine phenomena in broadening contexts and domains, to test the boundaries of evolving theory; and
- Offer contributions of practical relevance to the focal area defined (e.g. recommendations for policy makers, guidelines and materials for practitioners).

Healthy variety

Variation in what is studied

Throughout the work described here, we embraced variation in the learning-relevant aspects being studied. We found it useful to note that, across the variety of factors directly and indirectly related to learning, most studies examine one or more of these three:

- *(Groups of) Learners:* This includes key characteristics, needs, changes over time, conceptions, performance, attitudes)
- *Learning pathways:* These include conceptual builds, learning progressions, pedagogies, learning processes, learning theories)
- *Learning environments:* Features of the learning context that (directly or indirectly) shape teaching or learning processes or outcomes. These include:
    - *Human* features of context (e.g. peers, colleagues, teachers, leaders, coaches, citizens)
    - *Material* features of context, including immediate environment (lighting, architecture), pedagogical resources (for learner use) and performance tools (for teacher use)
    - *Structural* features of context, including norms and routines, but also (e.g. school, organizational, government, society) policies (at micro, meso, macro or supra levels)

Variation in structural characteristics

We explore this area from and across the social sciences, with expertise from all four clusters across the faculty of BMS. As such, the learning strand is rich with diversity. We envision that this can offer synergies and opportunities to push the boundaries of nascent theories. Specifically, the structural characteristics of learning research at BMS are varied in terms of:

- *Context*: formal (e.g. schools, organizations) or informal learning (e.g. museums, contests, libraries, on-the-job, community events)
- *Discipline*: all subjects/domains (for now - narrowing possible)
- *Goals*: learning for: life, personal development, citizenship, employability, qualification, professional functioning
- *Learners*: children through adult learners; individuals, teams, organizations; the team wonders about exploring the theme of machine learning

Throughout the work described here, we did not attempt to limit these factors. Rather, seeing more advantages than disadvantages brought by this diversity, we embraced and attempted to portray their variety.

3. Methods

Goal and questions

The purpose of the present inquiry was to understand the BMS setting better, so that a feasible and effective plan for developing a learning research program could be articulated.

We therefore set out to answer the following main question: *What are the core characteristics of a plan for developing the learning research program at the faculty of BMS within the UT?*

Related to this question, we asked three sub-questions:

1. On which *focal areas* should the learning research program be based and why?
2. Which *assets* can be leveraged, and which *needs* would need to be addressed to develop a high-quality research program on learning?
3. According to those researchers who will participate, what are *core design requirements* for a robust learning research program and why?

Respondents

Among staff with fixed contracts, there are approximately 50 researchers who either already are conducting research relevant to the theme of learning, or aspire to do so in the coming short term. The faculty of BMS has recently established four clusters, one of which (DDS) has a long-standing history of work related to learning, and all of which are represented in the learning research program. As researchers are mobile, the specific number of researchers is dynamic. However, this list offers an indication of how many researchers per cluster are participating in the learning research program:

- **9**: Technology, Policy and Society (TPS: HTSR-CSTM-PHIL-STEPS-CHEPS)
- **8**: Technology, Human and Institutional Behavior (HIB: CS-PA-PCRS-PHT)
- **28:** Technology, Data-analytics and Decision-support Systems (DDS: CPE-ELAN-IST-OWK-OMD)
- **6:** High-tech Business and Entrepreneurship (HBE: CMOB-HRM-IEBIS-FA-NIKOS-TM/S)

An overview of these researchers is given in Appendix A.

Core activities

Before a development trajectory for the learning research program can be articulated, clarity was sought on: focal areas, existing assets and needs, and design requirements for the program. This also includes a vision for what it would look like in five years' time. Once these are clarified (as done in Chapter 4), a plan for the developing the program could be written (contours are offered in Chapter 5).

Table 3.1 shows the core tasks which were undertaken from spring through the fall of 2017, and illustrates the data source triangulation on the focal areas, assets and needs, and design requirements to enable writing a plan for program development at the end of 2017. Thereafter, each element in the table is elaborated.

Table 3.1 Core activities to enable research program design

Core activities	Focal areas	Assets & needs	Design requirements
Staff survey	X	X	X
Document analysis		X	X
Workshops/guests	X	X	X
Partner outreach	X	X	
Site visits (see below)	X		X

Staff survey
The staff survey was an empirical task, featuring collection of data primarily from the SEP staff, and possibly other BMS researchers interested in this theme. It contributed to understanding of BMS views regarding focal areas, existing assets and needs, and design requirements for the learning research program. Three methods of data collection were undertaken: questionnaire, individual structured interview, and focus group discussions. The questionnaire was based on a tool already piloted during the BMS workshop in June, which primes respondents to articulate their own existing and desired research in relation to the theme of learning. During the interviews, these inputs were used in questions that aimed to distil participant views about focal areas, assets and needs and design requirements for their own participation in a learning-focused research program. This also included gathering information about the social and political networks in which our staff function and might be able to leverage (e.g. governing boards, research program committees, advisory councils, etc.). Thereafter, focus group discussions were held with the learning theme members from each BMS cluster (TPS, HIB, DDS, HBE), to inventory synergies as well as any potential hindrances to working on cluster development.

Of the 51 researchers invited to participate in the staff survey, 45 completed the questionnaire, 41 were interviewed, and 24 participated in the (in total five) focus group discussions. To enable themes to emerge from the data, no specific coding schemes were established ahead of time. Rather, data from all sources (questionnaire, interviews, focus groups) were analyzed inductively. The inductive coding was done by the research assistant and verified by a member of the LWG. The questionnaire is given in Appendix B, the Interview protocol is given in Appendix D, and the focus group protocol is given in Appendix F.

It should be noted that this investigation was undertaken as part of an internal exploration initiative, for the purposes of developing the BMS research program. It was not as part of the scientific investigation intended to contribute to theoretical understanding. As such, the level of rigor in data collection and analysis undertaken in this investigation was deemed appropriate by the LWG, and highly acceptable given the resources and time available.

Document analysis
Two types of document analysis were undertaken which, together contribute to understanding of assets and needs as well as design requirements. A quantitative and qualitative citation analysis of SEP staff publications related to learning was undertaken to provide an overview of existing strengths to be leveraged within the team. As focal areas are articulated, this analysis was also seen to be useful to judge viability, considering our goals related to research quality and relevance. Additionally, analysis of funding opportunities was undertaken. Here too, quantitative and qualitative analysis were conducted, this time focusing on (a) our funding track record for learning research and (b) current priorities as expressed in requests for proposals and research program documentation, taking the key sources of funding as identified in the staff survey as points of departure. Here too, to enable themes to emerge from the data, no specific coding schemes were established ahead of time. Rather, data from all sources (requests for proposals and publications) were analyzed inductively. The inductive coding was done by the student assistant.

Workshops
Prior to the LWG's start, two BMS workshops contributed to the development and sharing of ideas about the new research program. First, a full-day workshop was held on May 12 to stimulate participant thinking and distil initial ideas. Second, a shorter

workshop was held in conjunction with a BMS-wide conference on June 23, which focused on describing and sharing characteristics of existing learning-related research in our faculty. Each of these workshops also featured guest speakers who shared new ideas to inspiration to fuel thinking about the new research program. Two additional workshops were envisioned and planned as part of this inquiry: All-SEP and LWG/AB.

Held on December 6, the all-SEP workshop targeted the needs of the learning researchers, though was open to other BMS researchers interested in this theme. During this workshop, guest speakers offered multiple contributions during a full-day event (first with BMS researchers only, the second day with the external guests mentioned under partner outreach). The topics covered were based on interests and needs as articulated through the staff survey. Each participant had the opportunity to engage in the development of (at least) one research proposal, with attention to both methodological and conceptual considerations. Additional information about the workshop structure is available in Appendix L (Agendas for December 6 and 7), Appendix M (posters emerging from the work on December 6), and Appendix N (initial pre-proposals emerging from the work on December 7).

Held on December 8, the LWG/AB workshop focused on consolidating all experiences and findings throughout the development period. Key goals of this workshop were to finalize, articulate and validate the focal areas, assets and needs, and design requirements that were to be used to as a basis for the recommendations for future research program development.

Partner outreach
The relevance as well as the quality of our research is strongly influenced by how responsive we are to the needs and wishes of our external partners. Partner outreach helped us identify existing and desired learning research partners (assets and needs), as well as their concerns (focal areas). A networking event was held on December 7, as an extension of the December 6 workshop, in which partners could think along with BMS researchers about projects that address important societal challenges. These sessions were provided by BMS learning researchers together with external guest speakers. As such, engaging in the seminars with the external guest speakers also contributed to the professional development of BMS staff. An overview of the attending partners is given in Appendix A.

Site visits
Two site visits were envisioned to offer the LWG inspiration as well as cautionary tales. One site visit was to be conducted with a Dutch university group that has successfully passed SEP review. From this visit, the LWG had hoped to gain insight into what we could expect, as well as recommendations for how to prepare not only for the review, but also for long term program development. However, after much exploration, we concluded that this was premature (as we were unable to identify a suitable group). The other visit was to be conducted with the core staff of a European interdisciplinary research program on learning. The site for this visit has been selected for its potential to teach the LWG about various aspects of an interdisciplinary research program related to learning, and especially research quality. However, this visit has been postponed until 2018. Therefore, no information about site visits is included in this report.

Envisioned outputs
Program development recommendations
The primary output of this work was to be the composition of a recommendations for the long-term development of the learning research program. These include the domain challenges to be focused on in the research program, the scientific contribution it

aspires to make, and how the research program will achieve societal impact. Further explicit recommendations are given for developing the infrastructure required to realize this vision), including how BMS will nurture ownership and commitment among the key stakeholders. This output is offered in Chapter 5.

BMS learning research information
One secondary output of this work is the provision of evidence, which has shaped the learning research program development plan, but is also useful in its own right. Specifically, this work describes: the focal areas of the UT/BMS learning research program and their origins; key assets that should be leveraged and specific needs to be met for the UT/BMS learning research program to succeed; and design requirements that would have to be satisfied for the UT/BMS learning research program to be successful. This output is offered in Chapter 4, and supplemented in the appendices.

Commitment
Another secondary output of this work is the development of interest, ownership and commitment to participate in a new, BMS-wide research unit. This is a crucial pre-condition for enabling the new program to develop and thrive. This was stimulated by: inventorying and valuing UT/BMS expertise related to learning (staff survey, document analysis); sharing and leveraging existing UT/BMS expertise related to learning (workshop); inspiring with ideas from outside (site visits, workshop); supporting valorization and partner network development (partner outreach, workshop). While the commitment is of course not captured in the report, the informal feedback from BMS learning researchers suggests that these important steps have indeed stimulated initial development of interest and open minds toward commitment.

Operationalization
Timeline
Table 3.2 shows the LWG planning of the core tasks, which yielded inputs for writing the program development plan presented here. While site visits were later postponed until 2018, the remainder of the core tasks listed in Table 3.2 were carried out during 2017 within the budget allocated by BMS.

Table 3.2. LWG timeline

Core tasks Weeks	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Staff survey														
Questionnaire														
Interviews														
Focus groups														
Document analysis														
BMS Citations														
BMS Funding record														
Current programs/calls														
Site visits														
Partner outreach														
Workshops														

Resources
While the LWG and AB were certainly envisioned to contribute to realizing this plan, additional support was also deemed necessary. Key human resources included assistance for the research and project management as well as a project consultant. A scientifically educated (MSc) junior researcher was needed to provide support to the empirical studies in this plan (staff survey and document analysis). A project manager was needed to provide assistance with the logistics, network relations, and coordination of all core tasks. As some tasks did not require MSc level expertise, a student assistant supported some of the work (e.g. obtaining documents, helping pilot instruments for analysis).

A consultant was also deemed extremely valuable, as relevant external expertise could help the LWG team by guarding objectivity, offering new perspectives, and anticipating the views of an external review panel. The consultant required an outstanding track record related to multiple areas of learning research, extensive expertise in establishing successful (interdisciplinary) research programs, and the social competence to empathize with and support the LWG team.

4. Findings

Q1. Focal areas

The findings from the questionnaire, and focus groups yielded four key themes: Depth/Quality, Inclusion/Equity, Adaptability/Flexibility, and Differentiation/ Personalization. As discussed in the closing chapter of this report, learning researchers acknowledge both synergies and tensions between these areas. Summaries are presented below, but more detail is available. Namely, Appendix C shows the results from the questionnaire, Appendix E shows the results from the interviews, and appendix F shows the results from the focus groups. Appendix H shows a summary of the separate data gathering activities in relation to each research question.

Depth/Quality

The theme of depth and quality is relevant for most BMS learning researchers. The theme includes analyzing what factors contribute to quality learning, and how this should be organized on institutional, national and international policy levels. Furthermore, it has to do with (school/organizational) effectiveness research, quality assurance, enabling deep understanding, and eliciting rich performance. It also includes the effect of (technological) innovations on these aspects. All BMS learning researchers agree that it is crucial to monitor the quality and effectiveness of education, and to look for room for improvement. For several researchers, this theme is the focus of all their research (e.g. CHEPS). An example of a grand challenge on policy level mentioned during the questionnaire is: "Which governance arrangements (funding, quality assurance, ranking, information tools, etc.) stimulate higher education to enhance quality of its education?".

For others, quality and/or depth plays at least some role in their work (e.g. monitoring training programs or materials). This resulted in very diverse questions, such as: "Developing teachers, learning environments, and different forms of assessment that stimulate 21st century learning, bridging the gap between theory and school practice in this topic", and "The intersection of the individual and team, and team and organization learning and further impact at scale in the education system".

Besides the elaboration on grand challenges that were mentioned during the questionnaire, several new questions emerged during the interviews, such as: "The impact of new technology; not the change in didactics/ pedagogy, but the influence it has on how you organize education (on policy level) and quality assurance", and "How can we integrate new technologies like sensors based technology, VR tools, virtual and remote laboratories in learning environments in such a way that the learning experience or collaboration is enhanced".

Finally, one researcher showed a clear interest and strong track record in machine learning, which is another context for the use of the term, 'deep learning' This refers to pattern recognition in neural networks. It is mentioned here because this idea was viewed by others as potentially interesting.

Appendix H shows the themes/challenges related to the theme of depth/quality in yellow. As can be seen, many of the grand challenges that were mentioned during the data collection are connected to this theme. The questionnaire and individual interviews resulted in very diverse grand challenges, but during the focus groups the learning researchers identified five main challenges related to quality and depth; The added value of technology in education; Learning and working in partnerships/networks for effective education/learning; Preparing higher education for the future; The quality of academic education; and how to enable/facilitate deep learning.

Inclusion/Equity
Grand challenges related to inclusion or equity have to do with the need for learning and development to not only be of high quality, but accessible and with equal opportunities for all learners, from all backgrounds (socio-economic, gender, race, etc.). Throughout all clusters, this was considered an important theme in learning research. Table H shows the themes/challenges related to this theme in pink. The questionnaire resulted in several questions related to inclusion/equity, such as: "How to enable all [learners] to optimize their learning progression?", and "How to guarantee fair measurement of learning?".

During the interviews, more questions emerged for this theme, such as: "What are the (social) effects of the development of AI (inclusiveness instead of creating a divide); and "How can we create equal opportunities for students from different backgrounds (e.g. socio economic, gender), especially for higher education? And which barriers are there? What can a school/government/organization do about this? Do students eventually land in the right place?". The theme also refers to how we can prevent a digital divide and developing digital literacy. Additionally, equity also refers to funding, on an institutional and (inter)national level (e.g. bonus for study credits or for diplomas, deliverance of PhD's), guaranteeing fair measurements of learning and reducing learning inequalities and achievement gaps. The theme of inclusion is also mentioned in the national research agenda: What are the effects of inclusive education, and how can inclusive education be promoted? During the focus group, there were four grand challenges that the researchers agreed upon: social inclusion, inclusiveness, the digital divide, and equal opportunities for all students.

Adaptability/Flexibility
Adaptability and flexibility are important outcomes for today's learners. Schools, institutes, businesses, and other organizations today are characterized as changing, dynamic environments. With many new (technological) innovations, globalization and internationalization, it becomes increasingly important for professionals to be adaptable and flexible, and learn new ways to perform their job. In appendix H, the themes/challenges related to this theme are shown in green. Grand challenges that fall under this theme relate to professionals' ability to adapt to change, and make change in response to their environment. Additionally, an important theme identified by the data collection, is interdisciplinary teaching and working, which requires professionals to collaborate and integrate their knowledge. Among the BMS learning researchers, this theme was considered crucial in relation to learning. In this constantly changing society, it is essential that students are being prepared to deal with these changes and instability. As a result, students need to be taught different skills, that need to be identified and receive attention in educational programs. Furthermore, professionals also need to learn how to be adaptable and flexible. Nowadays, organizations include a lot of team learning in their professional development programs. Since these teams are often fluid (e.g. agile), it is important to consider how this affects their learning results. This theme is also mentioned in the national research agenda; How can education stimulate 21st century skills to prepare people for functioning in the future society.

The questionnaire resulted in many grand challenges related to adaptability or flexibility. Examples are: "The composition of teams constantly changes, how does this constant 'newcomer effect' influence learning (in project groups, agile or scrum teams) and how can we study this?", "How can we create (adaptive) support/feedback systems that enhance collaborative inquiry learning?", and "How can we help (future) employees to adopt 21st century skills of constant change that are crucial for them to survive in the workplace?". During the interviews, many of the grand challenges that were described in the questionnaire were further illustrated. During the focus groups, the participants agreed that three questions related to adaptability/flexibility were especially important:

"How can we prepare professionals for the job market?"; "Interdisciplinary learning/teaching (e.g. science)"; and "Retaining teachers in this changing society. The traditional role of teachers is changing a lot; how do you deal with this?".

Differentiation/Personalization
In contrast to the previous theme, which related to characteristics of learners, differentiation/personalization describes characteristics of the learning environment. Tailor made, customized and varied learning opportunities getting more and more attention. In contrast with the theme of adaptability/flexibility, this theme relates more to the adaptation of the environment, lesson material, and support materials, to make education more fitting to the learners' needs. In differentiated instruction, students' varying background knowledge, readiness, language, preferences and interests are recognized, and teachers customize their instruction based on these aspects. In this process, teachers take into account learners with different abilities, while all in the same classroom. During this process, the students' progress is continuously monitored, to be able to tailor the instruction accordingly.

A lot of the BMS learning researchers recognize the importance of differentiated/ personalized instruction, and many have already focused on this concept in their research and wish to continue to do so (see appendix H). Example themes that resulted from the questionnaire were: "Teacher life-long learning within the restrictions of their practical contexts", "The integration of ICT in classroom differentiation", and "Supporting and rewarding teaching excellence". During the interviews, more specific questions were articulated, such as: "How can we create (adaptive) support/feedback systems that enhance collaborative inquiry learning. For example, how can we optimize the way students share knowledge and benefit from their peers' expertise?", and "Technological advances allow us to collect learner data, how can learner data be used to empower the teachers and the learners?". Another theme that emerged here, was related to supporting and rewarding teaching excellence (e.g. senior qualification for teachers / educational leadership). This theme also received a lot of attention during the focus groups, but was extended to excellence in education – not only for teachers, but also for students. It was argued that in the Netherlands, the lower levels in education are organized very well, but challenging the higher-level students is still difficult and could be organized better. Talent development and excellence should receive more attention. The participants of the focus groups agreed that several other questions were especially important in their research, namely: "How can AI/technology support teachers in differentiating. How do you collect data about the students' needs and/or behavior, how do you use this data, and how do you assess in differentiated instruction?".

Q2. Assets and needs
An overall summary of the assets and needs mentioned by the participants can be found in appendix H. Most of the assets and needs were identified during the individual interviews. During most of the focus groups the participants had no further comments on the overview of the needs that was presented. They mostly agreed with what their colleagues had indicated. The participants' publications and past research grants were also analyzed to map their experience and expertise.

Human
The most significant asset within the BMS learning research program is related to the knowledge and expertise of the learning researchers. Throughout the program, there are individuals with extensive knowledge of varied topics related to learning. The participants recognize that collaborations could be very fruitful when this expertise is combined in interdisciplinary research projects. The participants of the learning research program had varied and broad networks (see appendix E, under assets), such as

governing boards, advisory boards, scientific journal committees, and research program committees. Examples are: chair of the scientific advisory board Cito, Research Advisory Board at the Centre for Evaluation and Monitoring (CEM), member of the Supervision Committee - Evidence-Based Education, and member of the Netherlands Educational Research Association (VOR), NeuroLab NL (NWA). Furthermore, many researchers had a broad network of partner and schools, and had good contacts (social and political) with local (e.g. Explain, Oberon, Saxion, TYF, Heutink ICT) and (inter)national (e.g. NRO, EC, ministry of OCW) organisations.

Key areas in which BMS learning researchers have published in the last 5 years were inventoried. Table 4.1 offers an overview of the 801 results, the full list is given in Appendix I.

Table 4.1. BMS learning research publications in the last 5 years

Code	**Subcode**	**#**
Philosophy of knowledge and learning	Epistemology	8
Cognitive development/neuronal basis for learning		10
Motor learning		9
Policy	Institution intern	10
	Governmental	23
Organizational or institutional change/improvement		5
Finance of education	University/student funding	35
Employability/usability of education		1
	Higher education	4
	Schooling and learning	1
	Choice of profession/study	6
Quality of education		3
	School evaluation and improvement	10
	Achievement-oriented working	6
	School size	3
	Universities (incl. doctoral training)/ completion rates	17
	Teaching/training quality/design	5
	Teacher research/ teacher design teams	20
Comparisons of institutions and education/ analyses of institutions		16
Educational institution management	Schools and secondary education	5
	Computer use in school management	1
	University management	3
	Expansion/growth in HE	1
	Internationalization	6
Behavioral change of leadership in education		1
Knowledge/information sharing/management		2
Research methodology/education research		31
	Data-driven educational research	2
Usage of data		15
	Datateams	27
	Data-based (decision) interventions	21
	Data-based/data-driven decision making	29

Code	Subcode	#
	Information technology/management	2
Educational innovation/methods		8
	Feedback learning	7
	Virtual learning environments/computer assisted learning	81
	Bologna/bama	1
	TOM (Twents onderwijs model)	3
	Practicals/experiments	9
	Interdisciplinarity	2
	Serious games	26
Team learning		3
Fairness	Fraud detection	1
	Responsible research	1
Teacher/coach education		20
Professional learning/development		18
	Teacher professionalization	22
	Workplace learning/additional education	4
Student/teacher perception		12
Student monitoring		4
Instructions/curriculum		24
Assessment/testing		20
	Computerized assessment	15
Environmental influences		12
Inclusion/equality in education		2
	Social inclusion (intercultural)	1
	Inclusion with disabilities/ different competence levels	9
	Student mobility	2
	(socio)economic status/OTL (opportunities to learn)	9
	Gender equality	3
	Individualization/talent facilitation	1
Student curiosity		3
Special need learners	Excellence support	7
	Slow learners	2
	Learning types	1
Learning networks/communities; group/team work		27
Learning methods		5
	Inquiry/discovery learning	20
	Modelling	9
Lifelong learning		2
STEM (science, technology, engineering, mathematics) education		14
Entrepreneurship education		2
Digital skills/literacy		20
Skill acquisition		2
General knowledge acquisition	Health education	1
	(adult) literacy	10
Technology demand/innovation		6
Machine learning		7
Other/unclear title		5
Total		**801**

The participants mentioned several areas of expertise and knowledge that they currently lack for their (aspiring) research. Interestingly, much of the kind of expertise that was mentioned is already available within the UT. This points to an opportunity, as well as the need to establish mechanisms for enabling researcher access to (especially internal) expertise. A lot of the mentioned expertise areas were related to research methodology or data analysis, such as: EDA data, data science, data mining, multi ranking research, and design-based research. Other areas of expertise that were mentioned several times, were HRD/HRM, philosophy, engineers, scientists, machine learning, serious-gaming, and change management. Furthermore, several participants argued that it is important to have good and inspiring conversational partners.

Material

The participants found it somewhat difficult to identify their needs in terms of material, because this is often very dependent on the specific research project. However, they identified several needs that are relevant for all their research in general. First and foremost, the BMS learning researchers identified time and money as essential needs. Without time or money, they cannot do effective and quality research. Moreover, the available time and money must be spent appropriately. For example, one researcher argued that the most funding should not go to the most experienced (senior) researchers, but to the best, and most innovative ideas. Time also needs to be spent wisely. Several needs were related to technology; good video equipment for observations, use of the BMS lab, and algorithms to make data available in real time.

Structural

The participants also referred to support of the university (management, financial administration and back office) as an important need. Most of the other identified needs were related to the organization of the people within BMS itself. Working in interdisciplinary teams was recognized to be a key aspect of the learning research program, which requires a different approach. It was articulated that a BMS/learning group should monitor proactively where research proposals can be submitted (look for future calls), and there should be time to work on co-writing research proposals, where one individual should be the main person responsible for the writing itself. This person does not necessarily have to be involved in the research, but should have excellent writing skills and knowledge of writing proposals. Previous experiences have shown that this approach is very effective.

Q3. Design requirements

Focal areas

Several design requirements were identified by the learning researchers during the individual interviews (see appendix E). Many requirements had to do with the content/theme of the research program. The participants felt that the theme should be broad enough to appeal to a lot of the researchers, but not too broad. They argued that it is important to make choices for a specific focus, otherwise the research will not be relevant. Also, they stressed the importance of focusing on important societal issues, which will also inspire context/domain transcending collaborations. The participants recognized that innovation and technology will play a big role in the research program, because of the UT's vision (High tech, human touch). Although they agree with the importance of technology, several participants argued that we should not forget the basic processes of learning, and not to lose ourselves in the 'wow-factor' of technology. Therefore, the focus should be on the added value of technology for learning. Several participants stated that the research should include a strong theoretical framework and make strong connections to practice. To measure the effects of the learning research, proper measurement validations (psychometric validation) should be included. Looking

forward, the research should be rooted in what is already here in the UT (e.g. expertise, knowledge, partnerships), but also innovative and explorative. During the focus group, discussions, the participants indicated that they agreed with these statements, and had no further comments.

Collaboration
To stimulate collaboration and involvement among the BMS learning researchers, and collaboration of other parties (dean, university, outside partners), it was argued that it is important to communicate the underlying purpose of the program. For interdisciplinary collaboration and knowledge sharing within the UT, it is important to think about how information will be shared. Several participants suggested creating a website or platform for internal use. On this platform, information can be shared about research projects (preferably organized by themes), BMS-wide colloquia, personal information (short biography), funding opportunities, and possibly more. The risk of such a platform is, however, that it needs to be kept up to date, and many people will not take the time to visit the platform often. Possibly, it could be a good way to facilitate those who are curious and willing to take the time to look for possibilities to collaborate within the UT. Besides the platform, people argued that they would like to have regular (social) activities or meetings where they can connect. These activities should be non-binding and informal, but include proper opportunities to share information about current or future projects.

During the focus groups, not a lot of new design requirements came up, but the participants elaborated further on the ones that were identified during the individual interviews. The discussion mostly centered around the question of how we can facilitate collaborations within the department/cluster, and promote knowledge sharing. All focus group participants agreed that this was an important issue that needs to be organized well in order for the learning research program to be successful. Although they indicated they were willing to spend time on this (e.g. regular meetings, social activities, seminars), they would prefer if the activities would build on existing ones. For example, ELAN regularly shares a newsflash (i.e. short newsletter with highlights of current research and projects) via email. This newsflash could also be shared with all departments within BMS, and contain information about all their research and projects. Most of the participants felt that an internal BMS website would be useful, although there were many discussions about whether people would read it. Furthermore, it needs to be kept up to date, and experience has shown them that this is often not done sufficiently.

Organization
Regarding the organization of the research program, many participants indicated that they would like for the program to include a balance between freedom and a sufficient foundation. Therefore, it was suggested that the program should depart from what is already within the UT, and build on this. Furthermore, the importance of investing in good contacts with partners in and outside the UT was stressed. For this, management support from the dean or university was also considered important, because this can facilitate visibility. Some participants felt it could be very useful to connect the program to the master program of Educational Science and Technology (or other programs). They argued that the interaction with students could be a huge asset to the research program.

During the focus groups, many participants indicated that 'new' activities should not take up too much time, but most of them agreed that regular meetings would be valuable. They indicated that the meetings should be informal and social, but organized to a certain degree. It would be ideal if people could give short pitches about their current or future research projects. This way, they can share ideas and look for possible collaborations within (and outside of) the faculty.

Funding track record and future opportunities

An analysis was done for current and future requests for proposals (RfP) related to the theme of learning to identify current priorities and opportunities for funding. The key sources of funding that were identified in the staff survey were taken as points of departure. In the last five years, BMS learning researchers have been awarded at least 99 grants, totaling over 32,336,188 Euro. Further detailed in Appendix J, BMS learning researchers have secured grants from at least the following sources of funding:

- 4TU
- Center of engineering education
- Chilean Government
- Cito
- Companys
- Dudoc
- Dutch School Inspectorate (&Snappet)
- EAPRIL
- Education, Audiovisual and Culture Executive Agency (incl. Erasmus)
- EU
- European Committee
- eX:plain
- IEA
- Kennisinstellingen
- KennisNet (&Snappet)
- Law School Admission Council
- Ministry of Education
- NWO
- NWO-BOPO
- NWO-PROO(-Excellence)
- NWO-NRO (+CA-ICT, ECDL, ECP-EPN)
- OCW
- Oxford University
- RAAK
- Saxion
- School aan Zet
- SLO
- Tech4People
- TechYourFuture
- Universidad Catolica del Uruguay
- UT

Future sources for funding to take into consideration were also inventoried. An overview is located in Appendix K. This was also shared with the BMS learning researchers prior to the workshop, and used as a resource during the workshop.

5: Discussion of key findings

Brief recap

We set out to understand: *What are the core characteristics of a plan for developing the learning research program at the faculty of BMS within the UT?* To answer this question, data were collected in relation to focal areas to prioritize, assets to leverage and needs to address, and stakeholder perceptions of design requirements for a robust program. As indicated in the results section (and elaborated in the appendices), each of these has been inventoried. Key findings per area are briefly summarized next.

First, while acknowledging that the focal areas of any research program are refined and shift over time, four main themes were identified. The focal areas to be prioritized in the coming term are: depth/quality, equity/inclusion, adaptability/flexibility, and differentiation/personalization. As discussed subsequently, we acknowledge both synergies and tensions between these areas. *Second*, the most significant asset within the BMS learning research program is the knowledge and expertise of the researchers, though participants did articulate some needs in terms of capacities they would like to (further) develop. Material assets include good laboratory facilities, needs are especially time (and funds to enable time) for focusing on research. In terms of structures, the current support from BMS is an asset that is highly appreciated, but additional investments are required for this research theme to grow and flourish. *Third,* in addition to meeting the needs (especially investments into time and broader institutional support), a key design requirement for developing this interdisciplinary line of research centers on community building. This pertains to the learning researcher community within the faculty, as well as our outreach structures. Many of the learning researchers are just beginning to get to know themselves as researchers within this theme (for many, this is new), and with the exception of the DDS cluster, few researchers know the other researchers in this group.

As mentioned previously, the activities described in this document were undertaken to inform the development of an interdisciplinary research program on the theme of learning. Here, we reflect on these findings in light of preparations for our next concrete steps: SEP self-assessment. Specifically, we discuss the domain challenges, scientific contribution and societal impact we aim to achieve, as well as the infrastructure that is necessary to do so. (The discussion presented here resulted from a two-day LWG retreat, more information about the retreat is available in Appendix O.)

What should the program focus on?

In the 21st century, societies all over the world have to learn to cope with climate change, rapid technological development (e.g. in the field of artificial intelligence and machine learning), changing demographics, and human migration triggered by military conflict or globalization. On a more concrete level, these larger trends in society create a series of major societal challenges for each of the four focal areas which need to be discussed in more detail.

As regards the *depth/quality* of learning, learners are confronted with an overload of digital information in the form of websites, twitter and Facebook messages, and messenger applications. In order to safeguard depth and quality in such a 'firehose society' in which focused and prolonged attention is the exception rather than the norm, BMS learning research needs to help create and shape educational systems and learning environments in schools, universities, companies, and cultural institutions, which motivate (groups of) learners to engage in 'deep' learning. Deep learning enables learners to understand, select, apply, synthesize and critically reflect upon any digital and analogue content. For teachers, 'deep learning' means that they are challenged to create a supporting learning environment. This will require the development of new

pedagogical content knowledge and new forms of technology enhanced learning. However, 'deep learning' is not only the result of interventions on an individual and institutional level. On a more general level, BMS researchers together with policy makers need to work on concrete policies which help to foster depth and quality in the educational system. In order to monitor and maintain, BMS researchers also need to invest in developing better frameworks and tools which allow to measure quality of new forms of learning. Especially the rise of MOOCS and SMOOCs and other forms of digital learning offer opportunities and challenges for learners which are not yet understood. BMS researchers together with national and international studies often used as rankings, such as TIMMS and Pisa, or global university rankings such as ARWU (Shanghai), QS, U-Multirank, and Times Higher Education can help societies to create, shape, manage and assess learning environments which allow individuals to rely on learning as vehicle for a better life.

As regards the theme *equity/inclusion*, learners are confronted with an increase in global connections that are afforded by technology. This challenge is paralleled by our collective awareness of the opportunities and threats for participation in society. In particular people with a weaker socio-economic background are less able to access information. Policy measures to remove net neutrality further aggravate the situation. Uneven access to digital and other learning environments widens digital, economic and educational divides in society. Instead of prioritizing excellency in learning, BMS learning research thus needs to focus on developing equitable pathways to learning opportunities in Twente, the Netherlands, Europe and the rest of the world. This enables teachers and other educators in universities, companies, and museums to work with and improve inclusive and differentiated pedagogies which make, among other things, use of new technologies. BMS research should help to provide learners with valued, connected and safe learning environments in which they can take responsibility for their careers as learners, professionals and citizens.

As regards the theme *adaptation/flexibility*, learners and institutions are confronted with a world in which participation in digital and other learning environments is not stable. Not only the rise of private companies (e.g. Coursera) which heavily invest in offering digital learning opportunities, but also technological advances monitoring student progress and changing social norms require learners to be adaptive and flexible. On a systems level, BMS research thus needs to focus on the resulting need to continuously adapt, re-learn, or sometimes even un-learn new skills and content. In order to cope with life-long learning, learning environments and educators need understand cognitive, emotional and physical needs of learners of all ages and backgrounds. BMS research can also help learners to adjust their own capacity (e.g. professional qualifications) to function in fluid societies in which high motivation, creativity and entrepreneurship can be of advantage.

The twenty first century is an age of customization. This inherently brings a number of opportunities and threats related to *differentiation/personalization*. On one hand, individualized digital learning environments will lead to a huge amount of data which can be used to improve learning processes for everyone. In particular the ability to tailor diagnosis, intervention and feedback to individuals can support talent development. However, the age of customization also yields a number of unintended consequences which must be addressed by BMS learning research. Next to a huge amount of data, some personalized systems also lead to deskilling (e.g. navigation ability decreases after long-term use of GPS), self-centeredness and social incompetence. In particular learning institutions such as universities and schools will need to find a way to productively balance opportunities and threats. BMS research can help educators to leverage customization without being blind to potential unintended consequences unintended

(e.g. commodification). In order to do so, BMS researchers should examine how automation or the rise of artificial intelligence in learning environments changes certain professions. Moreover, it is important that BMS researchers reflect upon the role of teachers and policy-makers in personalized and competency-based learning. As regards learners, BMS research needs to investigate how short-term triggers (e.g. likes) can be linked to long-term engagement and interest in a specific topic or skill. Moreover, potential tradeoffs for learners need to be analyzed. The physical process of note-taking has been shown to support learning more than typing on a computer keyboard. As BMS learning researchers we consider it as an important task to help taking learners out of their comfort zone bubble which reduces flexibility and open-mindedness.

How will these focal areas contribute to scientific understanding?
Within the learning theme, we conduct both fundamental and applied research, sometimes even blending both approaches within single projects. Innovative methods are used and collaboration with practice is prioritized. The contributions include epistemological and ontological contributions, for example related to (research on) the design and evaluation of interventions in real-world settings, and the implications for learners, learning environments, and the systems in which they function. Together, we seek systemic insights that help to describe, explain, predict and influence learning. Where feasible and effective, we do so through research approaches that, in and of themselves, are valuable to the participants.

In order to come to new knowledge and understanding, existing methodologies are extended and new methodologies are developed. Not only to measure the complicated, dynamic and new constructs the research questions relate to, but also do deal with the volume, velocity, variety, and veracity of the data that are available presently. Methodology and data analytics is integrated deeply in the design of the studies to position the learning research theme within the broader landscape of learning (sciences) researchers.

Researchers within the learning theme have various disciplinary backgrounds. For example, philosophers, communication scientists, historians, educational scientists, sociologists, policy scientists, methodologists, psychologists, and data scientists collaborate in multi-disciplinary teams to answer current questions in educational research. As might be expected from this group, capacity among researchers is developed continuously, to do excellent and socially relevant research. Besides, research questions are formulated and research is conducted both in academic settings and in strong collaborations with teachers, educators, and institutions, both at a national and at an international level.

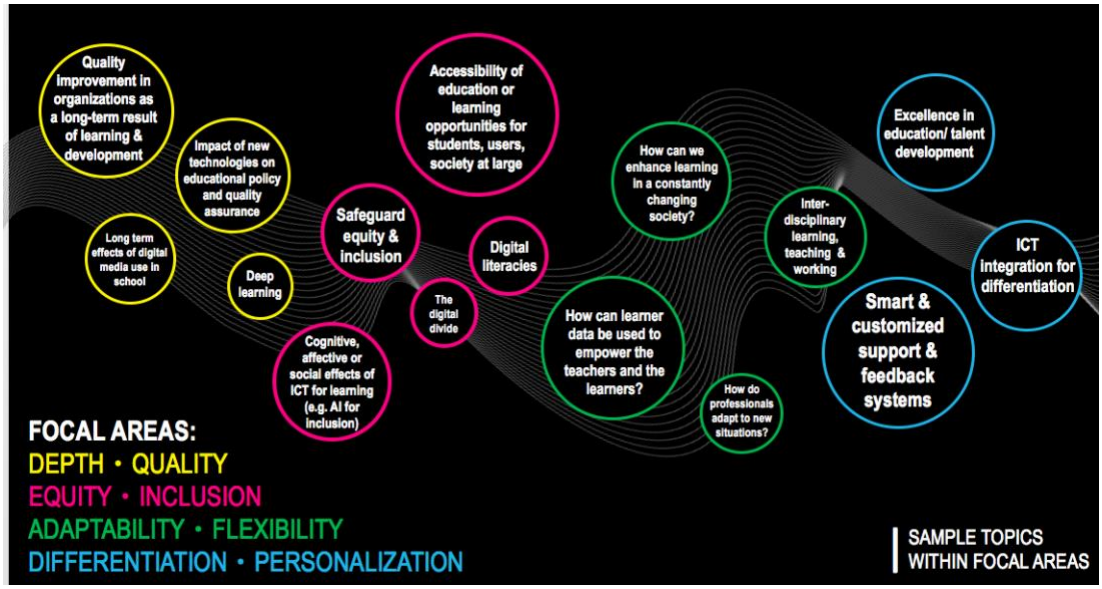


Figure 5.1. Sample topics previously identified within the focal areas

As described previously, we identified four, sometimes interacting, focal areas. These are shown in Figure 5.1. Stemming from previous discussion regarding these areas, general guiding research questions and sample sub-questions are articulated. These illustrate the topics we aim to explore within the coming years and the breakthroughs we would like to achieve. The questions that concern us have a difference in granularity. We give examples at three crucial levels, that of the learner, the learning environment, and the surrounding system. Thereafter, Table 5.1 presents possible sub-questions to illustrate how these could further be specified. Note that these are examples only and not at all intended to be comprehensive.

General guiding research questions

- Learner
    - How do people learn (specific knowledge skills or attitudes) well, and what elements of quality provoke cognitive, emotional, or physical development?
    - Why and how is teaching related to learning and what are the prerequisites?
    - How to inculcate adaptivity and flexibility, and the capacities that serve them?
    - Why, when and how do learners benefit from personalization?
- Learning environment
    - What does quality and deep learning imply for the blueprint of learning environments?
    - How can technology be used to equip the learning environment and to support educators to improve access, diversity, equity and inclusion?
    - Why, when and how should learning environments respond to changing demands?
    - What are the characteristics of learning environments that leverage opportunities for customization (e.g. big data) yet mitigate potential pitfalls (technical, misuse)?
- System
    - What are system level indicators of depth and quality, and why it is important for society and how quality and deep learning can be arranged within both formal and informal education?

- How can participation in learning can be broadened to leverage diversity?
- Show how we can enhance learning in a constantly changing society?
- How can personalized learning be developed, implemented, and reflected on to ensure that the content, pace and level of the learning is adapted by the learning system to the individual needs?

Table 5.1
Sample research project framing questions for each focal area and level

	System	Learning environment	Learner
Depth/ Quality	What knowledge is of most worth (to learn) in a given context?	What are the human, material and structural aspects of infrastructure that support (teacher) learning?	How do (specific kinds of) learners learn?
Equity/ Inclusion	What are the consequences of tests being related to the average/norm?	What are inclusive pedagogies?	How does the experience of the disenfranchised shape that of others?
Adaptability/ Flexibility	To what extent are system actors (policymakers, boards, advisors) sensitized to the (future) needs for learning?	How do educators respond to changing demands?	What is the impact of age on learning in a fast-changing world?
Differentiation/ Personalization	Which data really support learning (systems) and why?	When is machine teaching preferable to human teaching (also vice versa) and why?	Which learners benefit from which balance of (tools for) customization?

Several cross-cutting themes can be identified that are relevant for all four topics. Naturally, as part of a university that strives to make "high tech, human touch" contributions, one of the most prominent cross-cutting themes is the application and integration of *technology*. Being located at University of Twente enables researchers in the learning theme to benefit from the latest technological developments. For example, the use of big data analytics enables researchers to come to new answers to existing questions and to formulate new research questions. However, it also demands careful research to evaluate the pros and cons, the benefits and the risks of these new methods. Second, the use of *tests and qualification* systems to compare performances of individuals and/or institutions is another issue of interest. How to compare either

individuals or institutes with respect to quality, equity, in a changing society, or based on personalized learning pathways, is a challenge we face. Third, the *interdisciplinary* framing, approach and implications for our work is salient across projects. Finally, *mediating and moderating variables* (e.g. motivation, non-learning, self-efficacy, socio-political factors) are also factors that will be taken into consideration across focal areas and levels.

As we move forward, we plan to explore several developments on the horizon. For example, we wonder about how to position machine learning (also because it is in service of human learning, in our current projects). Most of the research questions formulated so far are focused on the human learner. However, machine learning is increasingly becoming a topic of research interest. It is strongly related to personalization, since machine learning accounts for the adaptations of the learning system, however, it is a topic of study by itself as well. One of the issues, for example, is unlearning of incorrect links, which turns out to be quite an issue.

How will these focal areas contribute to societal impact?
Achieving societal impact is a major perspective for all our scientific activities. We aim to create knowledge and resources that are of value to society (e.g. contribute to evidence-informed public debate) related to learning, especially learners, learning environments and learning systems, in order to respond to the social challenges mentioned above.

Substantially, we aim to contribute to learning of high quality (excellence), including the discussion of what quality and excellence in learning mean in the 21st century contexts. We realize that these contexts are fast-changing and may appear differently in terms of opportunities and threats to people in different loci (geographically and socially) in society. We want learning (systems) to contribute to a coherent society in Twente, in the Netherlands, in Europe and in the rest of the world, without social divides.

Where and how do we intend to do this? Our research in the Learning theme reaches from fundamental to application-focused. We know that this is not a binary opposition, but covers a gamut of approaches, with various types of involvement of stakeholders at various stages of the process. Thus, some of the research projects in the theme can be seen as generative research practices (i.e. stakeholders' participation in research processes is valuable to participants per se). In others, dissemination may be organized in a more classical way.

We aim at societal impact at all levels, from system-level decision makers, to partner organizations and schools, to individual educators and learners. And not to forget: society at large, including the public debate in the media (printed, mass, and social).
To maximize impact, it is important to maintain durable relationships with stakeholders. In particular, several groups have important RPPs, Research-Practice Partnerships. For instance, in school research, such stable partnerships are essential for successful research and equally for improvements to become sustainable in the partner schools. Long-term relationships with companies, like for example CITO or educational publishers, also enable enduring research programs that are immediately relevant to practice. Exploring models of formalized RPPs is likely to be useful to learning theme researchers, other themes at BMS, and beyond. Beyond RPPs, it remains important to establish, maintain and share relationships with stakeholders in a less formal and/or more project-by-project basis. The list below demonstrates some of our existing assets. Together, these examples demonstrate that this level of ambition is within our reach.

Selected outreach networks and activities (existing)

- Learners:
  - PreU
  - ProU
  - Center for Talent Development
- Learning environments
  - Museums, archives and other cultural institutions (e.g. Stichting Academisch Erfgoed, Twentse Welle, Naturalis Biodiversity Center)
  - Conceptliscious: Game designers
- Systems
  - Organization
    - Schools: Partner schools (together with Pre-U)
    - Universities: ECIU course for training of higher education management and leadership
    - Businesses: MOU with CITO
  - National
    - Advice to Ministry of OCW through reports on commissioned research (e.g. evaluation of Sirius programme for excellence), or through participating in national committees (e.g. Reviewcommissie Van Vught)
    - NWO/KNAW committees
    - Development and quality control of national testing programs in the Netherlands, United Kingdom and Italy.
  - Supra-/international
    - Peer learning workshops for ministries of (higher) education in the EU; training course for quality assurance agencies in Europe
    - PISA, TIMSS, and PIAAC, both as national coordinator and in the technical advisory boards.

Future activities in the next 5–10 years will aim to continue and strengthen the current type of societal impacts. We expect that the synergy from the learning theme will help spread good practices across the various researchers and clusters in BMS, thus increasing our social visibility and impact. Through our research and further development of interactions with these kinds of outreach networks and activities, we hope to achieve societal impact on each level:

- Learners
  - Contribute to empowerment of learners to cope with 21st century society's challenges is the overarching impact to be achieved at the individual level. This includes the following:
  - Learners are able to participate in learning
  - Learners become resilient citizens and professionals (e.g. teachers)
  - Individuals have capacity to contribute to addressing (societal, personal, professional) concerns/issues/problems (e.g. interdisciplinary working, domain knowledge, requisite skills like information literacy, e.g. ability to engage in societal issues)
  - Contribute to self-awareness and agency of learners to understand, identify, create, determine and choose (or direct) their own learning (pathways)
- Learning environments
  - Empower educators, e.g. lower work pressure, higher self-efficacy, improved collaborative/supportive structures
  - Contribute to schools'/universities' and organisations' capacity to employ inclusive pedagogies

    - Support educators to engage in debates surrounding changing needs of learners and especially how to meet them
    - Contribute to learning environments that possess understanding, resources, and practices that leverage opportunities for customization of learning and mitigate risks of its pitfalls
- Systems
    - Contribute to system mechanisms regarding defining quality and excellence in learning, e.g. nationale wetenschapsagenda and curriculum.nu, as well as to other, policy measures affecting (quality of) education and learning at national and European levels
    - Contribute to mitigating social divide(s) in learning, e.g. the digital divide
    - Contribute to learning systems that are responsive to the continuously changing learning needs of participants
    - We provide society with tools to understand and work with customised/personalised learning, e.g. information tools about achieved learning (e.g. individualised certificates/badges)
    - Contribute to establishing norms and practices for responsible customization of learning (e.g. data use for feedback to learners and for individual as well as collective analysis)

What infrastructure is needed to achieve all this?

In this section, we outline aspects of the infrastructure needed to support and promote BMS learning research according to the vision described above. While the BMS learning research program can benefit from the many assets described in Chapter 4 (and these should, of course, be leveraged moving forward), the current circumstances are not sufficient for collectively addressing the domain challenges described above. The theory of action behind this description can be summarized as follows:

- New investments are needed for institutionalization, to enable
- BMS learning research community building, which is necessary to develop
- Research of outstanding scientific quality, that has the ability to yield
- Relevant and meaningful societal impact

Below, we discuss the human, material and structural aspects of infrastructure that require further development for each of these four broad targets, as shown in Table 5.2. NB: This discussion is based on the outcomes of a strategic planning exercise conducted by the LWG during their writing retreat; outputs from this exercise are available in Appendix O.

Table 5.2. Structure of the discussion that follows in this section

Development targets	**Infrastructure required to achieve aspirations** in the coming 5 years		
	Human relationships, expertise, …	Material funds, tools, …	Structural policies, routines, …
Institutionalization			
Community building			
Scientific quality			
Societal impact			

Institutionalization is essential, if the BMS learning research is to become a successful and vivid research orientation. a coherent institutional unit needs to be established to the aim of effectively supporting, promoting and inspiring inter-, multi- and transdisciplinary collaborations. This institutional unit should have clear visibility and accessibility within BMS but also to stakeholders (research-partners, funding agencies, educators, schools, policy-makers etc.) and to society more broadly. It should become an institutional unit that the members (BMS staff and students connected to 'learning')

should feel connected with and be proud to be a member of. This points at important qualities of the institutional unit should aim at, such as being of real support, creating community and a culture of trust, having a clear, communicable mission, being proactive in favour of the members. In promoting the quality of learning research, it also aims to indicate and support new (interdisciplinary) research opportunities related to relevant societal issues, and to facilitate partnerships with relevant stakeholders. Furthermore, the institutional unit aims to promote a high scientific level, the development of new methodologies and the uses of current digital technologies.

A prerequisite for achieving this organizational unit is that it needs to be explicitly established, organized and assigned specific tasks and goals. The institutional dimension requires several things from BMS to make this feasible: Firstly, financial support to get this going. In order to get this research unit off the ground, strong leadership and a supportive management-team is needed (approx. 0.4-0.6 fte at HGL level, plus 1 fte management-team consisting of UHD level and management assistant level). The task of this team is to create this thriving research environment (virtual, physical, organization, and social), which involves to develop plans (including vision, regulations, finances, SWOT, year-plan for academic and social events, outreach activities, lobbies for funding, actions for acquiring supportive materials, etc.). Additionally, for such an institution to thrive, also commitment of individuals is crucial. Encouraging and prompting this, is an initial task for the leader and management-team as well. It requires that researchers are given the chance to engage at a sufficient level of autonomy (for instance, in organizing workshops, social events, colloquia, …). Secondly, crucial to the success of this organizational unit and the willingness of researchers to engage in it is that rules and regulations at BMS and UT level do not hinder interdisciplinary collaborations, but instead, support them. This may require to set up supportive measures and to examine which (financial, organizational, structural etc.) regulation could hamper this institutional unit to thrive. A third way in which BMS is asked to support, is to allow for strong branding of this institutional unit (e.g., visiting scholar program, colloquia, prizes, show-case of work like yearbook, 'vision on who we are').
The next three levels will be described to make the envisioned infra-structure in greater detail.

Community building warrants key investments. From the human perspective, several values and mechanisms play a role in building a thriving organizational unit. Important values to be lived are openness, welcoming, inviting and involving people (e.g., engage juniors). Also, it is important that people get opportunities to meet and exchange, which can be done through joint colloquia, social events and yearly events (such as strategic meetings for future plans). An important experience of the first strategic workshop (December 2017) has been that people get to understand each other's research and expertise best through well-organized workshops in which they actually have to work together. Additional, providing an updated overview of research funding agencies and research projects running in this organization is important for researchers helping each other (esp. junior researchers) in crafting their own research proposals. Another important mechanism is that people become engaged, by being invited to do things for this organizational unit (e.g., organizing social events of the Learning Research (including Friday-afternoon break-outs, or retreats to 'the island'); organizing scientific events and colloquia; workshops to promote exchange on methodologies and technological tools; mentorship / advisory on research proposals; code of conduct design; external relationships to make connections with relevant stakeholders and partners; proactive activities such as visiting Brussels to promote specific programs; support teams on apps; serious-gaming, networking; ad-hoc committees on specific tasks.) Materially, this requires an online environment, and at the structural level this

requires structures that promote such interdisciplinary (cross-border) collaborations (i.e., not hampered by financial etc. aspects).

The *scientific quality* of the learning research within BMS will thrive through establishing a strong institutional unit that promotes a community of research that aim at strengthen their research through inter- multi- and transdisciplinary collaborations. At the level of individual researchers, this requires easy access to specific expertise that supports their research (methodologically, programming). Additionally, a stimulating research environment promotes the quality of research, for instance, by having visiting scholars. Additionally, some material needs need to be met, such as a data lab (e.g. tools for social design); a methods lab (esp. video analysis software), other tools (e.g. software) to manage research; an environment to digitally collaborate with external researchers (e.g. video facilities); ethical guidelines for data collection and use (and standardized procedures or assistance in getting ethical approval); a simulation room for studying learning. Also connections with resources outside UT, vice versa, could be established, which requires assistance at the institutional level. Other needs at the institutional level given the material needs are, for instance, a helpdesk for methodological questions; international fellowships funding (or support to acquire such funding externally); institutional support for connecting with students, teachers etc outside BMS; to establish mechanisms and support for inter-, multi- and transdisciplinary collaborations; organization of workshops (e.g., proposal writing); opportunities for researcher's learning (e.g., methodologies and labs).

The *societal impact* of high quality research can be bolstered with targeted measures. At the human level, having such impact requires outreach activities, and also depends on the ability to productively connect with stakeholders and to arrange (long-lasting) partnership engagement. At the material level, this requires vehicles for information dissemination (e.g. Blog for engaging others and invite other views, such as 'bij nader inzien', which has an editorial board), but also attractive meeting-places. It may also be an option to think of opportunities to display research and results, making use of existing and new structures for outreach (like Curious U, Summer schools, or exhibition space in the -soon to become available- Faculty-Club Boerderij). Some of these outreach activities will require institutional support.

6. Recommended contours for the BMS learning research program

This chapter describes implications for the next concrete steps in developing the learning research theme. Based on the previous discussion, we offer key recommendations moving forward to further develop and sustain the BMS interdisciplinary learning research.

Domain challenges

Learning is the cornerstone of societal development. The development of individuals, groups and systems carries our heritage forth, enriches our existing experiences, creates new and better ways to care for our environment and one another, and provides structures to enable social, economic and political reform. To develop, we need to learn. While much is already understood about learning, current societal challenges require investments into particular aspects of learning. We believe four warrant particular attention (depth/quality, equity/inclusion, adaptability/flexibility, differentiation/personalization). The rationale for each of these is described below.

First, much of today's society is plagued by problems of plenty: more data than we can handle, more food than we can distribute well, more information than we know how to use, more access to technology than we can regulate well, and the list goes on. This firehose of opportunity presents a challenge to achieving depth and quality. In an age of plenty, learning characterized by *depth and quality* is under threat, in part because it requires the ability to select, make trade-offs, prioritize and narrow. Research is needed to understand (factors that influence) the depth and quality of learning, at the leaner, learning environment and system levels.

Second, for better and for worse, the problems of plenty are not experienced by all. As global consciousness increases, so does out collective awareness of the opportunities and threats for participation in society, on micro, meso and macro levels. We are increasingly aware of the urgent need for, and universal benefits of, learning that is characterized by *equity/inclusion*. We need research to help understand (ways to influence) broadened participation and (ways to leverage) diversity in learning.

Third, participation - even if achieved - is not stable. Changing industries, evolving social norms, migration, and technological advances are just a few examples of developments in the world around us which require learners to be characterized by *adaptability/flexibility.* We need research to help us understand how to support learners and their learning in a constantly changing world.

Finally, people need to be able to cope with change but the environments need to be able to cope with their (changing) needs. Developments in (social) media, industry and health care attest to the fact that we are already in an age of customization. And yet, we have much to learn about the *differentiation/personalization* of learning environments, Research is needed to understand and use the affordances of targeted learning opportunities while mitigating unintended consequences such as de-skilling, self-centeredness, commodification, or invasion of privacy.

Scientific contribution

The BMS learning research program conducts a productive blend of fundamental and applied research. Through robust collaborations with practitioners, research practices are ecologically valid as well as socially responsible. We aspire to achieve theoretical breakthroughs related to our four focal areas. We aspire to achieve methodological breakthroughs in association with big data, data collection technologies, and the development of instrumentation for innovation. Key theoretical and methodological challenges we will tackle in the coming period are:

- Theoretical
    - What influences the depth and quality of learning, and how can this understanding be harnessed to improve it?
    - What are the causes for (non-)equity and inclusion in learning access, opportunities and experiences, which ones can be influenced, how is this done and with what outcomes?
    - Which theories can describe, explain or predict the adaptability and flexibility of learners, as well as supportive or hindering conditions?
    - Which factors warrant attention in differentiation and personalization of learning, why are they salient, and how can this information be put to productive use?
- Methodological
    - Which big data collection sources or analysis techniques afford unique opportunities to describe, explain, predict or influence learning?
    - How can new and emergent technologies allow the collection of data that were would otherwise be impossible or impractical to obtain?
    - What are the characteristics of valid, reliable, and practical learning measures that can enable swift and nimble cycles of intervention testing and revision?

Societal impact

The learning research theme aspires to impact society at large by direct influence across and on three interacting layers: learners, learning environments, and the systems to which these are connected. *Learners* can include children, adults, employees, teachers (when the focus is on their own development), and in some cases teams, organizations or machines. We aim to develop learner capacities such that they are empowered to: function as productive citizens, ensure their participation, adapt to changing demands, and play a role in seeing, or shaping their own learning (pathways).

Learning environments pertain to the immediate surroundings of the learner, and include physical spaces, materials (e.g. books, software, equipment), peers, teachers, and even norms or routines within those immediate surroundings. Our research contributes to understanding and shaping learning environments so that they facilitate deep learning through means which are both inclusive and responsive in light of learner needs.

Systems refer to non-immediate aspects of the learning context which (in)directly influence either the learner or the learning environment, such as an organization (e.g. school, business, institute), government (e.g. local, state, nation), sector (public, private), etc. The learning research strives to contribute to systems through insights that help improve quality monitoring and assurance, mitigate divides, adapt to the changing needs of its participants, and establish practices that are responsible, reliable, and ethical and sustainable.

Infrastructure

The learning research program leverages existing assets and seeks new ones to foster the development of an interdisciplinary community of researchers that supports one another in conducting outstanding research that is of societal relevance. As inventoried and described in Chapter 4, the existing cadre of researchers (including their expertise, strategic networks, and track records in funding) is our strongest asset. Targeted investments are needed to develop the human, material and structural aspects of infrastructure that can enable this work to thrive. First, new investments are needed for *institutionalization*. While the research program benefits already from faculty support, the establishment of a formal structure with strong leadership and sustainable funding

seems crucial for reaching the goals described above. While also serving other goals, efforts to institutionalize the learning research program would support the crucial process of *community building*. While initial steps were taken in 2017 and there is definitely energy and will to establish this line of research, much work is need to develop a research community that could, together, tackle the challenges described above. The establishment of a strong community will nourish our researchers' abilities to conduct research of outstanding *scientific quality*. At the same time, additional investments into researcher capacity, laboratory facilities and organizational practices that foster knowledge sharing and professional growth are needed. Together, these measures will support the team's ability to yield relevant and meaningful societal impact. Additional priorities for outreach capacity include establishing long-term partnerships as well as the human, material and structural resources that can enable this.

Appendices

Appendix A. Meet the team/guests

TPS: Technology, Policy & Society

Andrea Kottmann

Senior research associate – CHEPS

At CHEPS Andrea is mainly doing research on the organizational aspects of teaching and learning in higher education, e.g. she is currently leading a study on Centres for (Excellence in) Teaching and Learning and how this effect the teaching function of universities. Andrea is also involved in research on academic or researcher careers. She has done a large-scale study on doctoral graduates from Research Training Groups (funded by the DFG) and is currently involved in a study on the impact of ERC funding on researcher careers. She has excellent knowledge of both qualitative and quantitative research methods and analysis.

Areas of expertise:

- Centres for (Excellence in) Teaching and Learning
- Doctoral training
- Researcher careers
- Evaluation of fellowship programs

Ben Jongbloed

Senior research associate – CHEPS

Ben Jongbloed is a senior research associate at CHEPS since 1992. He has published widely on governance and resource allocation issues in higher education. Ben was involved in several international research projects funded by the European Commission and Netherlands' Ministry of Education. He is supervising PhD candidates and teaching in a Bachelor course on Development and Sustainability.

Areas of expertise:

- Governance and management
- Resource allocation, and Student finance
- Commercialisation and engagement
- Indicators, classifications and rankings

Don Westerheijden

Senior research associate – CHEPS

Don mainly studies quality assurance and accreditation and their impacts, as well as university rankings and student information systems. He edited and contributed to books on quality assurance and on ranking in higher education, and (co-)authored many articles. Evaluation of higher education policies is another of his research interests. His activities also include advice, design and evaluation of quality assurance policies for higher education institutions, national governments and international agencies.

Areas of expertise:

- Quality management
- Globalisation
- Ranking
- Policy evaluation

Frans Kaiser

Researcher – CHEPS

Frans was involved in several international research projects funded by the European Commission, studying reforms in higher education, and the building of a classification of European higher education institutions (U-Map). He is currently working on the implementation of a multi-dimensional ranking of universities worldwide (U-Multirank). In 2011 he was seconded to the Dutch Inspectorate for Higher Education to develop a risk detection model on study success in higher education programs. Since 2012 he is part of the secretariat that supports the Review Committee – an independent body that monitors the outcome of the performance contracts agreed with individual higher education institutions in the Netherlands.

Research interests:

- Indicators, Study success
- Transparency tools (classifications and rankings)

Hans Vossensteyn

Director and senior research associate – CHEPS

Hans is the Director of CHEPS since 2011, where he is a Senior Research Associate since 1991. Hans is involved in various externally funded research projects and international consultancies, and gives many (key-note) presentations for international conference audiences.

Areas of expertise:

- Funding and economics of Higher Education
- Student financial support
- Internationalisation
- Institutional quality assurance
- National and institutional strategic management

Harry de Boer

Senior research associate – CHEPS

Within the field of higher education, Harry specialises in government university relationships, steering models, policy analysis, institutional governance, leadership and management, strategic planning and models of decision making. In research projects he mostly uses interdisciplinary approaches from the field of public administration and policy analysis. Harry has been lecturing several courses at the University of Twente as well as in international higher education programs and management training courses.

Areas of expertise:

- Governance, leadership and management of Higher Education Systems
- Institutional Management, leadership, (strategic) management
- Decision Making
- Policy Analysis, policy design, policy implementation and evaluation

Jon File

Director of development & consultancy – CHEPS

Jon's work at CHEPS has been varied and almost exclusively international as he has had only a very small role in projects concerning Dutch higher education. This international work has taken him to almost 50 countries over the past decade and a half. Most of his professional higher education policy work at CHEPS falls into three categories: major higher education development co-operation projects with developing countries; European policy orientated higher education research projects; and tailor-made workshops and contributions to formal degree programmes focused on the development of higher education leaders and managers.

Research interests:

- Higher education system dynamics, planning and policy
- University management and planning
- Leadership and management development in higher education

Sabine Siesling

Full professor – HTSR

She is involved in several (inter-) national studies (i.e. National Cancer Control Plan, trends in cancer in the Netherlands, EUROCARE, RARECARE, EUROCHIP, EUROCOURSE). Her main interests is the role of interventions (reaching from care pathways to technological innovations) in quality and cost-effectiveness of oncological care (i.a. in breast, lung, colorectal and rare cancers). She is involved in the project concerning the individualization of follow-up programs for cancer patients. Also the specific role of imaging techniques in oncological care in relation to geographical differences in incidence and outcome (i.e. cervical cancer, mesothelioma, melanoma) is topic of interest.

Research interests:

- Oncological care
- Imaging techniques

Mieke Boon

Full professor – PHIL

Her research project entitled "Using science in technology: towards a philosophy of the engineering sciences" aims at a philosophy of engineering sciences that provides a more adequate understanding of the role of science in technology. Its purpose is to contribute to the development of a not yet elaborated field within the philosophy of science and technology. Mieke also teaches several philosophy courses to bachelor and master students.

Research interests

- Philosophy of science
- Scientific practice
- metacognitive skills

Miles MacLeod

Assistant professor – PHIL

Miles MacLeod is an assistant professor for Philosophy of Science at the Department of Philosophy, University of Twente. Miles is philosopher of scientific practice and philosopher of interdisciplinarity committed to understanding model-building practices in modern technological and interdisciplinary science; in particular in modern biomedical engineering and computational biology, and in the environmental sciences. He uses empirical methods (qualitative and ethnographic studies) and cognitive analysis to track and examine model-building practices amongst researchers in these technological and interdisciplinary contexts.

Research interests:

- Model Validity and Validation
- Scientific Cognition
- Philosophy of Biology and the Bio-engineering Sciences
- Philosophy of Environmental Sciences
- Interdisciplinarity

Andreas Weber

Assistant professor – STEPS

Andreas Weber is a historian with a special interest in the long-term development of science and technology in society and digital heritage. Andreas has developed and taught BA and MA courses on the history of science (in particular biology and chemistry) and technology in Europe and Asia. He has also co-curated an exhibition at the National Museum for the History of Science and Medicine (Rijksmuseum Boerhaave, Leiden). He is interested in developing projects that use digital means to facilitate and study learning in museums, archives and digital collections.

Kornelia Konrad

Assistant professor – STEPS

Kornelia Konrad is Assistant Professor of Anticipation and Assessment of Emerging Technologies. She received a master's degree (Magister Artium) in sociology, physics and mathematics from the University of Freiburg i.Br (1997) and her PhD from the Technical University of Darmstadt (2002), where she participated in the Graduate School "Technology and Society". Learning features in her work in particular in the form of (social) learning processes related to innovation processes, for instance in emerging concepts and forms of use or learning processes in stakeholder interaction. Furthermore, from a more day to day practice perspective learning in interdisciplinary teaching is an important aspect as well.

Research interests

- anticipation in innovation processes
- sectoral dynamics in innovation
- technology use

HIB: Technology, Human & Institutional Behaviour

Alexander van Deursen

Associate professor – CS

Alexander's research is focused on one underlying theme; digital inclusion. In the debate on social inequality (or inclusive society / well-being), he evaluates the contribution of technological developments. In a scientific way, he tries to map out barriers for online participation and internet usage.

Research interests:

- Digital inclusion
- Social inequality
- Online participation

Joyce Karreman

Assistant professor – CS

Joyce is interested in research about the design and use of texts in professional contexts. She investigates which text characteristics affect comprehension and usability. She has done research about the effects of different information types in instructions for use and manuals, for example. In her research about the design of documents that are used in professional contexts, Joyce uses Human Centered Design Methods. This means that potential users are involved in every stage of the design process.

Research interests:

- Document Design
- Instructive texts
- Health Communication
- Low literacy
- Human Centered Design

Mark van Vuuren

Associate professor – CS

First and foremost, Mark is interested in communication, focused on the context of organizations. Primarily, he attends to the way people give meaning to their work. Second, he is concerned with the philosophy of science, again specific to the context of communication.

Research interests:

- Organizational communication
- Job crafting
- Professional identity work and technology
- Positive Organizational Scholarship

Sjoerd de Vries

Assistant professor – CS

Sjoerd focuses on digital (smart) media and the communication of organizations, such as smart marketing, e-business, Social CRM, and reputation management. Second, he is interested in the use of digital media for knowledge management and educational goals. For example, the Communities of Practice, blended education and virtual research centres.

Research interests:

- Smart media
- Networked knowledge

Suzanne Janssen

Assistant professor – CS

In her research, Suzanne tries to find out how working environments add to development, motivation and the wellbeing of employees. She attempts to map out what role the current, changing organizational context plays (e.g. Influence of technology, networked organization).

Research interests:

- Work relationships
- Employee communication,
- Qualitative research in organizations
- Motivation

Thomas van Rompay

Associate professor – CS

Thomas van Rompay has a background in cognitive psychology. After obtaining his master degree at Leiden University, he pursued his PhD at Delft Technical University, Department of Industrial Design Engineering. Since 2005, he works at The University of Twente. His research takes place on the threshold of design and consumer psychology.

Research interests:

- Visual communication
- Environmental and product design
- Design for healthcare
- Hi-tech and behaviour change

Ariana Need

Full professor – PA

Prof. dr. Ariana Need is professor of Sociology and Public Policy at the Faculty of BMS. She also teaches several courses in Public Administration.

Research interests:

- policy learning and policy diffusion
- adoption and diffusion of technological innovations

Martin Rosema

Assistant professor – PA

Martin Rosema teaches about political science, democratic legitimacy, and European politics in the bachelor and master programmes in (European) Public Administration and European Studies, while also lecturing about research methods in the pre-master programme in Psychology. His primary research interests are elections and referendums, with a focus on the psychology of voting (e.g. the role of personality, emotions, strategic considerations, and phased decision-making). He is also an expert on digital learning tools for elections, known as 'voting advice applications'.

Research interests:

- Voting behaviour
- Elections
- Referendums
- Political psychology

HBE: High-tech Business & Entrepreneurship

Desirée van Dun

Assistant professor – CMOB

Desirée says CM&OB fits well with her professional research and 10 years of Lean consulting expertise and aims to make a societal impact. She studies (micro-behavioural) social learning effects of leaders and followers in the high-performing workplace and publishes in high-impact journals.

Research interests:

- Lean Operations & Human Factors
- Effective Leaders' and Followers' Work Values and Behaviors
- Change Management, Leadership Development & Management Consulting
- Highly Performing Work Teams

Jan de Leede

Assistant professor – HRM

Jan is the founder of ModernWorkx (a business consultancy firm that specializes in flexibility, workhours and new ways of working). He also works at the University of Twente at the department of HRM for 1.5 day. Previously, he worked at TNO Work & Employment and as a fulltime assistant professor HRM at the University.

Research interests:

- Labour flexibility and working times
- Organizational redesign and teams
- HR Analytics

Ton Spil
Assistant professor – IEBIS
Research interests:

- Adoption and use of information services
- Inter-organizational information strategy
- E-health
- Business Modelling
- Serious Gaming

Ton also teaches serious gaming and e-strategizing courses.

Joost Brinkman
Lecturer – NIKOS

Joost is a lecturer and organisation / business developer at NIKOS. He is also a Blackbelt (lean six sigma). He describes himself as a people person, who likes to develop himself an help others to live from their souls. Besides his research, Joost also teaches Introduction to entrepreneurship, part of the High Tech Human Touch minor New Technology Business Development.
Research interests:

- Combining human capital in Business Development
- Entrepreneurship
- Lean Six Sigma

Kasia Zalewska-Kurek
Assistant professor – NIKOS

Expertise/research interests:

- University-Industry Collaboration
- Academic and Student Entrepreneurship
- Production and transfer of scientific knowledge
- Entrepreneurship education
- Methods: quantitative, Machine Learning, AI

Kasia also teaches Innovation& Entrepreneurship for Creative Technologies; Global Strategy& Business Development; and Entrepreneurship courses.

Rainer Harms
Associate professor – NIKOS

Among other activities, he is coordinating the International Entrepreneurship research group at UT. Prior to this position, he was Assistant Professor at NIKOS and at the Department of Innovation Management and Entrepreneurship, University of Klagenfurt, Austria (Habilitation), and Researcher at the WWU Münster, Germany (Doctorate).
Expertise:

- Entrepreneurship
- Innovation management
- Organization

DDS: Technology, Data-analytics and Decision-support Systems

Frank van der Velde

Full professor – CPE

His research interests concern the understanding and application of the (neural) mechanisms of cognition. Specific topics include cognitive architectures of grounded and productive cognition, visual perception and attention, working memory, higher-level aspects of cognition (language-reasoning), categorization (with learning) and neural models of sequential (control, motor) behaviour.

Research interests:

- (neural) mechanisms of cognition
- Cognitive architectures of cognition

Willem Verwey

Full professor – CPE

His research interest concerns the development and neurophysiological foundation of perceptual-motor skills. Why it is that we can develop such skills? And – a related interest – how can these insights be used to improve future robots and improve human-machine interfaces and training simulators?

Research interests:

- human machine interaction
- perceptual-motor skills

Adrie Visscher

Full professor – ELAN

Adrie is interested in how teachers can be supported in optimising the quality of their lessons and their impact on student learning by providing them with feedback: feedback about the features of their teaching activities (e.g. based on student perceptions, or lesson observations), and feedback about their impact on student achievement. His research also focuses on how teachers can be trained effectively for differentiating their teaching activities in line with students' varying instructional needs.

Research interests

- Teacher professional development
- Differentiation
- Integration of ICT in differentiation

Cindy Poortman

Assistant professor – ELAN

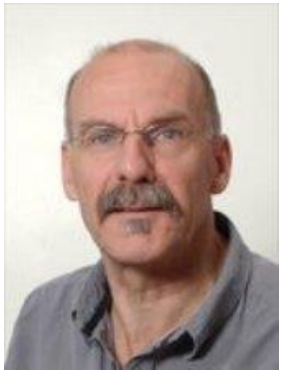
Cindy's research focuses on teacher and school leader professional development in teams and networks (Professional Learning Communities/Networks). Specific examples are data teams, and teacher design teams. Research shows that PLC/Ns can be effective for teacher learning. An essential challenge in research and practice, however, is to achieve transfer from within-school professional development in PLC/Ns to schoolwide, between-school, and system improvement and innovation. I am interested in studying and improving the learning process of teachers and school leaders in PLC/Ns to contribute to meeting this challenge.

Research interests:

- Professional development of educational practitioners in teams and networks

Fer Coenders

Assistant professor – ELAN



Fer's experience ranges from teaching chemistry at high school level, construction of national high school exams, pre- and in-service university teacher education, to the production of learning materials both for students as for teachers. His main responsibilities at the University of Twente in the department of teacher education (ELAN) are in the field of pre- and in-service of chemistry teachers and educational research.

Research interests:

- (Chemistry) Teacher professional development
- Lesson Study
- Teacher development teams (TDT)
- Context-based chemistry learning

Henk Pol

Assistant professor – ELAN

Henk studied Technical Physics, and holds a first-degree teacher qualification for Physics and Mathematics. He also contributed to research into 'good practices' of ANW schools and taught at the teacher education program of the University of Groningen. In his PhD project he focused on the use of computer assistance for students as they work out tasks individually. Since 2009 Henk works as 'vakdidacticus' at the University of Twente.

Research interests:

- Implementing educational research in practice
- Applying network-constructions to improve education

Jan van der Meij

Program director UT teacher education – ELAN

Jan van der Meij (1970) is Programme Director of the UT Teacher Education, ELAN, Department of Teacher Professional Development. Jan's research interest lies in teacher and learner use of ICT in the classroom. Currently he is investigating video feedback coaching of starting teachers.

Research interests:

- Learning with multiple representations
- Eyetracking
- (Live) video instruction
- Videofeedback coaching

Jan van der Veen

Associate professor – ELAN

Jan graduated in Physics, and after teaching physics and mathematics he started working on applications of ICT in Higher Education, project based learning and professional development at the University of Twente. Since 2004 he works as a physics teacher trainer at ELAN. In the period 2010-2014 he was Director of Education of the teacher training programs at ELAN working closely together with the schools in the region. Jan is now chairing the 4TU.Centre for Engineering Education in which the 4 Dutch technical universities work together on innovating and researching engineering education.

Research interests:

- Pedagogical Content Knowledge in Science and Engineering Education
- Professional Development
- Use of ICT in education

Juliette Walma van der Molen

Full professor – ELAN

Juliette focuses on research into the development of children's and teachers' skills and attitudes, effect studies of interventions, and research into the context factors that may affect successful talent development in science and technology and inquiry learning, the development of new measurement instruments, and new instruction technologies that may facilitate scientific and creative thinking strategies.

Research interests:

- Talent development
- Professional development of teachers
- Discovery and inquiry learning
- Scientific literacy

Kim Schildkamp

Associate professor – ELAN

Kim's research focuses on formative assessment, specifically on data-based decision making and assessment for learning. How can we support schools in the use of data to improve learning is one of her central questions. She is the initiator and project leader of the data team® procedure project. The data team® procedure has been used by schools in the Netherlands, England, Belgium, and Sweden. She also has been involved in several studies regarding the (professional development in the) use of data in different countries.

Research interests:

- Team learning
- Professional development
- Data use to enhance learning

Susan McKenney

Full professor – ELAN

Susan is especially interested in exploring and supporting the interplay between curriculum development and teacher professional development. Her past work has emphasized the supportive role of technology in curriculum and teacher development; she looks at these issues in various domains, especially science education and literacy. She is also committed to exploring how educational research can serve the development of scientific understanding while also developing solutions to real problems in educational practice.

- Teacher professional development
- Curriculum development
- Science and literacy

Tom Coenen

Lecturer – ELAN

Tom studied Applied (Technical) Mathematics, and obtained his PhD at the department of Stochastic Operations Research at the University of Twente. He also holds a first-degree teacher qualification in Science Education and Communication. Currently, he is doing research on Lesson Study for Mathematics in collaboration with the teacher design team.

Research interests

- Lesson Study
- (mathematics) Didactics for secondary schools

Hannie Gijlers

Assistant professor – IST

Hannie's research focusses on collaborative inquiry learning. She studies the interaction between cognitive and communicative processes in collaborative (inquiry) learning settings. Her research interests include student generated knowledge representations, generating shared representations, assessment of collaborative processes and the development of collaborative processes. In the context of her research Hannie uses technology to develop learning environments for learners as well as technology (video-observations, wearables) to assess students' behaviour.

Research interests:

- Inquiry learning
- Collaborative learning
- Computer supported learning environments

Henny Leemkuil

Assistant professor – IST

His research focuses on the use of computer based applications in education, teacher training, and telematics. He worked on several EC sponsored projects like MODEM: Multi Media Optimisation and Demonstration for Education in Microelectronics, KITS: Knowledge management Interactive Training System, the APOSDLE project which developed an Advanced Process Oriented Self-Directed Learning Environment, Open discovery space project and Go-Lab. The last couple of years his research focused on learner support in educational games. In 2006 he wrote a PhD titled "Is it all in the game? Learner support in an educational knowledge management simulation game". Currently he participates in the Next Lab project a follow up of the Go_Lab project which is focusing on promoting and supporting inquiry learning in primary and secondary education.

Tessa Eysink

Assistant professor – IST

After studying Psychology and Cognitive Science, she started a PhD-project in the Department of Instructional Technology. From January 2002 till now, she worked at Twente University in the Faculty of Behavioural Sciences in the Department of Instructional Technology, where she combines research and education.

Research interests:

- Cognitive processes
- Inquiry learning
- Computer-based learning environments
- Differentiation

Ton de Jong

Full professor – IST

Currently, Ton is full professor of Instructional Technology at the University of Twente, Faculty of Behavioural Sciences where he acts as department head of the department Instructional Technology and of the department of Educational Sciences. Ton de Jong is dean of education for the Educational Science and Technology programme. At the moment he is coordinator of the 7th framework project Go-Lab.

Research interests:

- Problem solving in science
- inquiry (computer-simulation based) learning environments
- learners' cognitive processes
- instructional design
- man-machine interfaces.

Bernard Veldkamp
Full professor – OMD

Bernard specializes in research methodology and data science. His work spans a range of issues in educational, psychological, and health sciences, from the development of new methods/models for the design and construction of (adaptive) psychological and educational tests, to the development of data mining models for analysing verbal data and large datasets in fraud detection. He founds his research in Psychometrics, Operations Research, Data Mining, and Statistics.
Research interests:

- Optimization
- Text mining
- Computer-based assessment

Cees Glas
Full professor – OMD

The focus of his work is on estimation and testing of latent variable models in general and of IRT models in particular, and on the application of IRT models in educational measurement and psychological testing.
Research interests:

- Fit to IRT models
- Computerized adaptive testing
- Health assessment and organisational psychology

Fulya Kula-Wassink
Assistant professor – OMD

Fulya has been studying mathematics and the teaching and learning of mathematics for about 20 years. She has been working at universities for 15 years. Her research interests, projects, and studies focus on teaching and learning mathematics, how to interpret the pile of research in education, and how the education should be renewed in the new technology era.

Hans Luyten
Associate professor – OMD

Research interests:

- Educational effectiveness
- Effects of schooling on cognitive and non-cognitive development
- Educational disadvantages and Matthew effects
- Cross-national comparisons
- Policy evaluation

Jean-Paul Fox
Professor – OMD

Main interest is focused on complex latent variable modelling in higher-dimensional problems. The areas of modelling research relate to theory and methods of multivariate analysis, stochastic simulation, mixed effects modelling, among other things. Applications and data analyses are executed in the field of educational, medical and psychological research.
Research interests:

- Bayesian response modelling
- IRT modelling

Jolien van Straalen – Pas
Lecturer – OMD

Jolien works at the Faculty of BMS, Department of Research Methodology, Measurement and Data Analysis (OMD). Although she only works 3 days a week, she would like to do research about learning in addition to teaching students all about research methodology and statistics.
Research interests: Jolien is not doing any research at the moment, but is interested in the questions related to teaching, such as:

- How to motivate students to learn?
- What is the best way to help students learn?
- How to assess whether students learned as much as possible from a course?

Martina Meelissen
Researcher – OMD

Since 1993, Martina is an educational researcher at the Faculty of Behavioural Sciences of the University of Twente. She has been involved in several, both qualitative and quantitative, national and international research projects in primary, secondary, vocational and adult education. Currently, she is the National Research Coordinator of TIMSS-2007 which is an international comparative study on the achievement of students in mathematics and science in primary education.
Research interests:

- Mathematics education
- Excellence in (Mathematics) education
- Digital literacy

Theo Eggen

Honorary Professor – OMD

Theo is a member of Cito's Psychometric Research Center. He has a major experience in advising on the methodological aspects (research design and data analysis) of educational research and test development, in conducting data analysis and in multidisciplinary cooperation projects. Besides that, he is professor of Psychometrics at the University of Twente. He has expert knowledge of statistical tools and packages, of specialized psychometric computer programs and of computer programming. He worked as a consultant in educational measurement at university, at Cito and internationally.

Research interests:

- Item response theory
- Missing data and computerised adaptive testing
- Quality of testing

Bas Kollöffel

Assistent professor – OWK

Bas Kollöffel studied educational psychology and graduated on a model predicting the occurrence of metacognitive processes as a function of time. He received a PhD from the University of Twente (NL) on a study about the effects of representational format in inquiry learning with computer simulations. Since 2009, much of his research focused on technology-based learning in vocational education.

Research interests:

- Instructional technology
- Effects of learning
- Transfer of learning
- Design and usability of online learning environments
- Cognitive styles and abilities

Maaike Endedijk

Associate professor – OWK

Maaike Endedijk works as a professor in Professional Learning in Organizations at the department Educational Sciences. Her main research interest is in self-directed professional learning at the workplace, with a focus on the technology, health and education sector. In her research projects, she focuses on the antecedents, consequences and interactions of individual and team-level processes of learning. Her ambition is to develop innovative measurement techniques (e.g., using sensor technology) to get more insights in this black box of learning processes.

Research interests:

- Self-directed professional learning
- Indiviual and team-level processes of learning

Marcella Hoogeboom
Lecturer, PhD student – OWK

Marcella's research focusses on understanding how team dynamics affect team performance, using field data collected in several private and public organizations. Current research questions include: How can we facilitate high levels of team learning and continuous improvement?; Which team dynamics positively and negatively affect team effectiveness?; How can teams effectively exchange knowledge and information? To study effective team dynamics, she makes use of a video-observation method, using specialized coding software ('The Observer XT') and a pre-set code-book to systematically and minutiously code leader and follower behaviors, in combination with the Empatica E4 wristband to explore the effects of Electrodermal Activity (EDA).
Research interests:

- Leader-follower dynamics
- Team routine behavioural patterns and dynamics
- Team learning
- Facilitation of learning at the workplace

Mireille Hubers
Assistant professor – OWK

Her main research interests include learning and developing as a larger process in an organisation. One of the biggest challenges she wants to address, is how we can measure organisational change, partly because change is an ongoing process. She is also interested in how (organizational) change as a result of (individual or team) learning and/or development.
Research interests:

- Organisational change
- Individual/organisational routines
- Individual/organisational learning

BMS Learning Research Workshops: External Guests

Consultant & Workshop Facilitator December 6 & 7

Christian Schunn

University of Pittsburgh

Christian Schunn is Co-director of the Institute for Learning, Senior Scientist at the Learning Research and Development Center and a Professor of Psychology, Learning Sciences and Policy, and Intelligent Systems at the University of Pittsburgh, and Scientific Advisor for Peerceptiv. He directs research and design projects in writing, science, mathematics, technology, and engineering education. This work includes studying expert engineering and science teams, building innovative technology-supported STEM curricula, and studying long and short-term factors that influence student and teacher learning and engagement. He is a Fellow of AAAS, APA, APS, and the International Society for Design & Development in Education.

Content Experts December 6

Hanne Andersen

Professor and Head of Department, University of Copenhagen

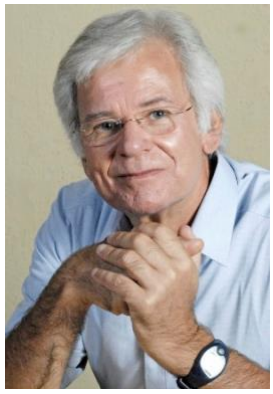
Hanne is currently Head of the Department of Science Education at the University of Copenhagen. As a philosopher of science at a Faculty of Science, Hanne is engaged in making philosophy of science relevant to science education and for scientific practice. She is an active member of AAAS, PSA. EPSA and SPSP, working for increased collaboration between history, philosophy and sociology of science and practicing scientists. Her primary research interests are interdisciplinarity, scientific collaboration, scientific change, and responsible conduct of science.

Tony Hall

NUI Galway

Tony Hall (BA, MIT, PhD) is Senior Lecturer (Associate Professor) in Educational Technology and Deputy Head of the School of Education, National University of Ireland, Galway. Tony's research interests centre on the potential of design-based research (DBR) to support innovation and technology in education. He was formerly a secondary school teacher of physical education, English, ICT, mathematics and SPHE, and a school ICT coordinator. Tony is a Fellow of the International Society for Design and Development in Education (ISDDE), and will jointly chair the 14th Annual ISDDE Conference at the NUI Galway, 28th-31st May 2018.

Joseph Kessels



Joseph Kessels is professor-emeritus of Human Resource Development (HRD) at the University of Twente (NL), where he also served as Dean of TSM Business School. At the Open University, he conducted research in the domain of educational leadership. From 1995- 2000 he held a similar chair at the University of Leiden (NL). In 1977 he founded Kessels & Smit, *The Learning Company*, an international consultancy firm specializing in HRD topics. Joseph Kessels has a specific research interest in the characteristics of learning environments that support knowledge productivity, social capital and innovation.

Regina Mulder

University of Regensburg

Regina H. Mulder is full professor in Pedagogy/Educational Sciences (University of Regensburg, Germany) since 2004, where she has been Dean, Vice Chair of the Senate, and Member of the University Council. Before, she was vice director of RISBO (EUR). Her research focuses on topics in 'Vocational Education and Training' and 'Learning in Organisations' (e.g design and evaluation of VET, innovative work behaviour, feedback, learning from errors, informal learning at work, team learning, diversity in teams, leadership). She is member of editorial boards (e.g. 'Educational research review', 'HRDQ', 'HRDI') and frequently reviews scientific research proposals (e.g. NWO/NRO, DFG, FWO).

Practice Experts December 7

Erwin van Harmelen

Principal, Prinseschool

My name is Erwin van Harmelen and I've been working at the Prinseschool in Enschede for eight years. Seven of which as an elementary schoolteacher and since the summer holiday I started as principal of the Prinseschool Daalweg. The Prinseschool is a school for elementary education which has around a thousand students split between four sites. In addition, I finished the master Educational Science and Technology at the University of Twente in June. What I really like about my current position, is the possibility to combine knowledge of teaching and knowledge of current scientific research to shape education in our school.

Jennifer Herek – University of Twente

Dean University College Twente and Professor of Optical Sciences

Jennifer Herek is currently the Dean of the University College Twente. UCT offers the only Honours Bachelor's programme in the Netherlands that combines Technology with Liberal education (ATLAS). It takes a unique approach to engineering education aspired to educate a different kind of engineers and global citizens who are capable of addressing global challenges and designing solutions in a wide range of social, cultural and political contexts. She is also Full Professor of Optical Sciences at the MESA+ Institute for Nanotechnology of the University of Twente. In their Optical Sciences group they study the interaction of light and matter at the nanoscale, with a focus on biomolecules and nanostructures.

Marjolein Krijgsman

Principal, Prinseschool

Since August 2013, Marjolein is the location manager of the school location Prinsestraat. Their school is characterized by the open, pleasant atmosphere. Combined with the fact that children from all nationalities interact in a respectful manner. The voice of each child counts, also in the form of the 'children board'. They can share their ideas and opinions about things that can done be better, more convenient or different.

Nikki Olde Monnikhof

Conservator Academie van Verbeelding at Rijksmuseum Twenthe/Museum TwentseWelle

Nikki Olde Monnikhof graduated in Art History at the University of Groningen. Since January 2015, she is curator at Rijksmuseum Twenthe and Museum TwentseWelle. She initiates the exhibitions and all (educational) activities in both museums. "It is the museum that imagines our ideas, knowledge, doubts, wonder and desires", is the mission of both museums. Rijksmuseum Twenthe is the museum of the imagination. It takes you on an amazing journey along dazzling and breathtaking paths of art, culture and knowledge. Museum TwentseWelle is a real museum factory. It is about the power of the imagination: how things are created, what happens when you put them together in unexpected combinations, how and why we give form and meaning to our world. People can see, play, tinker and experiment by themselves. All day, in the museum.

Mieke Posthumus

Organiseren van het leren

Mieke Posthumus graduated in Educational Studies at the University of Amsterdam and has since focused on organizational learning. Besides educating individuals, she's interested in how to improve the development of organizations e.g. by generating and sharing knowledge. Her background and experience in Didactics enables her to develop a broad range of customized corporate university programs. Alternating on-the-job and off-the-job, education, knowledge management and innovation will be connected. Mieke Posthumus runs her own business called "Organiseren van het leren" and is frequently consulted as an advisor for NSCU, The Dutch Foundation for Corporate Universities. She is the author of several papers on educational issues.

Wilma ter Riet

Project Leader Innova, eigentijds onderwijs

I' m Wilma ter Riet born 61 years ago in Enschede. I worked at the ITC until my first daughter was born. After the birth of my third daughter, I studied mathematics and became a teacher. I strongly believe in the self-determination of students. Developing an education system where students learn to choose and find out who they are, what they want and how to get there is my goal. The chairman of 'het Stedelijk Lyceum' gave me the opportunity to create this school called Innova. It started with 21 students and after 4 years the school counts 242 students.

Martien van Rijn

Owner Innitive Engineers hardware development, i.MX processors with mainline kernel

Connects education and business in Serious Gaming

Currently, I am building a community together with Rene Stam (Conceptlious) in Enschede at the Ariënsplein in the old management offices of the MST. We make room for serious game developers and E-health professionals to work interactively with the courses of ROC, Saxion and UT in this area. We do this by making an inventory of the issues that arise in the healthcare system with the help of multidisciplinary student teams and exploring possible solutions. This method of project education reduces the gap between the knowledge institute and society and therefore results in a better flow to the professional field.

Rene Stam

Owner at Conceptlicious

Rene is the owner of Conceptlicious, a company that develops (serious) games with a strong focus within the e-health. Their clients use games for training-, simulation- or educational purposes. At Conceptlicious, they have a strong focus and are specialists in thinking through, designing, and developing (serious)games, virtual reality solutions and augmented reality experiences. Their specialties include: Gamification, VR/AR and games.

Appendix B. Questionnaire: Sharing passions about research on learning

Thank you for making the time to share your interests about research on learning. Please read the FAQ before starting:
What is this? This questionnaire contains 10 closed and 3 open questions. It should take about 15 minutes to complete.
For whom is this? This questionnaire is for permanent research staff at BMS/UT who are interested in participating in the research program on learning.
Why are we doing this? The aim of this questionnaire is to inventory existing interests as well as ambitions for new research related to learning.
Next steps? The results of the questionnaire will inform the learning research program development plan. Further, they will provide starting points for an individual interview to be scheduled with you in the next few weeks.
How to answer? Some people participate in more than one research program (which is fine). In answering the questions here, please limit your responses to your interests in terms of the *learning* research program.

1. How would you characterize your desired research on *learners?* (check all that apply)
O I do not study leaners, per se
O I study key characteristics of learners
O I study learner needs
O I study how leaners change over time
O I study how learners think
O I study something else, namely _____.

2. How would you characterize your desired research on *learning pathways*? (check all that apply)
O I do not study learning pathways, per se
O I study conceptual builds or learning progressions
O I study (specific) pedagogies
O I study (specific) learning processes
O I study something else, namely _____.

3. What kinds of *people* does your desired research focus on? (check all that apply)
O I do not study people in relation to learning
O I study children or young adults
O I study adults: peers or colleagues
O I study adults: teachers, tutors or coaches
O I study adults: leaders or management
O I study citizens at large
O I study other people, namely _____.

4. What kinds of *material aspects* does your desired research focus on? (check all that apply)
O I do not study material aspects related to learning
O I study the immediate environment (lighting, architecture)
O I study pedagogical resources (for learner use)
O I study performance tools (for teacher use)
O I study other aspects, namely _____.

5. What kinds of *structural/context aspects* does your desired research focus on? (check all that apply)
O I do not study structural aspects related to learning
O I study the immediate environment (lighting, architecture)

O I study attitudes, norms or culture in relation to learning
0 I study routines or habits in relation to learning
O I study policies (e.g. of schools, organizations, government)
O I study other aspects, namely _____.

6. Does your desired research focus on a specific *discipline*?
O No, my research is not limited to a specific discipline
O Yes, my research is focused primarily on the following discipline(s) _____.

7. In which context(s) is your desired research focused? (check all that apply)
0 Most of my research is set in primary school
0 Most of my research is set in secondary school
0 Most of my research is set in vocational / higher education
0 Most of my research is set in organizations or businesses
0 Most of my research is set in lab settings
0 Most of my research is set in a different context, namely: _____.

8. The UT's approach is 'high tech, human touch', and technology influences our BMS research. However, that can be done in many ways. Which use(s) of technology in research interest you? (check all that apply)
O I use technology as a research/analysis instrument, e.g. I collect data online or through video; I used advanced technologies to analyse my data
O I use technology as an intervention, e.g. I use technology-rich learning environments to study learner motivation; I use technology-based tools to engender organizational learning
O I study technology as an object of research, e.g. I study learner motivation to optimize learning environments; I study optimization of data-mining techniques
O I use technology as context for research, e.g. I study teenager cyber-safety behaviour on social media; I study human factors predicting cyber-crime
O I use technology in another way, namely _____.

9. Which sources of funding are important for your desired research on learning? (check all that apply)
O NWO-NRO
O NWO-ZonMw
O EU-H2020
O ERC
O Other, namely _____.

10. Besides other researchers, who are the beneficiaries of your desired learning research?
O My work benefits learners, teachers or schools
O My work benefits public sector organizations (e.g. museums, governments)
O My work benefits private sector organizations (e.g. businesses)

A. Please list 1-3 grand challenges of learning research that interest you most.
(box here)

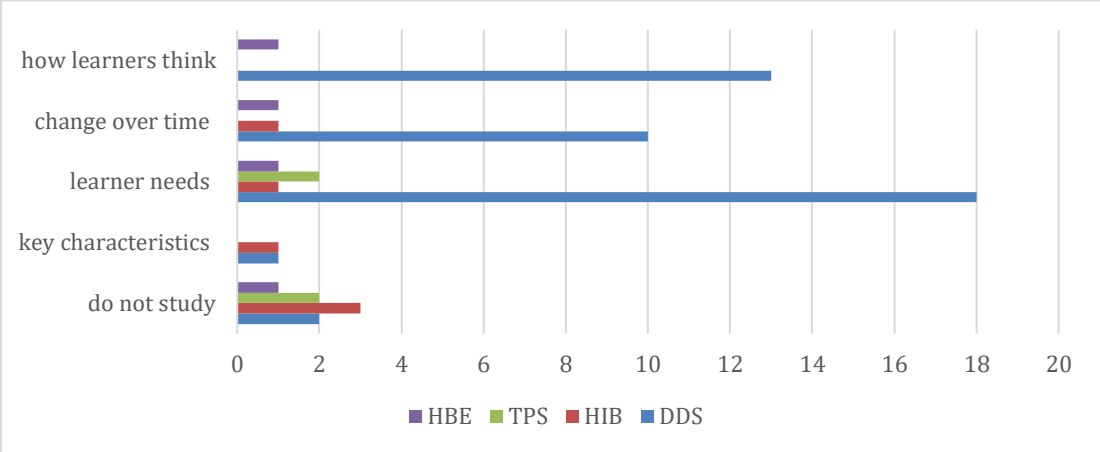
B. What kinds of expertise might help you address your biggest learning research challenges?
(box here)

C. What topics/themes/areas of learning research are you interested in learning more about

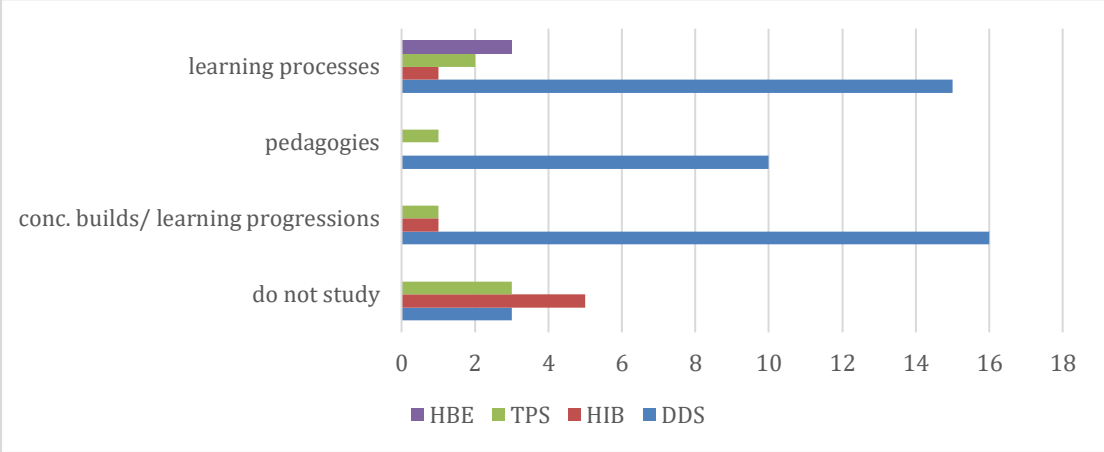
<<final page>>Thank you for making the time to complete this questionnaire. To send any suggestions, wishes or other comments, please email <<link to Miriam's UT mail here>>.
<<confirmation page, if there is one>> Your response has been recorded. You will be contact in the near future by Miriam Knoef for a follow-up interview. Thanks again!

Appendix C. Questionnaire results

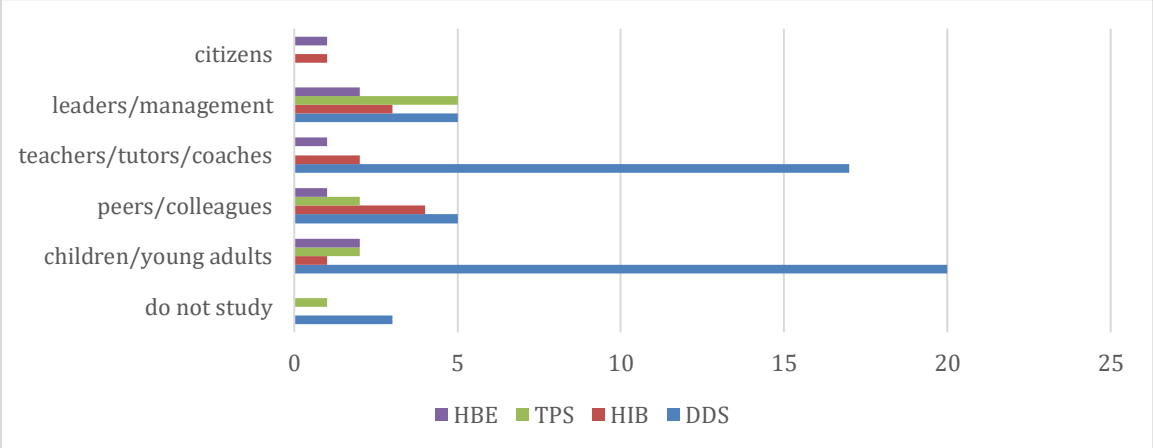
1. How would you characterize your desired research on *learners?*



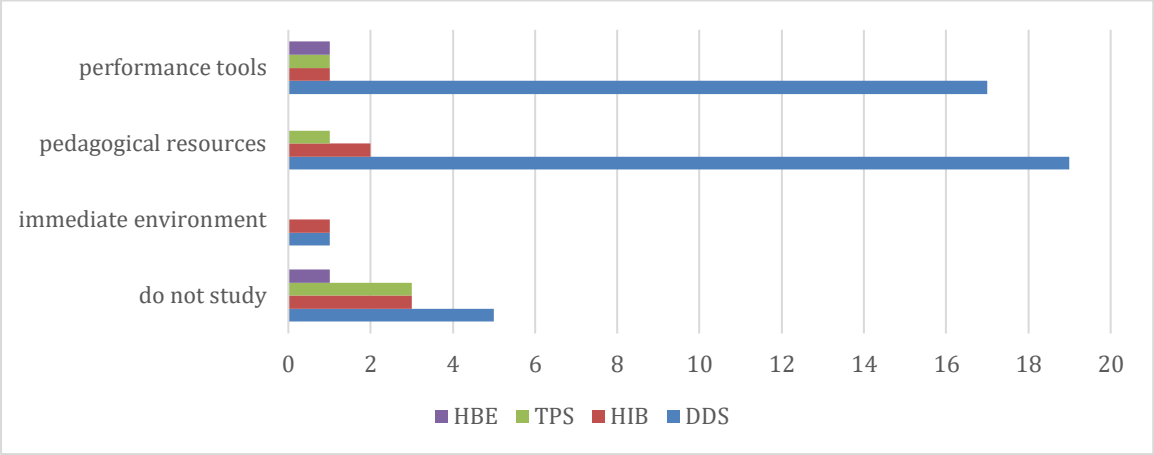
2. How would you characterize your desired research on *learning pathways*?



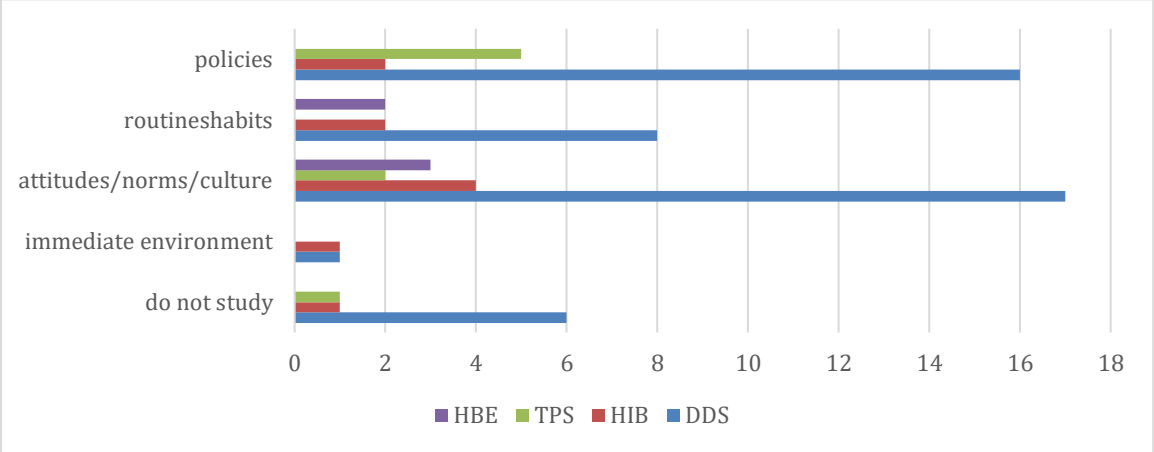
3. What kinds of *people* does your desired research focus on?



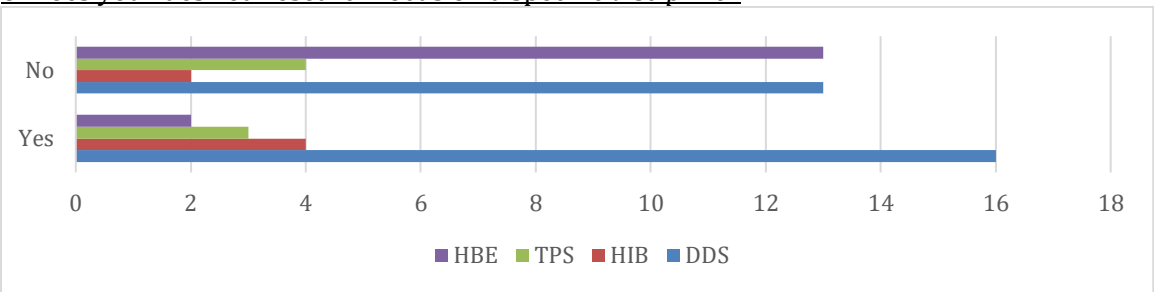
4. What kinds of *material aspects* does your desired research focus on?



5. What kinds of *structural/context* aspects does your desired research focus on?



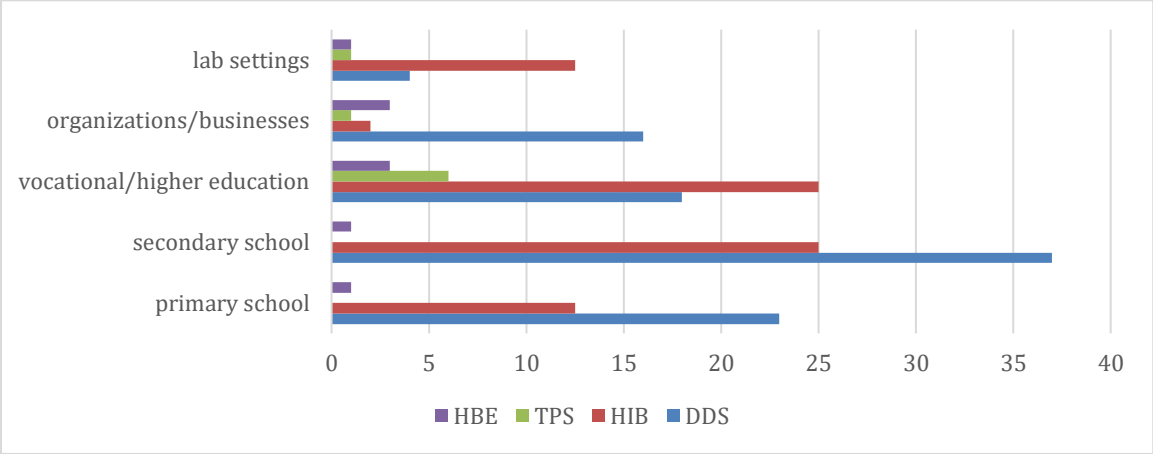
6. Does your desired research focus on a specific *discipline*?



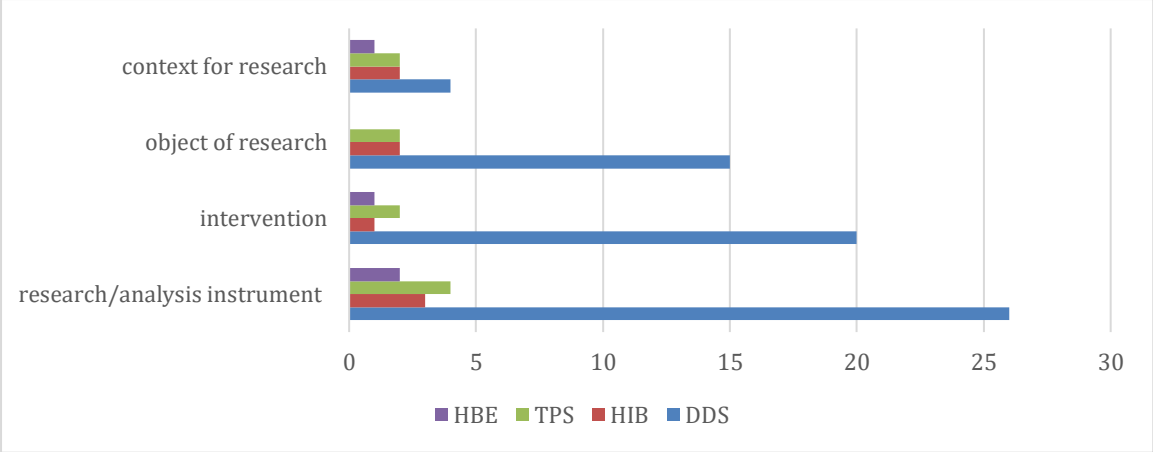
Disciplines			
DDS	HIB	TPS	HBE
Science and engineering (STEM) Cognitive Psychology (social, educational, developmental) Cognitive Neuroscience Psychology, management Natural sciences Physics	Political science (Environmental) Psychology communication, sociology organization studies (sub: communication) sociology	Engineering and social sciences Digital humanities/digital heritage/history economics, organizational theory, Political science Sociology	Serious gaming Entrepreneurship

The health and
high-tech sector

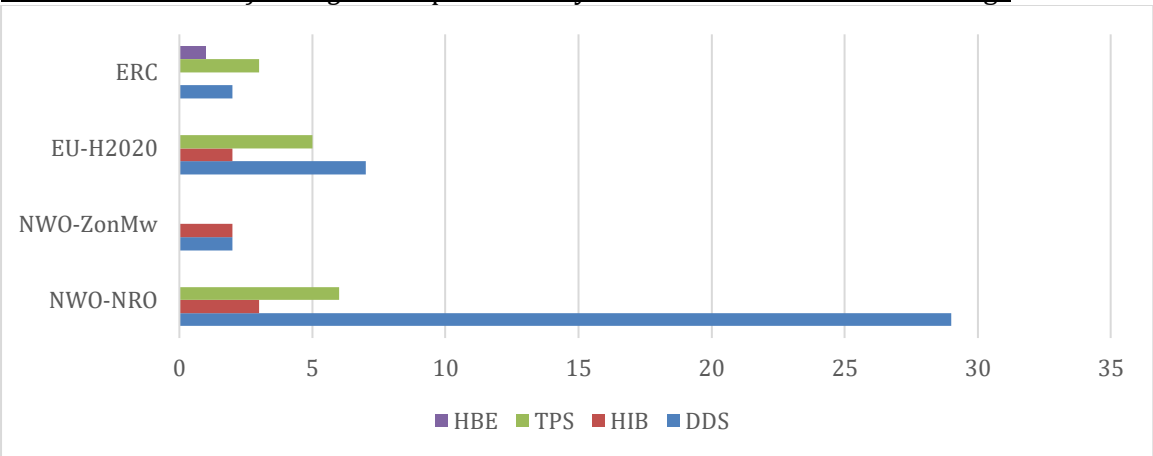
7. In which *context(s)* is your desired research focused?



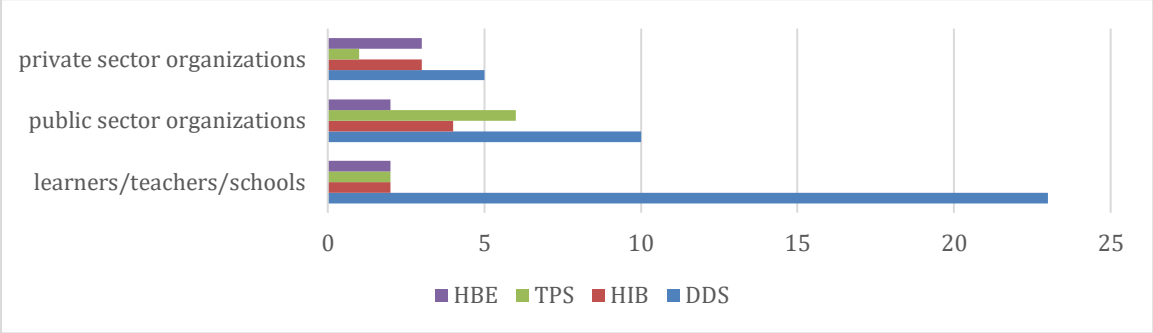
8. The UT's approach is 'high tech, human touch', and technology influences our BMS research. However, that can be done in many ways. Which use(s) of *technology* in research interest you?



9. Which sources of *funding* are important for your desired research on learning?



10. Besides other researchers, who are the *beneficiaries* of your desired learning research?



Focal areas: Grand challenges in learning research	
DDS	• How to enable all kids to optimise their learning progression? How to prevent the gap between those who have and those who don't? How to guarantee fair measurement of learning? • The (neuro-)cognitive underpinning of motor skill learning • Teacher life-long learning within the restrictions of their practical contexts. • The integration of ICT in classroom differentiation. • The preparation of the young learners for society (such as 21st century skills) • Further development of school effectiveness research • Studying dynamics of learning; how can we objectively measure when (and what) someone is learning at the workplace; how can we use (sensor)technology to (objectively) study (team) learning; the composition of teams constantly changes, how does this constant 'newcomer effect' influence learning (in project groups, agile or scrum teams) and how can we study this. • How can we enhance learning in a constantly changing society? How can we make use of different sources of data to enhance learning? • Developing (math)didactics for secondary schools • Setting up and executing Lesson Study collaboration with teachers • How to stimulate long-lasting effective organizational/educational change in which individual and organisational learning are embedded. • Learning and training in immersive virtual environments; Complex competences; Formative assessment; Reflective practitioners. • How to involve teachers in innovative practices? • ICT use in secondary schools (in chemistry education) • Context-based education and its challenges • How to improve the understanding and use of physics by secondary school students. Especially for the more uncommon subjects like Quantum Mechanics. • How people can respond and remain employable in the fast-changing society. • How we can support multidisciplinary work teams to solve grand challenges • How we can prepare and support a diverse group of students for a career in technology" • Contribution of formal schooling to learning; Achievement gaps (socio-economic/ethnic/gender); Learning gains over time • Making learning materials for science learning adaptive to learners • Intersection of individual and team, and team and organization learning and further impact at scale in the education system • Assessment of change in (learning) performance in real time. Develop statistical methods for automatic feedback to improve learning. • How to motivate learners, how to make a very reliable and valid exam • Interdisciplinary education • Supporting and rewarding teaching excellence • Current science & engineering research as a context for learning

	• Diagnostic assessment, assessment of and for learning • Developing teachers, learning environments, and different forms of assessment that stimulate 21st century learning, bridging the gap between theory and school practice in this topic. • Adaptive environments • Learning by (starting) teachers • Solving measurement of learning; computerized adaptive testing for learning; • Conceptual learning in humans and machines • Language learning and learning of reasoning in humans and machines • How to create (adaptive) support/feedback systems that enhance collaborative inquiry learning. • How can we integrate innovative technologies like sensors based technology, VR tools, virtual and remote laboratories in learning environments in such a way that the learning experience or collaboration is enhanced? • Technological advances allow us to collect learner data, how can learner data be used to empower the teachers and the learners? • Learning and training in immersive virtual environments; Complex competences; Formative assessment; Reflective practitioners. • Interdisciplinary education • Supporting and rewarding teaching excellence • Current science & engineering research as a context for learning
TPS	• Dealing with complexity and interdisciplinarity. Learning how to apply scientific knowledge in problem-solving. The role of reflection in developing metacognitive skills • Access to quality education; equitable funding; impact of internationalisation • How, under which conditions, can higher education contribute most to public value creation, conceived either within a (nation-)state or at the European level? • Which governance arrangements (funding, quality assurance, ranking, information tools, etc.) stimulate higher education to enhance quality of its education? • How can we stimulate higher education and policy-makers to understand quality in a broad sense, i.e. including social and '21st century' competences beyond employability for all its learners (from different gender, different ethnic and social backgrounds, different age, etc.)?" • Safeguarding equity & inclusiveness; Learning for sustainable development & social innovation; Preparing workers & students for the next industrial revolution • Impact of innovative technology; impact of government and organisational policies • How to analyse e.g. learning in the context of machine learning and AI applied to digital heritage. • How policy instruments are similar or differ across education sectors • Learner reactions to policy changes (e.g. study grants → loans; information provision through accreditation/ranking); internationalisation among learners; connections between learning in higher education and employability/social integration of learners in 21st century society. • The institutional frameworks surrounding the learners and the organisations that provide learning and research. How to design (smart) policies (at the various levels) that foster learning
HIB	• What is the role of (positive and negative discrete) emotions in learning processes? • How can citizenship education best be included in the school curriculum? • How can the learning of adult citizens in elections and referendums be improved? • Open education, digital education, learning analytics

	• By stimulation of desired mindsets (conducive to learning), my aim is to involve people in learning processes and as such to aid in educating people and ensuring/ facilitating creative developments. Both factors contribute to societal progress. • Social inclusion, well-being, digital inequality • How do professionals adapt to new situations? 2. Why are so many professionals hesitant to keep learning? 3. How do organizations learn to keep organizing themselves to improve fit with their telos? • Reducing learning inequalities
HBE	• How can we help (future) employees to adopt 21st century skills of constant change that are crucial for them to survive in the workplace? • How do real-time visualizations of performance data help or hinder employees to perform well and how can leaders play a supportive role in this on-site learning process? • How can hybrid change interventions (combining humans with high-tech) help managers and employees to learn new behaviours? • Change educational system to a student driven e-ducation • High-tech change interventions • Learning behaviour
Expertise (currently lacking)	
DDS	• Expertise on how to enable teachers to apply what we found/developed at universities and other knowledge centres. • Modelling with neural networks, fMRI expertise • Expertise on the learning-psychological aspects of teacher learning • Statistical expertise • More knowledge about analysing EDA data • Psychology expertise, data/data mining/algorithm expertise • Interdisciplinary expertise from e.g., Public Administration, Management, HRD, Educational Science etc. • Software development; Methodology and data analysis; Assessment. • Expertise in effective qualitative data analysis. • Expertise on data management, data science, programming tools / apps etc. • Computer science • Methodology to study learning processes (rather than outcomes) • Philosophers and engineers • HRD/HRM specialists • Scientists and engineers, design based researchers • Machine learning • Both scientific and practice-based expertise • From an experienced researcher in the same line of research • Expertise in the way children learn a conceptual understanding of their world • Multi-modal data analysis. We need to address the methodological challenges that arise from research that combines data from multiple sources, like interactions between learners (collaboration), interaction with technology, physiological measures and more traditional tests and questionnaires. • Software development; Methodology and data analysis; Assessment. • Scientists and engineers, design based researchers
TPS	• Educational sciences related to metacognitive skills development • Colleagues which think about learning in the context of machine learning and AI systems applied to digital heritage. • Translating qualitative data into quantitative data

	• Public administration; comparative education; ordinal mathematics • A combination of different expertise (primarily: Political Economy; Organisation Science; Policy Research)
HIB	• Data science, interaction designers • Expertise on how to implement findings from psychology in environmental design and technology • Professional learning and identity • Flexible organizing processes
HBE	• Change Management, Leadership and Followership Behaviour, High-tech change interventions, Operations Management • Serious gaming and e-learning expertise
Other topics/themes/areas of interest	
DDS	• Data visualisation • Effects of ICT-use in education • Digital literacy of learners • How learning is embedded in team routines; how learning develops over time; how a leader can stimulate higher levels of learning in a team (incl. contextual factors) • How to incorporate 'just in time knowledge' and 'need to know' in context-based education? • Optimising professional development: lesson study and teacher design teams. • Advances analysis techniques, such as dynamic modelling, machine learning, etc. • Text mining; statistical learning/ machine learning • Online learning, digital systems to support learning, learning in serious games • Learning motivation, exam preparation, the influence of self-studying vs mandatory tutorials/lectures, how to make a very reliable and valid exam, etc. • Analysis of physiological measures, analysis of patterns of collaboration.
TPS	• Pedagogy • How to analyse e.g. learning in the context of machine learning and AI applied to digital heritage. • How policy instruments are similar or differ across education sectors • Learner reactions to policy changes (e.g. study grants → loans; information provision through accreditation/ranking); internationalisation among learners; connections between learning in higher education and employability/social integration of learners in 21st century society. • The institutional frameworks surrounding the learners and the organisations that provide learning and research. How to design (smart) policies (at the various levels) that foster learning • New research methodologies
HIB	• How can citizens learn what they need to know as citizens (to adequately perform their role in elections and referendums)? • How can tools that assist citizens in learning about the policy preferences of political party's best be designed? • Networked learning models, personal curricula, • Social (group) learning, different facets of creative processes, • Social inclusion, well-being, digital inequality • How do network organizations manage to become both flexible and reliable?
HBE	• High-tech change interventions

• Learning behaviour

Appendix D. Interview protocol

1. Assets (9m)

Look through the list of publications and research grants. Mark the ones related to learning. Explain that our goal is to make an inventory of the assets and strengths that the BMS staff can leverage regarding the theme of learning.

   a. Are there any other strengths that you think we could leverage for the learning research program? (e.g. social and political networks; governing boards, research program committees, advisory councils, etc.)

2. Focal areas (9m)

Regarding your responses in the questionnaire, could you tell me more about:

   a. The key themes you would like to study
   b. What expertise could help you achieve these (research) goals?
   c. Other areas of learning you would take the time to learn about

3. Needs (9m)

   a. Given the previously discussed themes and challenges, what would you need to achieve these (research) aims?
      i. Would you need access to a certain kind of expertise?
      ii. Or material resources/lab?
      iii. Or different routines, policies or organizational structures?

4. Design requirements (3m)
   a. What (else) would make the learning research program a success to you?

5. Final questions
   a. Approximately how many FTE do you (anticipate being able to) spend on research within the learning theme? NB: If you are in another research theme, the hours can only be counted once.
   b. Will you be attending the workshops at 6 and 7 December?
   c. Do you have any supporting documents to illustrate the current research within your department (e.g. research proposals, reports)?

Appendix E. Interview results

Focal areas	
DDS	• Teacher life-long learning within the restrictions of their practical contexts • How we can support teachers to acquire complex teaching skills like differentiation • The integration of ICT for differentiation • Learning in virtual environments and the right pedagogical models that are fit for this type of learning. • Learning complex competences • Formative assessment; How to measure exactly what is being learnt through virtual environments/applications • Reflective practitioners • Conceptual learning in humans and machines • Language learning in humans and machines • Learning of reasoning in humans and machines • How to enable all kids to optimise their learning progression? • How to prevent the gap between those who have and those who don't? • How to guarantee fair measurement of learning? • Data visualization; how to make it easier to apply • Lifelong learning • Diagnostic assessment • Assessment of and for learning • Using/applying data – for example how teachers can use this information • How to involve teachers in innovative practices? • ICT use in secondary schools (in chemistry education) • Context-based education and its challenges • Intersection of individual and team, and team and organization learning, and the further impact at scale in the education system • Learning by individuals in a team – what is the effect on the whole system (PLG's) • Partnerships (e.g. education and health care) – can you use the Data team method in other sectors too? • How to motivate learners: increase intrinsic motivation by including internships in education or project-based learning. Motivating learners is always difficult, so it would be good to increase intrinsic motivation among students. • How to make a very reliable and valid exam: It is important to measure learning results, but how do you design a good exam to measure results accurately? • Contribution of formal schooling to learning – is learning really the effect of education that took place? • Achievement gaps (socio-economic, gender, ethnic) • Learning gains over time • How to create (adaptive) support/feedback systems that enhance collaborative inquiry learning. For example, how can we optimize the way students share knowledge and benefit from their peers' expertise. • How can we integrate innovative technologies like sensors based technology, VR tools, virtual and remote laboratories in learning environments in such a way that the learning experience or collaboration is enhanced? • Technological advances allow us to collect learner data, how can learner data be used to empower the teachers and the learners? • How to improve the understanding and use of physics by secondary school students. Especially for the more uncommon subjects like quantum mechanics -> a fairy new subject in secondary schools, which requires a new way of teaching. • Learning by (starting) teachers. Video feedback coaching, what is the long-term improvement? • Inquiry learning in primary education; How can you organize this (complex) • Flipped classroom

	• Interdisciplinary education • Supporting and rewarding teaching excellence; e.g. Senior qualification for teachers / educational leadership. • Current science and engineering research as a context for learning (Impuls project; learning concepts within a context) – does it make learning better? • Long term effects of digital media use in school (how is it most effective) • Educating teachers on this subject • How the human brain works / learns certain topics (lab setting) • Developing teachers, learning environments, and different forms of assessment that stimulate 21st century learning, bridging the gap between theory and school practice in this topic. • How the brain works, neuro-cognitive. TDCS – uses electrodes on your brain, or with magnetic pulses. • How can we enhance learning in a constantly changing society? – which knowledge do we need to teach? • How can we make use of different sources of data to enhance learning? There is also more knowledge on how students learn; how do we use this? • How people can respond and remain employable in the fast-changing society • How we can support multidisciplinary work teams to solve grand challenges • How can we prepare and support a diverse group of students for a career in technology? • Fast growing knowledge; how do you make this available? • The preparation of young learners for society (such as 21st century skills): also regarding digital literacy and self-reliance. • Further development of school effectiveness research: everything that influences students' learning performance. • Studying dynamics of learning (incl. interaction outside team boundaries/external networks) • How can we objectively measure when (and what) someone is learning at the workplace? • How can we use (sensor)technology to (objectively) study (team) learning? • When it comes to team learning, work groups are more fluid (i.e., not as permanent as a couple of decades ago): the composition of teams constantly changes, how does this constant 'newcomer effect' influence learning (in project groups, agile or scrum teams) and how can we study this. • Making learning materials for science learning adaptive to learners. • Developing (math)didactics for secondary schools • Setting up and executing lesson study collaborations with teachers
TPS	• Safeguarding equity & inclusiveness • Learning for sustainable development & social innovation • Preparing workers & students for the next industrial revolution • Policy in higher education • How to guarantee access to higher education • Effect/success of higher education • Identity of higher academics + quality thereof • The institutional frameworks surrounding the learners and the organisations that provide learning and research. How to design (smart) policies (at the various levels) that foster learning • Effect of ICT in the context of museums / digital heritage • The digital divide • (social) Effects of the development of AI; inclusiveness instead of creating a divide. • Digital literacy • AI and learning. The machine must learn first, before humans can control and steer them, but you must think about how you are going to do that. • AI in classrooms or museum

	• How, under which conditions, can higher education contribute most to public value creation, conceived either within a (nation-)state or at the European level? • Which governance arrangements (funding, quality assurance, ranking, information tools, etc.) stimulate higher education to enhance quality of its education? • How can we stimulate higher education and policy-makers to understand quality in a broad sense, i.e. including social and '21st century' competences beyond employability for all its learners (from different gender, different ethnic and social backgrounds, different age, etc.)? • Access to quality education: accessibility of education and equal opportunities for students from different backgrounds (socio economic or gender etc) – especially for higher education. And which barriers are there? What can a school/government/organization do about this? Do students eventually land in the right place? • Equitable funding; how do we fund education (bonus for study credits or for diplomas for example) • Impact of internationalisation • Dealing with complexity and interdisciplinarity: no good/thorough analysis has been done to research why this is so difficult. Needed: underlying understanding of how you learn science (wetenschap) • Learning how to apply scientific knowledge in problem solving • The role of reflection in developing metacognitive skills • Impact of new technology; not the change in didactics/pedagogy, but the influence it has on how you organize education (on policy level) and quality assurance. • Impact of government and organizational policies; higher education – financing by the government, and policy organizations as a result • Change educational system to a student driven e-ducation
HIB	• What is the role of (positive and negative discrete) emotions in learning processes? • How can citizenship education best be included in the school curriculum? • How can the learning of adult citizens in elections and referendums be improved? • How can citizens learn what they need to know as citizens (to adequately perform their role in elections and referendums)? • How can tools that assist citizens in learning about the policy preferences of political party's best be designed? • How do professionals adapt to new situations? • Why are so many professionals hesitant to keep learning? • How do organizations learn to keep organizing themselves to improve fit with their telos? • Open education, digital education, learning analytics for higher education • Networked learning models • Stimulation of desired mindsets (conducive to learning), • Social (group) learning, different facets of creative processes, • Social inclusion, well-being, digital inequality, digital literacy
HBE	• Which methods for entrepreneurship learning are most effective • How to learn from singular experiences (ambiguities of experience) e.g. in the entrepreneurship context. • Co-teaching organizing how to manage guest speakers, no intercultural research • How can we help (future) employees to adopt 21st century skills of constant change that are crucial for them to survive in the workplace?

	• How do real-time visualizations of performance data help or hinder employees to perform well and how can leaders play a supportive role in this on-site learning process? • How can hybrid change interventions (combining humans with high-tech) help managers and employees to learn new behaviours?
Assets	
DDS	• Network with expertise of machine learning • Cito, RCEC, bureau ICE (like cito but smaller), Explain, Oberon (advice bureau), NVE. Multiple clients; CDFD, ministry of OCW, NRO, internal partners • Vakdidactische netwerk van lerarenopleiders (scheikunde), KNCV (teacher professionalisation). • Carmel college, KPZ, Saxion, TYF • Onderwijsinspectie, ministry of OCW • University Olou, leiden • Many teachers • ECO – inquiry/collaborative learning • Heutink ICT and other publishing companies • 4TU • Data teams, data use for teachers/school leaders
TPS	• BMBF • OCW, European Commision, commissions for policy research • Many organizations within humanities/cultural sector. Digital humanities, museums, etc. But also with NWO. • Supervisor katholic primary schools, scientific advice board research institute Germany (DHWZ) • Policy network, NRO, ministry, university school leaders, EU
HIB	• ECPEPN platform - technical developments. London university of science, Arizona state university, university in Indonesia • Design lab fellow • Techno hal living smart campus • Projects at Saxion about social learning • EIT digital academy
HBE	• Tech4people • Workgroup entrepreneurship education (mail) + 3E conference 2018 • Head of R&D – change interventions and high-tech change. Also involved in: city commission Den Haag, 'giving back'. Students are given mentors to broaden their horizons (often students from weaker background).
Needs	
DDS	*Expertise* • learning-psychological aspects of teacher learning • Psychology expertise • Modelling with neural networks, fMRI expertise • Philosophers and engineers • HRD/HRM specialists • Scientists and engineers • How children learn a conceptual understanding of their world • R (statistical software) • Methodology and data analysis • Multi-modal data analysis • How to test learning ability

- Methodology to study learning processes (rather than outcomes)
- Design based researchers
- More knowledge about analysing EDA data (measuring with observations, what triggers learning behaviour?)
- Expertise in effective qualitative data analysis
- Machine learning
- Software development
- Expertise on virtual environments/apps (technical)
- Expertise on data management, data science, programming tools /apps etc.
- Computer science
- Data/data mining/algorithm expertise

Resources

- Time
- Money
- Manpower
- Access to classes/schools and material
- Colleagues /manpower
- Collaborating with other departments is good (for example with IST for co-labs); but there is too little time and money
- Not to formalized/forced. Making connections is good, but it can become too much
- In the case of internships/project-based learning: it needs to be possible to work with these organizations (collaborations).
- Getting schools to participate in research.
- Better video equipment
- BMS lab – could be better organized (supervised)
- Continuity in staff
- Funding from the UT for scientific literacy
- A different assessment system (appreciation)
- Focus on technology
- Making data accessible
- Online platform?
- Algorithms to make data real time
- Support from financial administration within the university, and general support for the execution of the research. Sometimes this can be difficult at the UT.
- Better link with domain specific topics – connect with that. This should be facilitated better.

TPS

Expertise

- Translating qualitative data into quantitative data
- Public administration (for policy questions)
- Comparative education (a lot of international comparative studies)
- Ordinal mathematics (multi ranking research)
- HRD knowledge
- Exceeding disciplinaries but also institutions
- Collaborating with organizations
- A combination of different expertise (primarily: Political Economy; Organisation Science; Policy Research)
- Educational sciences related to metacognitive skills development
- Serious gaming and e-learning expertise
- Research methodologies
- New data collection methods, like big data

Resources

- Right people that supplement each other, innovative ideas (young people)
- Flexible organisation

	• Time and money that is used well; not the most money to senior researchers, but to the best ideas. • A team (body of knowledge). By yourself you cannot accomplish this • Collaboration with colleagues • Financing – stability from the UT • Working on cowriting research proposals • Traveling budget • Good people from different disciplines, someone that is appointed as the main person for writing proposals (someone who is good at that, not necessarily involved in content). Colleagues who are visionaries.
HIB	*Expertise* • How to implement findings from psychology in environmental design and technology • Designers/technology • Data science • Interaction designers • Professional learning and identity • Flexible organizing processes • Psychological, technological skills (maybe industrial design) • Big data analysis *Resources* • Collaborating interdisciplinary teams • Conversational partners • An organisational structure that understands the question • Very relevant BMS/learning group that monitors proactively where research proposals can be submitted. Looking forward to future calls • Advanced data gathering equipment is needed, but they are working on that in EIT. Backoffice that helps us. • Need to work in teams • Psychological, technological skills (creative input)
HBE	*Expertise* • Change Management • Leadership and Followership Behaviour • High-tech change interventions • Operations Management *Resources* • Funding for using big data • Time • Workgroups in multidisciplinary teams • Good funding for capacity
Design requirements	
DDS	• Interdisciplinary collaboration • Sufficient aio's – do a lot of research. • Good collaboration with partners • OWK works with a lot of funding from governments/ministry of OCW. This could be better mapped (knowing what others are working on). • (invest in) Good contacts with schools and with the educational programs (and professors) • Opportunity to present work to others (like the 'nieuwsflits'). Vakgroepvoorzitters should take the lead in this. It should be non-binding. • Making a connection with a specific subject

	• Focus on technology (boundaries of...) • Collaboration (interdisciplinary) • Getting to know each other (BMS), sharing interests/knowledge. Possibly in small breaks -> meetings/activities • Good theoretical framework; Good definitions of concepts • Measurement validation (elaborate psychometric validation) • Sharing good valid instruments within the department • Focus on practice (gap theory- practice) • Collaboration between departments. How to share information? Activities, maybe involving a pitch • Interdisciplinary (collaboration) • Knowledge sharing • Context/domain transcending collaborations – working on societal grand challenges
TPS	• Broad theme • Stability in research program • Regular meetings (workgroups or seminars) to stimulate interaction • Focus; not too broad. There are too many people with a different focus, so that will be difficult • Innovative • Meeting each other and sharing knowledge between different departments (platform?) • Different perspectives • Sufficient foundation • Bigger purpose/story – to stimulate collaboration and involvement, and backing by other parties (dean, university, outside partners) • Underlying societal issue • Management support from the dean/university, also for visibility • Mutual collaboration with other disciplines/departments • keep it broad -> not just focus on learning process. • Focus on publications (importance of networking) • Internal networking, having a lot of (social) activities to connect, non-binding but stimulating to attend • Rooted in what is already here at the UT, but also innovative (ideally international) • Also, ideally connected to the master program EST (or other) – interaction with students, could be a huge asset.
HIB	• Making connections, also outside of the university • Lean & agile working – no fixed program • Collaborating interdisciplinary teams. Technology, but that is already there.
HBE	• Support from university in collecting data • Supportive of networking within the UT

Appendix F. Focus group protocol

A. Opening

12:30 – 12:40 (10 minutes)
- Word of welcome
- The goal of the focus group meeting is explained:
    - Primary: (focal areas) To articulate key themes that more than one individual wants to address in learning research, possibly themes that are shared among all members of the focus group.
    - Secondary (assets/needs, design requirements): Identify the assets and needs of the individuals involved in the program.
    - Tertiary: To facilitate the group starting to think about their research as part of a (bigger) program, and to interact with others in the cluster that contribute to that program.
- Introductions of all participants (a lot of whom have not met before)
- Recap of questionnaire results (see appendix C) on cluster level.
- Room for questions.

B. Discussion

12:40 – 13:05 (25 minutes)
- Recap of the grand challenges distilled from the questionnaire and individual interviews.
- Discussion of main themes and grand challenges: The participants are asked to comment on the grand challenges individually.
- Next, the participants discuss which grand challenges they feel are important (and why), and which key themes they recognized in these challenges.
- Through their discussions, it will become clear which grand challenges and themes are deemed important by more than one individual in the group, and at times even all individuals.

13:05 – 13:15 (10 minutes)
- Discussion of needs: Recap of the needs identified during the previous activities
- The participants are asked to comment on the identified needs, and articulate further what people think they will need (that they currently lack) to work on the themes and challenges mentioned.

13:15 – 13:25 (10 minutes)
- Discussion of design requirements: Recap of the design requirements identified during the previous activities.
- The participants are asked to comment on the identified design requirements, and articulate further what requirements would have to be satisfied for the UT/BMS Learning Research Program Development Plan to be successful.

C. Conclusion
13:25 – 13:30 (5 minutes)
- The participants are thanked for their time and input.
- It is explained briefly that the focus group sessions will contribute to the workshop content, by articulating several themes of interest that were shared among (the majority of) the BMS staff.
- Room for questions

Appendix G. Focus group results

Key themes and grand challenges	

DDS	• Inclusiveness
	• Preparing professionals for the job market
	• Added value of technology in education
	• Use of technology to support teachers and students
	  o E.g. development of effective learning environments
	  o Requires different knowledge and skills (21st century skills, future-oriented learning)
	  o Effective technology may have a positive effect on the teacher shortage (ease the teachers' tasks)
	  o Possibilities for differentiation and adaptive learning
	• Interdisciplinary learning/teaching
	  o E.g. 'science' and 'stem' education
	  o Requires different skills
	  o Questions related to didactics, but also different ways of testing
	• Retaining teachers in this changing society; adaptability. The traditional role of teachers is changing a lot; how do you deal with this? How to educate teachers and what is the effect thereof?
	• Excellence in education. In the Netherlands, the lower levels in education are organised very well, but challenging the higher-level students is still difficult. Talent development and excellence should receive more attention.
	• Differentiation or adaptive learning; how can AI/technology support teachers in differentiating. How do you collect data about the students' needs and/or behaviour, how do you use this data, and how do you assess in differentiated instruction?
	• Adaptive learning/ personalized learning – can also be linked to data use / technology use: which knowledge is needed. ICT also can enable teachers to be involved in the learning process in a very different way. Which feedback do you give to students (real time)? Also, different types of assessment needed (adaptive/formative testing)
	• Learning and working in partnerships/networks – for more effective education (or in organizations) – how can you organize and facilitate people effectively working and learning together?
	• New ways of measuring – based on innovative technology
	• Interdisciplinary teaching/learning; also found interesting – new curricula

TPS	• Interdisciplinary learning/teaching • Preparing higher education for the future. Several questions can fall under this theme, such as: how to prepare academic education for the future – with new technological innovations. Also; what knowledge, skills or competences are needed and should be taught? • Quality of academic education: How to learn content and skills for disciplinary challenges. • Inclusiveness; connect academical knowledge with the citizens (citizen science). • Equal opportunities for all students • Adaptability
HIB	• Digital education • Social inclusion • The digital divide
Assets/needs	
DDS	No additional assets or needs identified

TPS	Time and money for small projects in groups. For example: a collaborative research market. Appoint someone who write Research Proposals – someone with excellent writing skills who is not necessarily involved in the research itself.
HIB	Knowledge sharing/collaborating in teams; needs a reward. If you take the time to write proposals etc, you need to be rewarded simply for putting in the effort and time (also if the proposal does not go through)

Design requirements

DDS	• Create a website to stimulate collaboration within the department, including: current research projects (possibly organized by themes), current news, colloquia dates from the whole department, personal bio's. However, not everyone will read the website, and it needs to be kept up to date. Experience shows that this is often difficult. • Informal meetings or a newsletter to stimulate knowledge sharing • Look for ways to improve what is already there; not too many new things
TPS	• Collaborating within the departments. Important: good chemistry. How to facilitate and encourage collaboration with other departments (also outside of BMS)? • National research agenda: important societal challenges – interdisciplinary – will be important. • Organize meetings • To encourage collaboration, use a best practice approach: e.g. where are people working in consortia, where are they effective?
HIB	• Connect to people's expertise to create more research output. • Not too many changes on educational level, but focus on stability in the environment (university). • Continuity in manpower/people.

Appendix H. Summary of results

Table 3. Summary of focal areas

	Questionnaire	Individual interviews	Focus Groups

Focal areas
Depth/ Quality
Equity/ Inclusion
Adaptability/ Flexibility
Differentiation/ Personalisation
	• Further development of school effectiveness research
	• Contribution of formal schooling to learning
	• The intersection of individual and team, and team and organization learning and further impact at scale in the education system
	• Developing teachers, learning environments, and different forms of assessment that stimulate 21st century learning, bridging the gap between theory and school practice in this topic.
	• How, under which conditions, can higher education contribute most to public value creation, conceived either within a (nation-)state or at the European level?
	• Which governance arrangements (funding, quality assurance, ranking, information tools, etc.) stimulate higher education to enhance quality of its education?
	• How can we stimulate higher education and policy-makers to understand quality in a broad sense, i.e. including social and '21st century' competences beyond employability for all its learners (from different gender, different ethnic and social backgrounds, different age, etc.)?
	• Impact of innovative technology; impact of government and organisational policies
	• internationalisation among learners
	• Connections between learning in higher education and employability/social integration of learners in 21st century society
	• Deep learning
	• How to design (smart) policies (at the various levels) that foster learning
		• Impact of innovative technology; not the change in didactics/ pedagogy, but the influence it has on how you organize education (on policy level) and quality assurance.
		• Intersection of individual and team, and team and organization learning, and the further impact at scale in the education system
		• Learning by individuals in a team – what is the effect on the whole system (plg's)
		• Partnerships (e.g. education and health care) – can you use the data team method in other sectors too?
		• How to motivate learners: increase intrinsic motivation by including internships in education or project-based learning.
		• Contribution of formal schooling to learning – is learning really the effect of education that took place?
		• How can we integrate innovative technologies like sensors based technology, VR tools, virtual and remote laboratories in learning environments in such a way that the learning experience or collaboration is enhanced?
		• Inquiry learning in primary education; How can you organize this (complex)
		• Long term effects of digital media use in school
		• Developing teachers, learning environments, and different forms of assessment that stimulate 21st century learning, bridging the gap between theory and school practice in this topic.
		• How can we make use of various sources of data to enhance learning? There is also more
			• Added value of technology in education
			• Learning and working in partnerships/networks – for more effective education (or in organizations) – how can you organize and facilitate people effectively working and learning together?
			• Preparing higher education for the future. Several questions can fall under this theme, such as: how to prepare academic education for the future – with new technological innovations. Also; what knowledge, skills or competences are needed and should be taught?
			• Quality of academic education: How to learn content and skills for disciplinary challenges.
			• How to enable/facilitate deep learning?
			• Social inclusion
			• Inclusiveness; connect academical knowledge with the citizens (citizen science).
			• The digital divide
			• Equal opportunities for all students.
			• Preparing professionals for the job market
			• Interdisciplinary learning/teaching
			  ○ E.g. 'science' education
			  ○ Requires different skills
			  ○ Questions related to didactics, but also different ways of testing
			• Retaining teachers in this changing society; adaptability. The traditional role of teachers is changing a lot; how do you deal with this? How to educate teachers and what is the effect thereof?
			• Excellence in education. In the Netherlands, the lower levels in education are organized very well, but challenging the higher-level students is still

	• How can citizenship education best be included in the school curriculum? • How do organizations learn to keep organizing themselves to improve fit with their telos? • How to enable all kids to optimise their learning progression? • How to prevent the gap between those who have and those who don't? • How to guarantee fair measurement of learning? • Achievement gaps (socio-economic/ethnic/gender) • Access to quality education • Equitable funding • Impact of internationalisation • Safeguarding equity & inclusiveness • Social inclusion, well-being, digital inequality • Learning for sustainable development & social innovation; • Preparing workers & students for the next industrial revolution • The composition of teams constantly changes, how does this constant 'newcomer effect' influence learning (in project groups, agile or scrum teams) and how can we study this. • Studying dynamics of learning; how can we objectively measure when (and what) someone is learning at the workplace • How can we enhance learning in a constantly changing society? • How can we make use of different sources of data to enhance learning? • How to stimulate long-lasting effective organizational/educational change in which individual and organisational learning are embedded. • How to involve teachers in innovative practices? • How people can respond and remain employable in the fast-changing society.	knowledge on how students learn; how do we use this? • Further development of school effectiveness research: everything that influences students' learning performance. • The institutional frameworks surrounding the learners and the organisations that provide learning and research. • How to design (smart) policies (at the various levels) that foster learning • How, under which conditions, can higher education contribute most to public value creation, conceived either within a (nation-)state or at the European level? • Which governance arrangements (funding, quality assurance, ranking, information tools, etc.) stimulate higher education to enhance quality of its education? • Impact of government and organizational policies; higher education – financing by the government, and policy organizations as a result • How to enable all kids to optimise their learning progression? • How to prevent the gap between those who have and those who don't? • How to guarantee fair measurement of learning? • Achievement gaps (socio-economic, gender, ethnic) • The digital divide • (social) Effects of the development of AI; inclusiveness instead of creating a divide. • Digital literacy • Equitable funding; how do we fund education (bonus for study credits or for diplomas for example) • Safeguarding equity & inclusiveness • Accessibility of education and equal opportunities for students from different	difficult. Talent development and excellence should receive more attention. • How can AI/technology support teachers in differentiating. How do you collect data about the students' needs and/or behaviour, how do you use this data, and how do you assess in differentiated instruction? • ICT also can enable teachers to be involved in the learning process in a very different way. It requires different knowledge and skills (21st century skills, future-oriented learning) • Effective technology may have a positive effect on the teacher shortage (ease the teachers' tasks) • Which feedback do you give to students (real time)? Also, different types of assessment needed (adaptive/formative testing).

	• How we can support multidisciplinary work teams to solve grand challenges • How we can prepare and support a diverse group of students for a career in technology • Making learning materials for science learning adaptive to learners • Interdisciplinary education • How to create (adaptive) support/feedback systems that enhance collaborative inquiry learning. • How do professionals adapt to new situations? • How can we help (future) employees to adopt 21st century skills of constant change that are crucial for them to survive in the workplace? • How can hybrid change interventions (combining humans with high-tech) help managers and employees to learn new behaviours? • How do real-time visualizations of performance data help or hinder employees to perform well and how can leaders play a supportive role in this on-site learning process? • The preparation of the young learners for society (such as 21st century skills) • Teacher life-long learning within the restrictions of their practical contexts. • The integration of ICT in classroom differentiation. • Supporting and rewarding teaching excellence • Technological advances allow us to collect learner data, how can learner data be used to empower the teachers and the learners?	backgrounds (socio economic or gender etc) – especially for higher education. And which barriers are there? What can a school/government/organization do about this? Do students eventually land in the right place? • How can we stimulate higher education and policy-makers to understand quality in a broad sense, i.e. including social and '21st century' competences beyond employability for all its learners (from different gender, different ethnic and social backgrounds, different age, etc.)? • Learning in virtual environments and the right pedagogical models that are fit for this type of learning. • How to involve teachers in innovative practices? • Interdisciplinary education • Supporting and rewarding teaching excellence; e.g. Senior qualification for teachers / educational leadership. • How people can respond and remain employable in the fast-changing society • How can we prepare and support a diverse group of students for a career in technology? • Fast growing knowledge; how do you make this available? • The preparation of young learners for society (such as 21st century skills): also regarding digital literacy and self-reliance. • When it comes to team learning, work groups are more fluid (i.e., not as permanent as a couple of decades ago): the composition of teams constantly changes, how does this constant 'newcomer effect' influence learning (in project groups, agile or scrum teams) and how can we study this. • Studying dynamics of learning (incl. interaction outside team boundaries/external networks)

	• How can we help (future) employees to adopt 21st century skills of constant change that are crucial for them to survive in the workplace? • How do real-time visualizations of performance data help or hinder employees to perform well and how can leaders play a supportive role in this on-site learning process? • How do professionals adapt to new situations, and what can be reasons for their hesitance to learning? • Teacher life-long learning within the restrictions of their practical contexts • How we can support teachers to acquire complex teaching skills like differentiation • The integration of ICT for differentiation • Using/applying data – for example how teachers can use this information • How to create (adaptive) support/feedback systems that enhance collaborative inquiry learning. For example, how can we optimize the way students share knowledge and benefit from their peers' expertise. • Technological advances allow us to collect learner data, how can learner data be used to empower the teachers and the learners?

Table 4. Summary of Assets/Needs

	Assets	Needs
Human	Expertise areas of all learning researchers are described in Appendix A (Meet the Team). The list below reflects existing strategic affiliations mentioned by learning researchers themselves as important for the development of this reseach program. • Network with expertise of machine learning • Cito, RCEC, bureau ICE (like cito but smaller), Explain, Oberon (advice bureau), NVE. Multiple clients; cdfd, ministry of OCW, NRO, internal partners • Vakdidactische netwerk van lerarenopleiders (scheikunde), KNCV (teacher professionalisation). • Carmel college, KPZ, Saxion, TYF • Onderwijsinspectie, ministry of OCW • University Olou, Leiden • ECO – inquiry/collaborative learning • Heutink ICT and other publishing companies • 4TU • Data teams • BMBF • OCW, European Commission • many organizations within humanities/cultural sector. • Supervisor catholic primary schools, scientific advice board research institute Germany (DHWZ) • ECPEPN platform - technical developments. London university of science, Arizona state university, university in Indonesia • Design lab fellow • Technohal living smart campus • Projects at Saxion about social learning • EIT digital academy • Tech4people • Workgroup entrepreneurship education (mail) + 3E conference 2018 • Head of R&D – change interventions and high-tech change • International Society for Design & Development in Education (ISDDE) • International Society of the Learning Sciences (ICLS)	• Data science expertise • HRD/HRM specialists • Philosophers and engineers' expertise • Expertise of learning-psychological aspects of teacher learning • Expertise of modelling with neural networks, fMRI expertise • Expertise of methodology and data analysis (e.g. data science, data mining, translating qualitative data into quantitative data) • Software development, virtual environments/apps (technical) expertise • Public administration expertise (for policy questions) • Comparative education expertise (a lot of international comparative studies) • Ordinal mathematics expertise (multi ranking research) • Expertise of educational sciences related to metacognitive skills development • Serious gaming and e-learning expertise • Change Management expertise • Expertise of Leadership and Followership Behaviour • Expertise of high-tech change interventions • Expertise of Operations Management • Expertise of psychological, technological skills (creative input) • Manpower and continuity in staff • Collaborating with other departments is good (for example with IST for co-labs • Right people that supplement each other, innovative ideas (young people); divide roles, someone that is appointed as the main person for writing proposals (someone who is good at that, not necessarily involved in content). • Very relevant BMS/learning group that monitors proactively where research proposals can be submitted. Looking forward to future calls • *From focus groups: Appoint someone who write Research Proposals – someone with excellent writing skills who is not necessarily involved in the research itself.*
Material	• Design lab • BMS TechForPeople lab • Campus • Financial support for establishing this line of research	• Time and money that is used well; not the most money to senior researchers, but to the best ideas. • Getting schools to participate in research • Better video equipment

		• *From focus groups: Time and money for small projects in groups. For example: a collaborative research market.*
Structural	• Institutional policies that align with SEP • BMS leadership endorses this work	• Flexible organizing processes • Funding from the UT for scientific literacy • A different assessment system (appreciation) • Support from financial administration within the university, and general support for the execution of the research. Sometimes this can be difficult at the UT. • Flexible organisation • Working on cowriting research proposals • *From focus groups:* Knowledge sharing/collaborating in teams; needs a reward. If you take the time to write proposals etc, you need to be rewarded simply for putting in the effort and time (also if the proposal does not go through)

Table 5. Summary of Design requirements

	Individual interviews	Focus groups
Focal areas	• Focus on technology (boundaries of…) • Focus on practice (gap theory- practice) • Bigger purpose/story – to stimulate collaboration and involvement, and backing by other parties (dean, university, outside partners) • Rooted in what is already here at the UT, but also innovative (ideally international)	• National research agenda: important societal challenges – interdisciplinary – will be important.
Collaboration	• Interdisciplinary collaboration • Good collaboration with partners • Collaboration between departments. How to share information? Activities, maybe involving a pitch • Meeting each other and sharing knowledge between different departments (platform?) • Getting to know each other (BMS), sharing interests/knowledge. Possibly in small breaks -> meetings/activities. Non-binding, with lots of opportunities to share work. • Making connections, also outside of the university	• Collaborating within the departments. Important: good chemistry. How to facilitate and encourage collaboration with other departments (also outside of BMS)? • Create a website to stimulate collaboration within the department, including: current research projects (possibly organized by themes), current news, colloquia dates from the whole department, personal bio's. However, not everyone will read the website, and it needs to be kept up to date. Experience shows that this is often difficult. • Informal meetings or a newsletter to stimulate knowledge sharing • To encourage collaboration, use a best practice approach: e.g. where are people working in consortia, where are they effective?
Organisation	• Sufficient AIO's – do a lot of research. • Stability in research program • Management support from the dean/university, also for visibility • Focus on publications (importance of networking) • Also, ideally connected to the master program EST (or other) – interaction with students, could be a huge asset.	• Look for ways to improve what is already there; not too many new things • Connect to people's expertise to create more research output. • Not too many changes on educational level, but focus on stability in the environment (university). • Continuity in manpower/people.

Appendix I. Publication analysis results

Note: Grey colored publications are coded more than once, meaning that they are already mentioned under another code.

1. Philosophy of knowledge and learning

1.1. Epistemology

Boon Mieke (2017). *Philosophy of Science in Practice: A Proposal for Epistemological Constructivism*. Chapter 16 in: *Logic, Methodology and Philosophy of Science – Proceedings of the 15th International Congress (CLMPS 2015).* Hannes Leitgeb, Ilkka Niiniluoto, Päivi Seppälä & Elliott Sober (eds). College Publications. pp 289-310. ISBN: 978-1-84890-229-9 http://www.collegepublications.co.uk/lmps/?00016

Boon M. (2017). *An Engineering Paradigm in the Biomedical Sciences: Knowledge as Epistemic Tool*. In: *Progress in Biophysics and Molecular Biology* (special issue: Validation and Models in Computational Biomedical Science: Philosophy, Engineering and Science, A. Carusi and B. Rodriquez eds.). DOI: http://10.1016/j.pbiomolbio.2017.04.001 http://www.sciencedirect.com/science/article/pii/S007961071630044X

Boon M. (2017) *Measurements in the Engineering Sciences: An Epistemology of Producing Knowledge of Physical Phenomena*. Chapter 15 in: *Reasoning in Measurement*, N. Mößner and A. Nordmann (eds.) Series "History and Philosophy of Technoscience". London and New York: Routledge, 203-219.

Baalen, S.J. van, and Boon, M. (2017). *Evidence-based Medicine versus Expertise – Knowledge, Skills, and Epistemic Actions*. Chapter 2 in: *Knowing and Acting in Medicine*. Robyn Bluhm (ed.). Rowman & Littlefield, 21-38.

Baalen, S.J. van, and Boon, M. (2015) *An Epistemological Shift: From Evidence-Based Medicine to Epistemological Responsibility. Journal of Evaluation in Clinical Practice*, 21(3): 433-439. ISSN 1356-1294, DOI: 10.1111/jep.12282.

Boon, M. (2013) *Kennis als Denkgereedschap: Wetenschapsfilosofie voor de Technische Wetenschappen.* Filosofie, 23(3): 31-36. ISSN 0925-9449.

Boon, M. (2012) *Understanding Scientific Practices: The Role of Robustness Notions.* Chapter 12 in: Lena Soler (Ed.), Characterizing the robustness of science : after the practice turn in philosophy of science. Boston studies in the philosophy of science. Springer, Dordrecht, 289-315. ISBN 9789400727588

Boon, M. (2012) *Scientific Concepts in the Engineering Sciences: Epistemic Tools for Creating and Intervening with Phenomena.* In: U. Feest & F. Steinle (Eds.), Scientific concepts and investigative practice. Berlin studies in knowledge research (3). De Gruyter, Berlin, 219-243. ISBN 9783110253610.

2. Cognitive development/neuronal basis for learning

Barnhoorn, J.S., Dorner, F., van Asseldonk, E., & Verwey, W.B. (2016). Similar representations of sequence knowledge in young and older adults: A study of effector independent transfer. Frontiers of Psychology, 7(1125). doi: 10.3389/fpsyg.2016.01125.

Verwey, W.B., Groen, E.C., & Wright, D.L. (2016). The stuff that motor chunks are made of: Spatial instead of motor representations? *Experimental Brain Research*, 234(2), 353-366.

Wright, D.L. Verwey, W.B., Buchanan, J.J., Jing, C., Rhee, J., & Immink, M.A. (2016). Consolidating behavioral and neurophysiologic findings addressing contextual interference during motor sequence learning. *Psychonomic Bulletin & Review*, 23(1), 1-21.

Verwey, W.B. (2015). Contributions from associative and explicit sequence knowledge to the execution of discrete keying sequences. *Acta Psychologica*, 157, 122-130.

Ruitenberg, M.F.L., Verwey, W.B., Schutter, D.J.L.G., and Abrahamse, E.L. (2014). Cognitive and neural foundations of discrete sequence skill: A TMS study. *Neuropsychologia*, 56, 229-238.
Jouen, A.-L., Verwey, W. B., Van Der Helden, J., Scheiber, C., Neveu, R., Dominey, P. F., et al. (2013). Discrete Sequence Production With and Without a Pause: The Role of Cortex, Basal Ganglia and Cerebellum. *Frontiers in Human Neuroscience*, 7.
Luursema, J.-M, Verwey, W.B., & Burie, R. (2012). Visuospatial factors in laparoscopic simulator training. *Learning and Individual Differences*, 22, 5, 632-638.
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Electroencephalogram Recordings Indicate That More Abstract Diagrams Need More Mental Resources to Process. van Leeuwen, T., Manalo, E. & van der Meij, J. 2015 In : Mind, brain and education. 9, 1, p. 19-28
The role of perceptual cues in matrix diagrams. van der Meij, J., Amelsvoort, M. & Anjewierden, A. A. 25 Aug 2015

3. Motor learning

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Abrahamse, E. L., Ruitenberg, M. F. L., De Kleine, E., & Verwey, W. B. (2013). Control of automated behaviour: Insights from the Discrete Sequence Production task. *Frontiers in Human Neuroscience*, 7(82).
Ruitenberg, M.L., Abrahamse, E.L., & Verwey, W.B. (2013). Sequential motor skill in preadolescent children: The development of automaticity. *Journal of Experimental Child Psychology*, *115*, 607-623.
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Ruitenberg, M, de Kleine, E., van der Lubbe, R.H.J., Verwey, W.B., & Abrahamse, E.L. (2012). Context dependent motor skill and the role of practice. *Psychological Research*, *76*, 812-820.
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4. Policy

4.1. Institution intern

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de Boer, H., R. Kolster, et al. (2016). "Bestuursbenoemingen over de grens. Hoe is de procedure in andere landen geregeld?" TH&MA 5-15: 81-85.
De Boer, H., E. Epping, M. Faber, F. Kaiser, and E. Weyer (2013). Continuing Higher Education. Part One: general impressions of an international inventory and explorative analysis of policies concerning flexibility in continuing higher education for workers (42 p), Part two: Five Countries (138 p). Part 3: Five

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Ngo, J., H.F. de Boer and J. Enders (2013). The way deans run their faculties in Indonesian universities. Tertiary Education and Management, 20, 1. http://dx.doi.org/10.1080/13583883.2013.848924
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File, J., de Weert, E., Vossensteyn, H., Kaiser, F., Jongbloed, B., Goedegebuure, L., . . . Cremonini, L. (2013). *Policy Challenges for the Portuguese Polytechnic Sector: A report for the Portuguese Polytechnics Coordinating Council (CCISP)*. Retrieved from Enschede:
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5. Organizational or institutional change/improvement

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6. Finance of education

6.1. University/student funding

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Boer, Harry de, Jongbloed, Ben; Benneworth, Paul; Cremonini, Leon; Kolster, Renze, Kottmann, Andrea, Lemmens-Krug, Katharina, Vossensteyn, Hans (2015): Performance based funding and performance agreements in 14 higher education systems. CHEPS.
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Appendix J. Funding portfolio results

Table J portrays BMS funding for learning research in the last 5 years. It includes all kinds of funding (e.g. also co-funding, in-cash funding, etc.).

Because 100% accuracy would have required resources beyond the scope of this project, this information should be regarded as indicative, but not comprehensive. This list is less likely to contain inaccuracies, and more likely to contain omissions. As a result, it offers a conservative indication. Grant-specific specifications are available upon request.

Table J. Conservative indication of BMS learning research funding in the last 5 years

Source	**Grants**	**Total amount**
4TU	1	10.000.000
Companies	4	1.135.100
Cito	1	400.000
Center for Engineering Education	1	50.000
Chilean Government	1	100.000
Dudoc	2	412.000
EAPRIL	1	+1
Erasmus et al: Education, AV & Culture Exchange Agency	2	82.000+1
European Committee	1	500.000
EU	2	110.000+1
eX:plain	1	20.000
IEA	2	40.000+1
Law School Admission Council	1	180.000
SLO	1	+1
NWO-PROO(-Excellence)	1	200.000
NWO-BOPO	1	195.219
NWO	3	718.707+1
NWO/NRO (+CA-ICT, ECDL, ECP-EPN)	6	504.000+5
NRO	9	1.941.000+3
RAAK	1	+1
KennisNet (&Snappet)	9	386.000+4
Tech4People	3	256.300
TechYourFuture	6	754.865+1
OCW	9	10.374.000+1
Dutch School Inspectorate (&Snappet)	2	450.000
Ministry of Education	6	749.320+2
School aan Zet	1	38.732
Oxford University	1	13.531
Saxion	4	26.754
UT	5	272.825+1
Universidad Catolica del Uruguay	1	100.000
Kennisinstellingen	1	4.800
Unknown	9	2.527.035+4
Totals	**99**	**32.542.035+28**

+x = also x grants with unknown amounts.
Sources (in parentheses) = Co-funders whose amounts could not be separated, and are true for only one time.

Appendix K. Request for proposal analyses

Requests for proposals (RfP) inspiration

List of current calls (2018) related to the theme of learning

Deadline	Who	Substansive	Conditional	Link
Continuous application	NWO >NRO	*Kennisbenutting Plus* Kennisbenutting Plus is a grant for activities that stimulate the utilization of educational research.	A budget of € 100.000 is available.	https://www.nwo.nl/en/funding/our-funding-instruments/nro/kennisbenutting-plus/kennisbenutting-plus.html
Continuous application	NWO > KIEM	*Creative industry - Knowledge Innovation Mapping (KIEM).* The Creative industry - KIEM programme aims to encourage and facilitate public-private partnerships in the domain of the Creative industries. Senior researchers can apply for funding via KIEM on behalf of consortia of companies and researchers.	Budget Total of 1 million euros, to bes pent on: Replacement costs for (co-) applicant time to cover the cost of teaching and other tasks (max. 15.000 euros); Material costs for the research project	https://www.nwo.nl/en/funding/our-funding-instruments/gw/creative-industry/creative-industry---knowledge-innovation-mapping-kiem/creative-industry---knowledge-innovation-mapping-kiem.html
10 January, 10 April and 10 September 2018	TechYourFuture	TechYourFuture encourages and initiates research and activities aimed at systematizing knowledge about good technology education. To this end, TechYourFuture offers the entire educational column, companies, government and researchers the opportunity to create meaningful technical education in close cooperation, to train professionals, to connect theory and practice and to make all knowledge available in an open source. Every research carried out under the banner of TechYourFuture has a demonstrable connection with the mission and the objectives of TechYourFuture; choose technology, learn in technology, work in technology. Moreover, this research is aimed at connecting existing parties and initiatives in education and the labour market.	There must be a demonstrably relevant educational issue, initiated by a consortium of at least three different partners (from education, research, business or government) that is in line with TechYourFuture's objectives. In order to prove the need and importance from the business community and the education sector, these partners must contribute co-financing of at least 50% of the total costs. This co-financing can consist of an in-	http://www.techyourfuture.nl/onderzoek-aanvragen

			cash and / or an in-kind contribution. Budget: unknown	
17 January 2018	EU > Marie Curie > Innovative Training Networks	*Innovative Training Networks* ITN supports competitively selected joint research training and/or doctoral programmes, implemented by partnerships of universities, research institutions, research infrastructures, businesses, SMEs, and other socio-economic actors from different countries across Europe and beyond.	Budget: 375,000,000 euro	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/msca-itn-2018.html
11 januari 2018	NWO > NRO	*Samenhangende onderzoeksprojecten* With the financing instruments cohesive research projects, the NRO aims to enable depth and cohesion in educational research. Within the NRO, research is being done for policy and practice within Dutch Education.	Budget: 600.000 euro, for a maximum of 5 years. The grant is meant for proposals for cohesive research projects with a larger scope, where multiple researchers collaborate.	https://www.nwo.nl/financiering/onze-financieringsinstrumenten/nro/samenhangende-onderzoeksprojecten/samenhangende-onderzoeksprojecten.html
February 1st, 2018	EC > EACEA > Erasmus+	*Erasmus+ programmas* Zenden en ontvangen van studenten en staff voor studies/traineeships/onderwijs/training	Max. 1 applicatie per HEI, valid ECHE required, use existing PIC, declaration of honour signed by LR, application for incoming + outgoing mobility, duration 16 or 26 months	www.erasmusplus.nl
February 1st, 2018	EC > EACEA > Erasmus+	*Strategic partnerships in the field of youth* The call support the development, transfer and implementation of innovative practices as well as the implementation of joint initiatives promoting cooperation, peer learning and exchanges of experience at European level. Projects may support innovation or exchange of good practices. Partnerships must address at least one horizontal priority or at least one specific priority relevant to the field of youth that is mostly impacted.	Proposals must include at least two organisations from at least two programme countries. Grants are each worth €12,500 per month for six to 36 months, up to a maximum of €450,000.	https://www.researchprofessional.com/funding/opportunity/1395925/
February 5h, 2018	NIH: National Cancer Institute, US and other funders	*Education and health: new frontiers (R01 clinical trial optional)* This supports research that will further elucidate the pathways involved in the relationship between education and health outcomes and to carefully identify the specific aspects and qualities of education that are responsible for this relationship, and what the mediating factors are that affect the nature of the casual relationship.	Application budgets are not limited but need to reflect the actual needs of the proposed project. The maximum project period is five years.	https://grants.nih.gov/grants/guide/pa-files/PAR-18-387.html

February 20th, 2018 (Forecast)	Department for International Development, GB > SPHEIR	*Open call for partnerships, under the strategic partnerships for higher education innovation and reform programme.* This aims to catalyse innovative partnerships in low-income countries that can transform the quality, relevance, access and affordability of higher education.	Partnerships must target or involve activities located in specific countries. Up to 10 partnerships may be funded. Grants are worth between £1 million and £5m each. Projects must last at least two years and may start between April and June 2017.	http://www.spheir.org.uk/apply/call-for-proposals
February 28th, 2018	EC > EACEA > Erasmus+	*Knowledge alliances* This aims to strengthen Europe's innovation capacity and foster innovation in higher education, business and the broader socio-economic environment. Proposals must intend to achieve at least one of the following goals: •develop new, innovative and multidisciplinary approaches to teaching and learning; •stimulate entrepreneurship and entrepreneurial skills of higher education teaching staff and enterprise staff; •facilitate the exchange, flow and co-creation of knowledge.	Funding is worth up to €700,000 for two-year alliances and up to €1 million for three-year alliances. Proposals must involve a minimum of six independent organisations from at least three programme countries, out of which at least two must be HEIs and two must be enterprises.	http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2017.361.01.0032.01.ENG&toc=OJ:C:2017:361:TOC
March 2018	Porticus > Onderwijs	*Porticus: Education theme* Porticus supports charitable projects, which promote respect for human dignity and social justice. All partners of Porticus are active in the areas of education, society, belief and/or (medical) care.	A couple of 100€ up to big amounts	Mail: porticusNL@porticus.com https://nl.porticus.com/nl/onderwijs
March 6th, 2018	NWO > SGW NWO > ZonMw	*Replication studies* This encourages replication research that provides insights into effective ways of including such research in programmes and helps evaluate NWO requirements related to methodology and transparency.	The total budget is €1 million. Type 1 grants are worth up to €75,000 and type 2 grants up to €150,000 over two years. Funding may be used to cover personnel and material costs. Applicants must be independent of initial researcher, hold a PhD and are employed for the duration of the project at one of the Dutch knowledge institutions	https://www.researchprofessional.com/funding/opportunity/1779290/ https://www.nwo.nl/en/funding/our-funding-instruments/sgw/replication-studies/replication-studies.html

			specified in the calls for proposals.	
March 6th, 2018	NWO > SGW NWO > ZonMw	*Space outreach and education* Make young people interested in space-related careers, educate them to become space scientists or engineers and facilitate and encourage lifelong learning.	1 million €, other amounts possible	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/dt-space-08-biz-2018.html
March 13th, 2018	NWO > SGW NWO > ZonMw	*Mapping and overcoming integration challenges for migrant children* Integration of migrant children in schools while contributing to the research agenda of education.	3 million €, other amounts possible	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/migration-05-2018-2020.html
2018: March 13th, 2018 **2019: March 14th, 2019**	EU > H2020	*DT-Transformations-07-2019* *The impact of technological transformations on children and youth* Explanatory models will inform relevant stakeholders and practitioners on the long-term effects of ICT on child development and on practices that maximise risks (risk factors), minimise risks (resilience factors) and maximise benefits (enhancing factors).	Max. 3 million € 2018 total 48,5 million € 2019 total 55,4 million € 2020 total 23 million €	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/dt-transformations-07-2019.html
March 15th, 2018 **October 18th, 2018** **March 13th, 2018** **October 19th, 2019**	NWO > SGW NWO > ZonMw	*Peer learning of innovation agencies* Learning activities have to be based on clear methodologies and they have to be demand driven, launched at the moment agencies themselves recognise the need to revise programme formats. Furthermore, peer learning activities need to benefit from a secretariat or an animation structure that assures horizontal flow of information among interested agencies.	Fixed lump sum 15.000€/50.000€	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/innosup-05-2018-2020.html
March 31st, 2018 (Forecast)	EC > EACEA > Erasmus+	*Erasmus charter for higher education* The award is a prerequisite for higher education institutes to apply and participate in learning mobility of individuals or cooperation for innovation and good practices under the programme. Higher education institutes established in one of the following countries may apply: EU member states, EFTA-EEA countries, the former Yugoslav Republic of Macedonia and Turkey. The charter is awarded for the full duration of the programme.	Directed grants to institutions, research groups etc; Networking/collaboration	http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2017.033.01.0004.01.ENG&toc=OJ:C:2017:033:TOC

March 31st	DUO Bèta-techniek	*Technieknetwerken 2017-2020 (technical networks)* Publication Subsidie. Financial aid for expansion and sustainability of activities.	Available € 2.588.000 for 2018 and € 2.065.000 for 2019 Qualified are the existing networks and 7 new ones.	https://www.dus-i.nl/subsidies/beta-technieknetwerken
April 15th onwards Deadline unknown	EP-Nuffic	*Subsidy scheme for internationalization po (passend onderwijs, suitable education) and vo (voortgezet onderwijs, secondary education)* Support/introduction/development of internationalization (of education concepts) + mobility of students and teachers across borders. 2017-2020	2017-2018: 1.710.000€ available, other schoolyears 832.000 Max. amount is 25.000 € No combination with Erasmus+ possible The foreign institution may not have Dutch as instruction language (besides schools in Flanders) and this institution may not be commercial	https://www.rijksoverheid.nl/documenten/beleidsnota-s/2017/03/24/subsidieregeling-internationalisering-po-en-vo
April 2nd, 2019	EU > H2020	*Research innovation needs & skills training in PhD programmes* Development of skills-related training, integration and intelligence for researchers and scientists in all career stages	0,75-1 million €, other amounts possible	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/swafs-08-2019.html
April 10th, 2018	EU > H2020	*H2020-SwafS-2018 science with and for society* Science with and for society will help citizens, organisations and territories to open a new chapter of their development through joint research and innovation activities in five strategic orientations.	Min. 1.000.000 € Max. 1.500.000 € Total budget 9.000.000 €	https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-swafs-2018-2020.html#c,topics=callIdentifier/t/H2020-SwafS-2018-2020/1/1/1/default-group&callStatus/t/Forthcoming/1/1/0/default-group&callStatus/t/Open/1/1/0/default-group&callStatus/t/Closed/1/1/0/default-group&+identifier/desc
April 10th, 2018	EU > H2020	*Exploring and supporting citizen science.* Call for research regarding citizen science; What relationship can and does citizen science have to informal and formal science education? Are there limits to citizen science, and if so what are they?	Budget: € 6,000,000	https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/swafs-15-2018-2019.html
April 10th, 2018	EU > H2020	*Open schooling and collaboration on science education*	Budget: € 3,000,000	https://ec.europa.eu/research/participants/portal/desktop/en/oppor

		The proposed action targets the creation of new partnerships in local communities to foster improved science education for all citizens. This action aims to support a range of activities based on collaboration between formal, non-formal and informal science education providers, enterprises and civil society in order to integrate the concept of open schooling, including all educational levels, in science education.		tunities/h2020/topics/swafs-01-2018-2019.html
April 10th, 2018	EU > H2020	*Innovative methods for teaching ethics and research integrity* On the basis of existing successful educational practices, the action will develop and test innovative educational student-centred methods (formal and informal) aiming to promote a culture of research integrity and raise awareness of students and early career researchers.	Budget: € 2,500,000	https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/swafs-02-2018.html
April 10th, 2018	EU > H2020	*SwafS-20-2018-2019 Building the SwafS knowledge base* Understanding the evolution of science and society will help proactive and anticipatory policy making. This includes examining how societal actors, including young people, behave, understand, react to and interact with science and scientific developments, and their motives for engaging in science-related activities. The present topic is completely bottom-up. Research and innovation actions are invited, using the above specific challenge to help stimulate ideas about where research is most needed.	Budget: € 6,000,000	https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/swafs-20-2018-2019.html
May 1st, 2018 (forecast)	European Association for International Education, EUR	*Constance Meldrum award for vision and leadership* Recognition of inspiring leaders who have made a contribution to demonstrating and developing vision and leadership in the field of international higher education.	1.000€ Nominees should have been active in the field for at least 10 years and should have been involved with the EAIE and its activities, but are not required to be members.	https://www.eaie.org/community/awards/vision-leadership.html
May 11th, 2018	Directorate-General for Education, Youth, Sport and Culture, EU	*Framework partnership agreement with a European policy network in the field of the key competences* The call aims to support an EU-wide network of relevant organisations to promote co-operation and the development and implementation in the field of key competences, including the improvement of basic skills. The network will be expected to strengthen cross-European cooperation between public authorities and associations stakeholders and practitioners, higher education institutions, research bodies, foundations and other organisations on the promotion of competence-oriented education.	Max. 300.000 € Co-funding rate up to 75% Grant may be used to cover salaries, administrative costs, travel, equipment, consumables as well as dissemination and translations. The network must have partners that are legal entities established in at least 15 different Erasmus+ programme countries.	http://ec.europa.eu/education/calls/framework-partnership-agreement-european-policy-network-field-key-competences_en

May 11th, 2018	Directorate-General for Education, Youth, Sport and Culture, EU	*Framework partnership agreement with a European policy network on teachers and school leaders* This call supports a Europe-wide network of relevant organisations to promote cooperation, the development and implementation of policy at different governance levels as well as supporting the European Commission's policy work on teachers and school leaders.	The total budget is worth €300,000. The grant may be used to cover salaries, administrative costs, travel, equipment, consumables as well as dissemination and translations. The network must have partners that are legal entities established in least 15 different Erasmus+ programme countries.	https://ec.europa.eu/education/calls/framework-partnership-agreement-european-policy-network-teachers-and-school-leaders_en
May 17th, 2018	EC > EACEA > Erasmus+	*2018 Erasmus+ Vocational Education and Training Mobility Charter* Through this call, the European Commission aims to consolidate strategic approaches and quality in mobility in VET. The aim of the Erasmus+ VET Mobility Charter is to help organisations with good track records of organising VET mobility for learners and staff to further develop their international strategies.	Unknown	http://ec.europa.eu/programmes/erasmus-plus/calls/2017-eac-a06-vet-mobility-charter_en
June 1st, 2018 (forecast)	Foundation for Education Fund > COCMA Stichting Onderwijsfonds , NL	*COCMA education prize* Recognition of persons who have made a significant contribution or made an outstanding achievement *to part-time higher education in the Netherlands*	Prize worth up to 5.000€ Nomination by 2 persons who are unrelated to the nominee	https://www.researchprofessional.com/funding/opportunity/1044004/
June 22nd, 2018 (forecast)	US Department of Education (ED) > US Institute of Education Sciences	*Special education research grants CFDA 84.324A* Advancing the understanding of and practices for teaching, learning and organizing education systems for infants, toddlers, children and youth with disabilities.	Max. between 600.000 and 3,8 million USD Max. period of 5 years	https://ies.ed.gov/funding/18rfas.asp
June 22nd, 2018 (forecast)	US Department of Education (ED) > US Institute of Education Sciences	*Education research grants CFDA 84.305A* Advancements of understanding and practices for teaching, learning and organizing education systems. The purpose is to improve education outcomes for all students, particularly those at risk of failure. All levels of students (prekindergarten through postsecondary and adult education).	Max. between 600.000 and 3,8 million USD US and foreign organisations may apply.	https://ies.ed.gov/funding/18rfas.asp
June 30th, 2018 (forecast)	International English Language Testing System > IDP Education Australia; The British Council	*Research grants* Current concerns and issues (development and validation, issues relating to context of use and issues of impact) of the IELTS test of English language in international context	Max. 70.000 AUD or 45.000 £ over one or two years	https://www.ielts.org/teaching-and-research/research-proposals
July 15th, 2018 (forecast)	IEEE foundation	*IEEE Foundations grants program* Promote public understanding about how science and technology are being or could be used to address global challenges, including energy,	Between 5.000 USD and 100.000 USD for projects lasting no longer than 12 months	https://www.researchprofessional.com/funding/opportunity/247103/

		cybersecurity, security, health care and sustainability. The theme should align with IEEE mission to enhance technology access, literacy and education.	IEEE organizational units only	https://www.ieeefoundation.org/Grants
July 31st, 2018	EC > EACEA > Erasmus+	*KA107 Mobility with partner countries* The Erasmus+ Programme promotes the mobility of students and teachers. The action Erasmus+ KA107 of this program provides funding for exchange mobility with partner countries.	The grant consists of a travel allowance and a monthly amount according to the flat rates stated by the Erasmus+ Programme: Daily amount: 800€ / month	http://www.uab.cat/web/international-exchange/incoming-exchange-students/erasmus-plus-ka107-partner-countries-1345698504390.html
September 5th, 2018 (forecast)	NWO	*Open Mind* Verassende onderzoek ideeën die kunnen leiden tot duidelijke maatschappelijke toepassing. De nadruk ligt op nieuwe ideeën die nog niet eerder zijn uitgevoerd binnen de huidige onderzoekslijnen van de indieners.	Max. 50.000 €	http://www.stw.nl/nl/content/open-mind-2017
September 5th, 2018 (Forecast)	NWO > Free competition (humanities)	*Free competition in the humanities* This call supports curiosity-driven research that does not fall under the thematic funding programmes. Projects must consist of at least two sub-projects to be funded by NWO that seek answers to one central research question.	Grants are worth between €500,000 and €750,000 each and will cover both personnel and material costs. The maximum funding period for the entire programme is six years.	https://www.nwo.nl/en/funding/our-funding-instruments/nwo/free-competition/gw/free-competition.html
September 6th, 2018	EU > H2020	*Research, innovation and educational capacities for energy transition* The energy sector is evolving rapidly creating new job opportunities while requiring new skills and expertise to be developed. The challenges are significant. Over the coming years, the growing low-carbon energy sector requires many employees to be educated, trained or re-skilled.	Budget: € 4,000,000	https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/lc-sc3-cc-5-2018.html
September 15th, 2018 (Forecast)	OCW > RVO	*COMING SOON: Practice-based learning grants* The Netherlands Enterprise Agency (RVO) and the Ministry of Education, Culture and Science invite applications for their practice-based learning grants. These enable organisations to offer work experience placements for students.	The total available budget until 2019 is €196.5 million. Grants are worth up to €2,700 per practice-based workplace and may be used for the supervision of students.	https://www.rvo.nl/subsidies-regelingen/subsidieregeling-praktijkleren
September 15th, 2018 (Forecast)	OCLC/ALISE > Science Research Grant Program	*Library and information science research grants* Research related to the following areas is encouraged: •impact of digital technology on libraries, museums and archives; •social media, learning, and information-seeking behaviour; •new developments in knowledge organisation.	Grants are worth up to USD 25,000 each for one year.	http://www.oclc.org/research/grants.html

September 27th , 2018	NWO > SGW NWO > ZonMw	*Availability and use of research infrastructures for education, training and competence building* Enhance collaboration between international nuclear research and training facilities	1-2 million €, other amounts possible	http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/nfrp-2018-7.html
December 14th, 2018	NWO > NRO	*Peil.onderwijs Rekenen-Wiskunde einde (speciaal) basisonderwijs* Voor deze subsidieronde kunnen aanvragen worden ingediend voor het uitvoeren van peilingsonderzoek naar de stand van zaken met betrekking tot de vaardigheid rekenen-wiskunde van leerlingen in groep 8 van het basisonderwijs en schoolverlaters in het speciaal basisonderwijs, mede in relatie tot de resultaten op de vorige peilingen. Daarnaast dient het peilingsonderzoek zicht te geven op het onderwijsleerproces op het gebied van rekenen-wiskunde.	Budget: 310.000 euro. Dit budget geldt als richtlijn en absoluut maximum. Financiering kan worden aangevraagd ter dekking van zowel de direct aan het onderzoek verbonden personele als materiële kosten. Een bijzonder aandachtspunt voor het peilingsonderzoek is, dat de afname deels zal worden gecombineerd met TIMSS 2019.	https://www.nwo.nl/financiering/onze-financieringsinstrumenten/nro/peil.onderwijs-rekenen-wiskunde-einde-speciaal-basisonderwijs/peil.onderwijs-rekenen-wiskunde-einde-speciaal-basisonderwijs.html
Unknown	EU > H2020	*COMING SOON: Educational innovation around nature-based solutions* The tenderer will develop innovative educational programmes and materials to raise awareness on nature-based solutions and their social, economic and environmental benefits among children, young people and their families in an interdisciplinary, problem-based learning approach. This should combine the use of ICT, audio-visual productions and social media with real life experiences with local NBS.	The total indicative budget is worth €500,000.	https://ec.europa.eu/programmes/horizon2020/en/h2020-section/climate-action-environment-resource-efficiency-and-raw-materials

Appendix L. BMS Learning Workshops Agendas

6-12: Scoping pre-proposals

8:30-9:00	*Arrival, coffee*
9:00-9:45	Welcome, goals, introductions
9:45-10:30	Explore broad themes
10:30-11:00	Choose a point of departure
11:00-12:30	Generate and refine a problem statement
12:30-13:30	*Lunch*
13:30-15:30	Generate the skeleton of a project
15:30-16:00	Coffee and stickers on project posters
16:00-16:45	1 min poster pitches and rapid-fire expert panel feedback
16:45-17:00	Next steps
17:00	*Cocktails*

7-12: External stakeholders' perspectives and pre-proposal refinement

9:30-10:00	*Welcome, coffee*
10:00-11:00	External guests comment on what the broad themes mean for them
11:00-12:30	Guests think along on project development
12:30-13:30	*Lunch*
13:30-15:00	Draft pre-proposal
15:00-15:45	Share and support
15:45-16:00	Next steps
16:00	*Cocktails*

BMS Learning Researchers Distribution per Cluster & Department
Grey cells indicated workshop attendance December 6 & 7

Learning researchers from	6	7
TPS: Technology, Policy & Society		
CHEPS		
CHEPS		
CHEPS		
CHEPS		
CHEPS		
CHEPS		
CHEPS		
HTSR		
PHIL		
PHIL		
STEPS		
STEPS		
STEPS		
HIB: Technology, Human & Institutional Behavior		
CS		
CS		
CS		
CS		
CS		
CS		
PA		
PA		
HBE: High-tech Business & Entrepreneurship		
CMOB		
HRM		
IEBIS		
NIKOS		
NIKOS		
NIKOS		

BMS learning researcher	6	7
DDS: Technology, Data-analytics and Decision-support Systems		
CPE		
CPE		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
ELAN		
IST		
IST		
IST		
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OMD		
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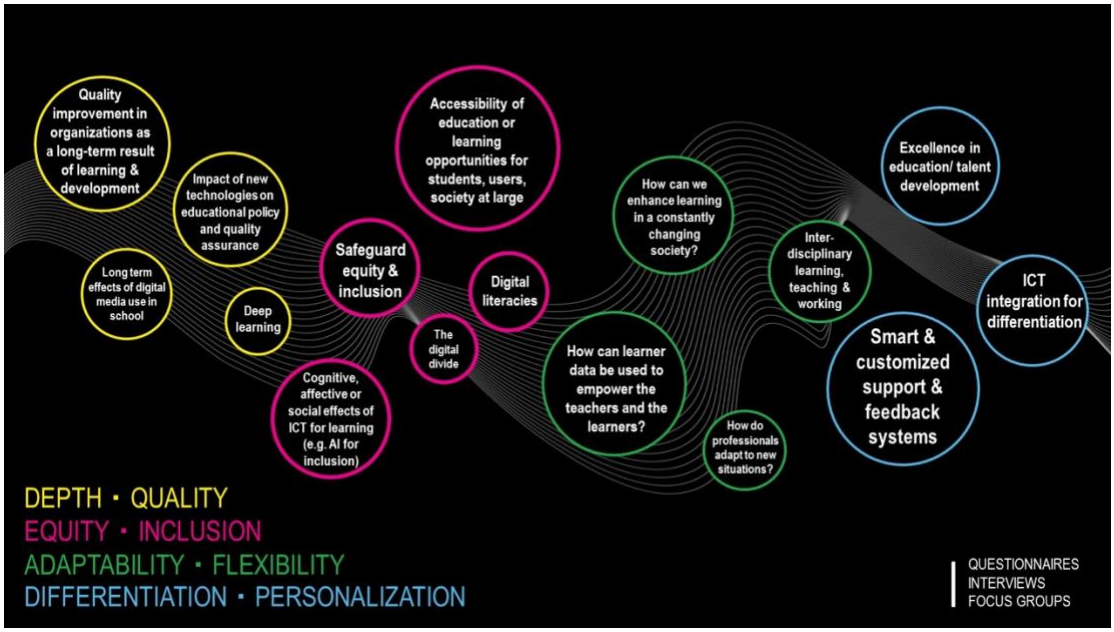
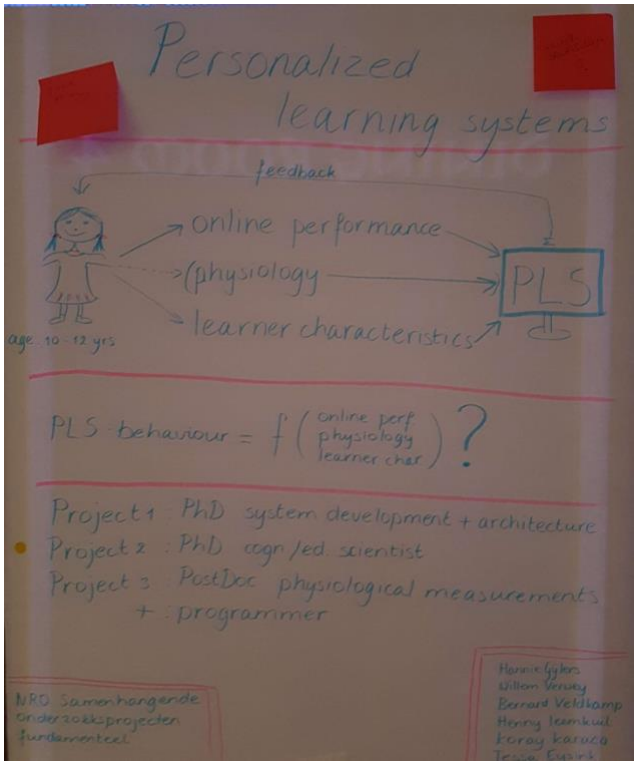
OWK		
OWK		
OWK		
OWK		

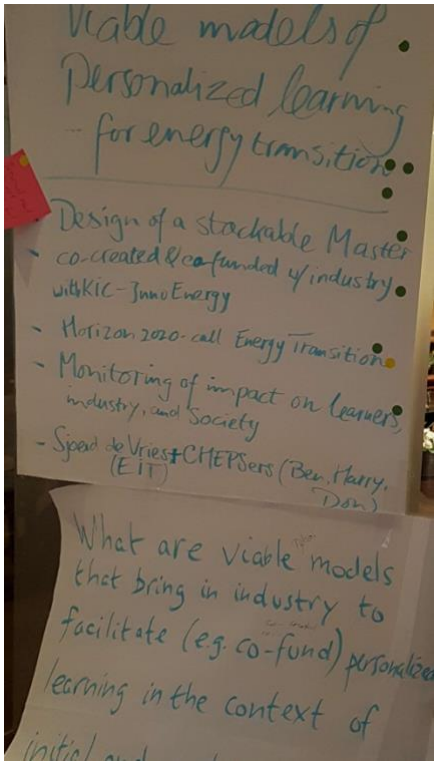
Appendix M. Workshop posters (photos)

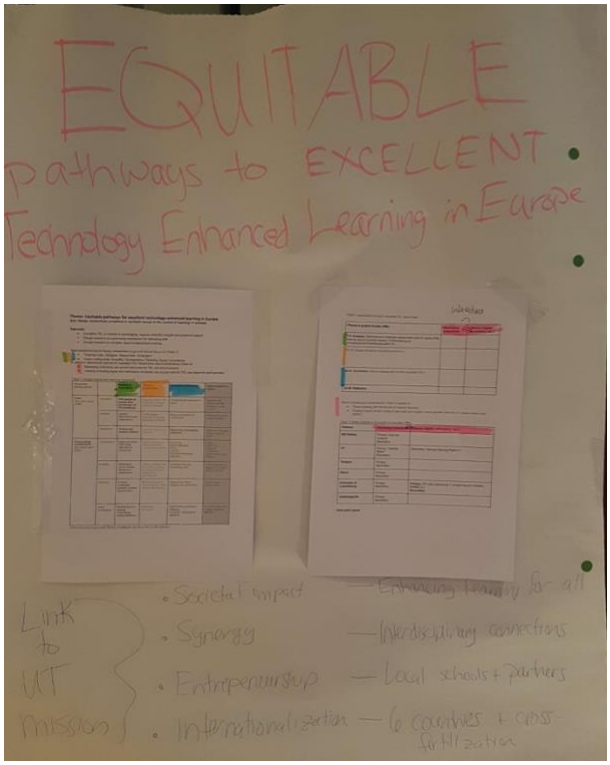
1. Themes poster

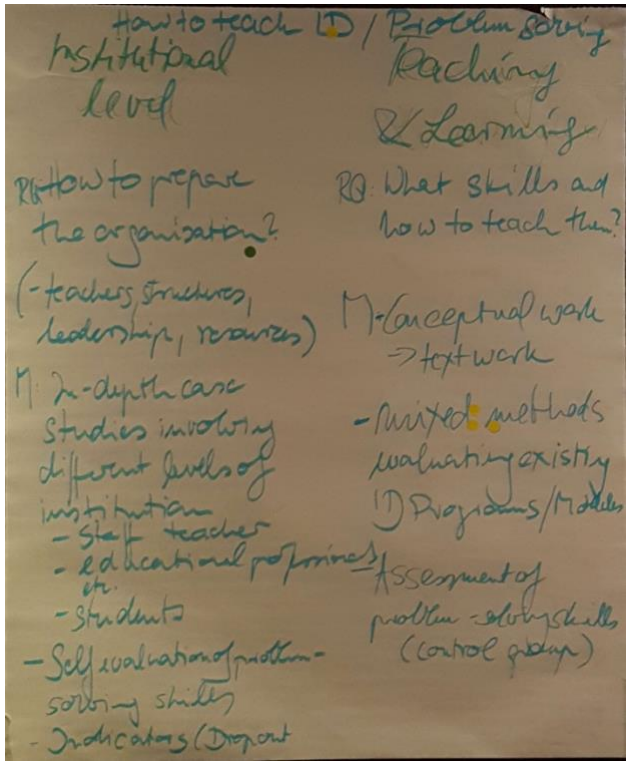


2. Problem statement posters






EQUITABLE
pathways to EXCELLENT
Technology Enhanced Learning in Europe
Link to UT mission
• Societal Impact — Enhancing learning for all
• Synergy — Interdisciplinary connections
• Entrepreneurship — Local schools + partners
• Internationalization — 6 countries + ODSS-fication


how to teach
institutional level
RQ: how to prepare the organization?
(- teachers, structures, leadership, resources)
M: in-depth case studies involving different levels of institution
- staff teacher
- educational performers etc.
- students
- Self evaluation of problem-solving skills
- Indicators (Dropout
ID / Problem Solving
Teaching & Learning
RQ: What skills and how to teach them?
M: Conceptual work → text work
- mixed methods evaluating existing ID Programs/Models
Assessment of problem-solving skills (control group)

3. Request for Proposal (RfP) posters

NWO

FREE COMPETITION (HUMANITIES)

Deadline: 9 January 2018 14:00

SUBSTANSIVE

Background

Within the Free Competition Humanities, researchers can apply for funding for curiosity-driven research that does not fall under the thematic funding programmes. Researchers are therefore free to choose the subject of their project, as long as it fits within the humanities.

For what

Each year a single evaluation round will take place for the Free Competition (humanities) and the submission of a preproposal is a compulsory part of this. The project must consist of at least two sub-projects to be funded by NWO that seek answers to one central research question. The final product of the project (for example a book, congress or series of articles) has to provide clear added value compared to the individual sub-projects.

Criteria

The selection committee will assess proposals for:

- Scientific quality (including objective, methodology and research team)
- Programmatic criteria (added value, coherency, organisation)
- Knowledge utilisation

Any investment costs should justify how these will help answer the research questions, and the contribution made to strengthening the national knowledge infrastructure

Procedure

Preproposals: The selection committee assesses all the preproposals on the basis of the three criteria, without using external referees. The committee will prioritize the preproposals and will determine the expected quality.

Full *proposals*: External experts will advise on each proposal, and applicants may respond to the experts' reports. The selection committee can invite applicants for an interview, and will use a point scale in its assessment. The NWO Social Sciences and Humanities Domain Board will take the final granting decision based on the selection committee's advice.

CONDITIONS

Senior researchers with a tenured or temporary appointment at an institution recognised by NWO can submit a proposal.

The grant is intended for the funding of:

postdoc and PhD research

the release of applicants from educational and other duties so that they can jointly work on final products within the project (maximum 50,000 euros in total)

material costs incurred for the project

investment costs in personnel and materials incurred within the framework of the project (for example, the purchase and construction of databases, digital corpora, tools, resources such as hardware, software and equipment)

Per proposal a minimum of 500,0000 euros and a maximum of 750,000 euros can be applied for. The maximum funding period is six years for the entire project.

Link: https://www.nwo.nl/en/funding/our-funding-instruments/nwo/free-competition/gw/free-competition.html

NWO > NRO

SAMENHANGENDE ONDERZOEKSPROJECTEN

Deadline: 11 January 2018 14:00

SUBSTANSIVE

Background

With the financing instruments cohesive research projects, the NRO aims to enable depth and cohesion in educational research. Within the NRO, research is being done for policy and practice within Dutch Educational.

You can only submit applications for topics and issues within the seven chapters of the NRO Research Program 2016-2019:

- Educational courses and curriculum
- Education and technology
- The socializing function of education
- Professionalisation of education professionals
- Education and life course
- The education system and management of and in education
- Educational innovation and the role of research

Criteria

- Scientific quality
- Scientific meaning
- Past performance en trackrecord
- Progammatic meaning

Procedure

The assessment procedure consists of two phases:

• The assessment of the preproposals (phase 1)

• The assessment of the detailed proposals (phase 2)

A broadly composed committee assesses the applications and advises the Program Council for fundamental educational research at the NRO. The most promising candidates will receive an invitation in mid-April 2018 to submit a full proposal. The less promising candidates are advised not to write a detailed application.

CONDITIONS

You can apply for a grant for cohesive research projects with a maximum duration of five years and up to a maximum of 600,000 euros.

This funding is intended for applications for coherent research projects of a larger size in which several researchers work together.

You can only submit a preliminary application if you are a PhD researcher with a permanent appointment at a Dutch (para) university institution.

Pay attention! Main or co-applicants whose applications have been honoured in the 2016-2017 Cohesion Research Projects subsidy cannot submit an application in the current funding round Cohesive research projects 2018.

Pay attention! The funding rounds for Cohesive Research Projects 2018 (PROO) and Policy-oriented Educational Research 2018 (ProBO) take place simultaneously. It is not allowed to submit an

Link: https://www.nwo.nl/financiering/onze-financieringsinstrumenten/nro/samenhangende-onderzoeksprojecten/samenhangende-onderzoeksprojecten.html

NWO > NRO

KENNISBENUTTING PLUS

Deadline: Continuous application

SUBSTANSIVE

Background

Have you just completed an NRO project or are you still in progress? And do you have a good idea to make the outcomes of that project (further) suitable and usable for application in educational practice or in education policy? Then the NRO subsidy 'Knowledge utilization plus' might be something for you.

Knowledge utilization Plus stimulates implementers of NRO projects to maximize the use and dissemination of knowledge, insights and results from their projects. In addition, the grant aims to involve users in the use of scientific educational research. With users we mean all target groups in and around education that benefit from applying results from educational research.

Knowledge utilization Plus thus contributes to the mission of the NRO: to strengthen the connection between scientific research on education and the practice of education, to come to innovation and improvement of education.

Criteria

When assessing the application, the NRO uses the following criteria:'

- Potential of the product
- Project approach
- Team
- Accountability

Procedure

The application is submitted via Isaac, the electronic application system from NWO. The main applicant submits the application with his own Isaac account and uses the application form NRO Knowledge utilization Plus.

The application is assessed by an external advisor and the NRO agency. The advisor is appointed on the basis of his or her expertise in the field of application.

CONDITIONS

The budget for NRO Knowledge utilization Plus is € 100,000 per year.

Funding can be requested to cover the material costs for development of the product. All costs must be substantiated.

Applications for NRO Kennisbenutting Plus are submitted by the main applicant for a current or just completed NRO project, together with one or more partners from practice or policy. This can be a partner from the existing research consortium, but it can also be a new partner. This partner is the future user of the product and contributes to the development, distribution and commissioning of the product. The partner is also a co-financer.

Together the main applicant and the partner(s) develop products or activities. Examples are: public expenditure, manuals, teaching material, tests, apps, websites, checklists, symposiums, workshops and training courses. The funding can also be requested for further development and dissemination of products that have already been developed during the research project.

Link: https://www.nwo.nl/en/funding/our-funding-instruments/nro/kennisbenutting-plus/kennisbenutting-plus.html

EC > HORIZON 2020

SCIENCE WITH AND FOR SOCIETY

Deadline: 10 April 2018 17:00

SUBSTANSIVE

Background

Science with and for society will help citizens, organisations and territories to open a new chapter of their development through joint research and innovation activities in five strategic orientations. It will contribute to the implementation of Responsible Research and Innovation through institutional governance changes in Research Performing (RPOs) and Funding Organisations (RFOs), focusing on developing new partnerships and involving researchers, policy makers, citizens and industry. It will step up support for gender equality in R&I policy by promoting institutional changes and focusing on key areas of research to advance gender equality. It will explore and support citizen science in a broad sense, encouraging citizens and other stakeholders to participate in all stages of R&I. Finally, it will build the knowledge base for SwafS through a combinati on of totally bottom-up and open topics and targeted topics including two looking for the first time at science communication and due and proportionate precaution.

Specific calls

1. Accelerating and catalysing processes of institutional change
   a. Open schooling and collaboration on science education
   b. innovative methods for teaching ethics and research integrity
   c. Science4Refugees
   d. Research innovation needs & skills training in PhD programmes
2: Exploring and supporting citizen science
3. Building the knowledge base for SwafS

Criteria

Results should contribute to the implementation of ERA priorities, a greater involvement of all stakeholders in R&I, and a better and more sustainable engagement with society. Moreover, the backdrop of deep and profound implications on science as a discipline, a profession and as a practice, and also on science's relationship with and for society, should also be considered.

CONDITIONS

Depending on the specific call, the budget ranges from 1,000,000 – 6,000,000 euros.

1a. € 3,000,000

1b. € 2,500,000

1c. € 1,000,000

1d. 0,75-1 million €, other amounts possible

2. € 6,000,000

3. € 6,000,000

Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Developing new partnerships will be a priority.

Open access must be granted to all scientific publications

Link:https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-swafs-2018-2020.html#c,topics=callIdentifier/t/H2020-SwafS-2018-2020/1/1/1/default-group&callStatus/t/Forthcoming/1/1/0/default-group&callStatus/t/Open/1/1/0/default-group&callStatus/t/Closed/1/1/0/default-group&+identifier/desc

EC > Directorate-General for Education, Youth, Sport and Culture

FRAMEWORK PARTNERSHIP AGREEMENT WITH A EUROPEAN POLICY NETWORK ON TEACHERS AND SCHOOL LEADERS

Deadline: 11 May 18

SUBSTANSIVE

Background

The call aims to support a Europe-wide network of relevant organisations to promote co-operation and the development and implementation of policies with regard to teachers and school leaders. The network will be expected to strengthen cross-European co-operation between public authorities and associations of stakeholders and practitioners, higher education institutions, research bodies, foundations and other organisations on policies in pursuit of quality and professionalism in the teaching professions, including teachers and school leaders.

Teachers and school leaders are central to learners' success and to the quality and equity of school education. This is reflected in growing expectations towards their roles and performance. Setting high quality standards for the teaching professions and supporting the professionalisation of the workforce therefore receive much political attention across Europe. EU Education Ministers have underlined the importance of effective school leadership and support to teachers' professional development and competences, and have outlined political priorities in this field. The network will be expected to facilitate dialogue and co-operation among experts from policy, research and practice and to promote and support evidence-informed policy-making and continuous collaboration both among partners and with other relevant stakeholders at international, European, national, regional and local levels.

Expected scope

The network will be expected to represent a broad geographic scope and a balance of different education systems, as well as a variety of backgrounds of participating institutions and associations, from policy, practice and research. Focus is on policies relating to teachers and school leaders working in the field of general education of children and young people (0-18 years).

A webinar will be organised on 16 January 2018 at 14.30-15.45 CET to clarify possible general questions.

CONDITIONS

The Commission intends to support the network through a four-year framework partnership agreement, which will set out the conditions governing annual grants for an action.

The network must have partners that are legal entities established in least 15 different Erasmus+ programme countries.

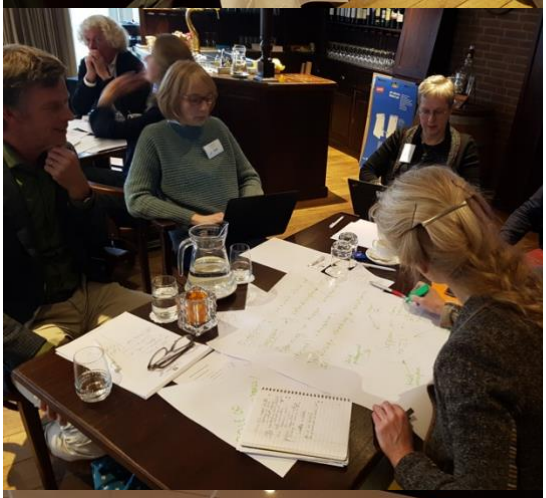
The total budget is worth €300,000. The grant may be used to cover salaries, administrative costs, travel, equipment, consumables as well as dissemination and translations.

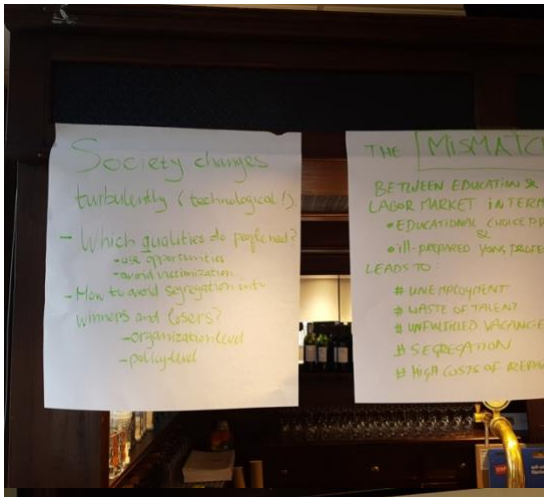
The EU grant is limited to a maximum co-funding rate of 75% of eligible costs. This amount will cover the work plan for 2018-2019. Due to the specific and unique nature of this Call, the Commission expects to fund only one proposal (network). The network should agree on the distribution of the budget between the co-beneficiaries – including the self-contribution, which may vary between the co-beneficiaries.

Link: https://ec.europa.eu/education/calls/framework-partnership-agreement-european-policy-network-teachers-and-school-leaders_en

BMS Learning Research Workshop 6 and 7 December – Photo impression




Society changes
turbulently (technological!)
- which qualities do people need?
-use opportunities
-avoid victimization
-How to avoid segregation into
winners and losers?
-organization-level
-policy-level
THE MISMATCH
BETWEEN EDUCATION &
LABOR MARKET IN TERM
• EDUCATIONAL CHOICE
&
• ill-PREPARED YOUNG
LEADS TO
UNEMPLOYMENT
WASTE OF TALENT
UNFULFILLED VACANCIES
SEGREGATION
HIGH COSTS OF





acer




Appendix N. Workshop pre-proposals

<<Co-architects and team members: please polish>>

BMS Learning Research Program Proposal 1

Background information

Project team
Architect(s): Willem Verwey, Bernard Veldkamp, Tessa Eysink
Thinker(s): Hannie Gijlers, Henny Leemkuil, Koray Karaca

Project title
Personalized learning systems

Sector in which learning takes place
Primary school (10-12 years old)

Main theme to which this proposal is related
Differentiation/personalization

Duration of project (in months)
48 months

Funding program with which this proposal is aligned
NRO Samenhangende onderzoeksprojecten (fundamenteel)

Funding targets
Personnel:
Material:

Research proposal

Summary (100 words)
Develop a Personalized Learning System that is adjusted based on the performance of the learners during a certain task. During experimentation use physiology and gather learning characteristics. In the literature, a lot is known about the relationship between learner characteristics and learning progress. The system adjusts and the learner is being helped to improve his/her learning.

Societal relevance (500 words)
General guidelines for systems (e.g. robots)

Digital competencies become more and more important in the lives of young children. They are confronted with digital information in their daily life and in school. Mobile phones, tablets and smart TVs are present in most of the households and the children have to be capable and knowledgeable about both the possibilities and the risks of living in a digital society. Besides, more and more school transit towards digital learning, either using chrome books or tablets, and either using more traditional learning methods that have been adapted to a digital learning environment, or by choosing online learning methods that have been especially developed within a digital environment. In order to be successful and to flourish in a digital society, children have to master competencies like information literacy, media wisdom, or computational thinking. The first

competence deals with the ability to collect and process information, media wisdom related to the capability to judge and interpret information, and computational thinking is related to the ability to (include definition) … . Learning these competencies is the responsibility of both parents and teachers. Up to now, resources for learning these competencies are very limited. In this proposal we aim to support teachers in learning children in groups 6 or 7 of primary education to develop these competencies.

Learning these competencies is quite a complicated task. Not only because the digital competencies are relatively new, and the definitions have not been settled in full detail yet. On top of this, the Jeugd and Media Monitor (Kennisnet, 2017) showed that there are quite some individual differences within this age group. Some of the children master them, where others still need to grow. In order to offer successful support all individual children, teachers would have to differentiate their teaching by personalizing the instruction, which is a very labour some tasks.

For teachers, this comes on top of all the responsibilities they already have and the working pressure that comes with it. Working pressure of teachers in primary education already is quite in issue in the Netherlands at the moment and it might only become more of an issue taking the expected shortage of teachers into account that is about to originate due to the retirement of a substantial proportion of the teachers in the coming years.

Because of this, we propose to develop an online system to

(teacher shortage) (development of didactic skills - computational thinking)

Problem statement, theoretical base, research questions, methods (750 words)

Problem statement
Info goes here

Theory base
Theoretical underpinnings belong here.

Intelligent Tutoring (Henny) - what has been done? Why do we think our project will do better?

"the user model in ITS is known as a student model and represents mostly the user's knowledge of the subject in relation to expert-level domain knowledge" (Brusilovsky & Millán, 2007, p. 4).

Table from **Rossi, P. & Fedeli, L. (2015)**

Table1
SHIFT IN AIED RESEARCH 2000-2010

Support for 1-to-1 learning	Support for personal, collaborative and social learning
Support for learning in tightly defined domains and educational contexts	Support for open-ended learning in ill-defined domains across varied physical and social cultural settings and throughout the lifetime
Support for knowledge acquisition	Support for knowledge construction, skills acquisition and meta-cognitive, motivational and affective support
Small-scale systems and laboratory evaluations	Large-scale deployments, evaluations in real settings and learning analytics
Focussed analysis of relatively small quantities of experimental data	Discovery and learning from educational data mining of large amounts of data captured from real use
Constrictive technologies and interfaces	Accessible, ubiquitous, wireless, mobile, tangible and distributed interfaces
Designing educational software	Designing technology-enhanced learning experiences

Knowledge models used to build ITS: rule-based model, constraint based models, expert system.
Relate to existing research on adjustable interfaces.

Research questions
How can we improve learning of computation thinking skills and make the learning process more time and cost efficient in primary school students?

Different types of feedback (motivational, cognitive, directief, elaborate, etc.) for different students (profiles, learner characteristics; age, gender, intelligence, personality etc.) and different types of errors (not reading, no attention, inefficient strategies, etc.).

Subprojects
Project 1 (OMD): 4-year PhD project on system architecture, online data analysis techniques and algorithm development.

Project 2 (IST): 4-year PhD project focussing on the educational aspects, learning, instruction, behavioural experimentation. This project will determine the way in which the system should adjust its behaviour depending on various input variables. This will involve context-specific help, and also adjusting the order and possible repetition of the assignments to be learned.

Specify tasks and computer environment in which students are supposed to work. Categorize possible errors.
Based on knowledge on feedback effectiveness describe principles for providing specific feedback (what kind of feedback is likely to be most effective? Stimulate students to find solutions, give hints). Translate into concrete clues when specific errors are made. Effect of feedback can be assessed if feedback is assigned (at random) to experimental vs. control groups (students may switch from control to experimental group).

Issues: analysis of the task and types of errors that students make, how should the task be adjusted. Which feedback should be given and is most appropriate. This involves

Project 3 (CPE): 2-year Postdoc project aimed at extracting indices from behaviour and physiology. This researcher will be an expert in psychophysiological measures including heart rate and eye movements. He/she will focus on developing the algorithms that provide insight into the progress and strategies being used. In addition, indications will be derived about the attention the pupil devotes to the task. This also involves an index as to whether a pupil is actually concentrated on the task.

Technical support project

Support will be provided by the Conceptlisious company in Enschede (4 h/week across a 4-year project). They will supervise a number of student projects from the ROC Enschede (Community College), and Saxion HBO (University of Applied Sciences Saxion). Their task will be coding the learning system (task) including its adaptability, and the algorithms needed to provide input to his system.

Methods

Physiological indices have been found to especially reflect levels of arousal and activation, rather than a detailed indication for emotions. We therefore will use physiology primarily to test hypotheses as to the pupil's involvement in the task. That is, heart rate and heart rate variability will indicate cognitive effort whereas eye movements - related to the phase of the task - will indicate whether pupil's are actually working on the task, or are distracted.

Phase 1: adjusting and/or developing a task to be learned. This task should involve behavioural indications as to the individual steps that are being taken, should sow clear improvement by resolving assignments of increasing complexity. Preferably it sold be a task for which a clear knowledge base and open software is available. Next, this task

Phase 2: determining useful behavioural and physiological correlates in a learning environment.

Phase 3: developing personalization by determining how the system responds to input. This input consists of static pupil characteristics, and online assessment of the pupil's general behaviour, task performance, and physiology

TIMELINE (across 4 years)

References

Brusilovsky P., Millán E. (2007), User Models for Adaptive Hypermedia and Adaptive Educational Systems, in: Brusilovsky P., Kobsa A., Nejdl W. (Eds), The Adaptive Web, Lecture Notes in Computer Science. 3-53, Berlin, Springer-Verlag.
Paviotti G., Rossi P.G., and Zarka D. (Eds) (2013), Intelligent Tutoring Systems: An Overview, Lecce, Pensa Multimedia.
Rossi, P. & Fedeli, L. (2015). Personalization, adaptivity, attunement. Journal of e-Learning and Knowledge Society, 11(1),. Italian e-Learning Association. Retrieved December 7, 2017 from https://www.learntechlib.org/p/150722/.

Deal: promotie premies gelijk te verdelen over IST, OMD, CPE.

BMS Learning Research Program Proposal 2

Background information

Project team
Architect(s): Don Westerheijden, Sjoerd de Vries, Ben Jongbloed
Thinker(s): Harry de Boer, Regina Mulder, Mieke Posthumus, Wilma ter Riet, Jennifer Herek *+ potentially: Gijs Kleinen/Jelle van Dijk (coordinators of Masters' Honours education @ UTwente → make participation in design of 'our' programme part of their honours programme)*

Project title
Viable models of personalized learning for energy transition

Sector in which learning takes place
Higher education (Master from KTH Stockholm and perhaps PDEng from UT)

Main theme to which this proposal is related
Personalisation / quality & depth

Duration of project (in months)
3 years?

Funding program with which this proposal is aligned
Horizon2020-call energy transitions: LC-SC3-CC-5-2018 – CSA Coordination and support action

Funding targets
Personnel: 2–4 M€
Material:

Research proposal

Summary (100 words)
Ambition:
- Design of an agile, stackable (modular/badge-based) Master, responding to personalised learning needs of (1) initial and (2) post-experience learners focusing on challenges within energy transition (energy storage, solar race challenge, solar boat challenge)
    - Co-created and co-funded with industry, with government agencies, with universities, using KIC-InnoEnergy's master program that is being developed as one among the cases to be coordinated and supported.
    - Coordination and support of development of set of intended learning outcomes + monitoring of impact on learners, industry and society.

Societal relevance (500 words)
1. an innovative model for programme development for high-level learning ('higher education') that will be viable/sustainable in the knowledge society of 2025.
2. To be exemplified by one or a few cases of programme development to educate a generation of graduates (mainly engineers) equipped to develop, improve and deploy new energy technologies,
3. contributing to meeting the challenges of the energy transition in (European and African) societies.
4. Contribute to integration of social and technical innovations.

Table required in the H2020 call:
Expected impacts for several stakeholders [to be detailed]

For universities /EIT:

How to measure impact? (KPIs)

How to achieve the impacts?

Problem statement, theoretical base, research questions, methods (750 words)

Problem statement: What is the problem?

Programme development in higher education is often supply-driven and uniform, thereby (1) missing opportunities to connect with societal needs and grand challenges and (2) missing opportunities to connect to learning needs of diverse learners, with different backgrounds (initial vs. post-experience learners; different national backgrounds from Europe and the Global South).

Theory base

[Note: the H2020 call is for coordination & support, not for 'pure' research]

- Relationships in public-private networks
- Learning (style) theories: adult learners, part-time learners in practice/jobs
- Design thinking
- Policy programme implementation/evaluation

Research questions

To be written.

Methods

- Process design is the crux: get cooperation of universities, business world, (government agencies —mentioned in the beginning but role needs to be detailed...)
- Design requirements / expected learning outcomes
- Design needed facilities for such a programme:
    - Assessment of incoming learners' qualities & competencies
    - Mentoring / student advisor capacity to guide learners through the options to gain the learning they need to meet their challenge

References

BMS Learning Research Program Proposal 3

Background information

Project team
Architect(s): Tony Hall, Andreas Weber, Susan McKenney
Thinker(s): Fulya Kula, Ton Spil

Project title
Equitable pathways for excellent technology-enhanced learning in Europe

Sector in which learning takes place
K-12 STEM learning

Main theme to which this proposal is related
Equity/Inclusion

Duration of project (in months)
48 months?

Funding program with which this proposal is aligned
EU > Marie Curie > ITN: Innovative Training Network

Funding targets
Personnel: Funds are requested for 6x2 PhDs, training, exchange and coordination
Material: To be added

Research proposal

Summary (100 words)
We suggest the establishment of a Marie Curie ITN Training Network on the theme **technology enhanced learning in primary and secondary schools in Europe.** The challenge we have identified is that **just/equitable pathways** to these (technological) interventions need to be developed. We argue that these **pathways** can be best conceptualized as design problem. In order to develop equitable pathways, we think that a group of early stage researchers (ESRs) needs to be trained (three roles: researchers, consultant, designer). Actual research clusters around the themes 'disclosing collections' and digital (il)literacy.

Societal relevance (500 words)
To be written.

Problem statement, theoretical base, research questions, methods (750 words)
Questions:

1. Is it clear to you what we are doing?
2. Should we focus on a specific area of the curriculum (STEM) or should we leave it open?
3. Should PhD training be separated in formal and informal trajectories? Or should we research how informal and formal can be connected?

Rationale

- Equitable TEL in schools is challenging, requires scientific insights and practical support
- Design research is a promising mechanism for delivering both
- Design research is complex, requires specialized training

Specialized training for design researchers in general should focus on (Table 1)

- Tripartite roles: Designer, Researcher, Consultant
- Cross-cutting skills: Empathy, Orchestration, Flexibility, Social competence

In addition, specialized training for equitable TEL researchers should emphasize (Table 2):

- Disclosing collections are crucial resources for TEL use (environment)
- Literacy (including digital and information literacies) are crucial skills for TEL use (teachers and learners)

Theory base

Table 1. Design researcher learning framework[1]

Researcher learning about		**Analysis & Exploration**	**Design & Construction**	**Evaluation & Reflection**	**Implementation & Spread**
Roles (key *work* in each phase)	Consultant	**Gets people to expose their (knowledge of) the problem(s)**	Supports design with expertise; manages people processes	Trouble-shoots when plans derail	Supports with advice/expertise; champion, moral purpose
	Designer	Gathers descriptions and explanations	**Crafts design process as well as designed products**	Recommendations for revision/use	New ideas for what could (not) work
	Researcher	**Frames and studies problem**	Supports design with research	**Rigorously investigates solutions**	Observes to broaden understanding of context
Cross-cutting competencies (key *uses* in each phase)	Orchestration	Literature review Field study Site visits & networking	Exploring solutions Mapping solutions Constructing solutions	Screening Expert appraisal Pilots Tryouts Structured & organic reflection	Adoption Enactment Sustained maintenance Dissemination and diffusion
	Empathy	Attending to needs, wishes, concerns of stakeholders	Creating designs that are usable, practical and congruent with target group needs/wishes	Understanding and interpreting data	Understanding how designs fit (or not) in specific contexts
	Flexibility	Critically investigate problem; uncover opportunities	Remain focused on achieving goals; Seek creative alternatives	Deduce and induce; Question why and what if	Goal-oriented improvisation
	Social competence	Developing trust, building relationships, inviting frankness	Negotiation, stimulation	Engendering cooperation, mitigating frustration, encouraging objectivity	Providing leadership, modelling positive attitudes

[1]Bold denotes especially heavy emphasis on this role in this phase

Table 2: specialized training for equitable TEL researchers

Phases in project months (PMs)	**Disclosing Collections (can be museum, but can also be online resources)**	**Literacy (digital, information, etc.)**
1-9: Analysis: Dilemmas and challenges stakeholders wish to tackle (that science cannot currently resolve). Problematizing and conceptualization/framing equitable TEL		
10-35: Design iterations, formative evaluation:		
36-41: Evaluation: How to measure and monitor equitable TEL?		
42-48: Reflection		

Research questions
Research questions go here

Methods
Varied contexts and manifestations (Table 3) needed for:

- Theory building (test the bounds of nascent theories)
- Practical impact (border variety of new tools and insights means greater channels for dissemination and impact)

Table 3: Varied contexts in this project on equitable TEL

Partners	**Disclosing Collections**	**Literacy (digital, information, etc.)**
NUI Galway	Primary: local city museum Secondary...	
UT	Primary: Twentse Welle? Secondary:	Secondary: Serious Gaming Platform?
Tampere	Primary: ... Secondary:..	
Ghent	Primary: Secondary:	
University of Luxembourg	Primary: Secondary:	**Primary:** DH Lab Luxemburg => project source criticism, RANKE 2.0 **Secondary:**
Cambridge/UK	Primary: Secondary:	

Each phd 4 years

Partners		
Primary schools		
Secondary schools		
Vocational training		
University of applied science		
Serious gaming platform		
Museums		

Dissertation topics:

UT (PhD topics)

1. **Possible topic I:** access and curricula development (digital museum collections, open access vs. paywall collections)
2. **Possible topic II:** disclosing digital museum collections blurs boundaries (what is a museum visitor? What is digital property?)
3. **Possible topic III:** curating collections, e.g. story telling with elderly (school kids record), use easy devices, no high tech
4. **Possible topic IV:** foldable microscope in combination with iPhone
5. **Possible topic VI**: serious gaming
6. **…**

Introduction Serious Gaming

Serious games represent games that effect the behaviour of its players (Thompson, 2008) with the intention of serving learning goals, behavioural goals, organisational goals and or intervention goals set by its developers. Serious games are applied in a broad spectrum of domains (Göbel, 2010). Serious Games need to manifest an explicit and carefully thought-out purpose (De Wit, 2011). Transposed to an educational setting Greek Philosophers early on recognized the value of play in relation to learning. "You can discover more about a person in an hour of play than in a year of conversation" (Plato). Addressing its role in the transfer of cultural explicit and implicit knowledge Huizinga (1944) stated that “Play is older than culture” (Huizinga, 1944). Huizinga (1944) posed the idea that games provide a magic circle where knowledge can be gained that can be transferred to actual reality, providing a safe learning environment fostering knowledge transfer; an aspect later addressed by Hays and Singer (1989) regarding training systems design. The application of game elements in education is furthermore associated with enhanced student motivation (Dominguez et al., 2013) and engagement (Dijk et al., 2015). Games and its educational function is omnipresent in both history and present.

Practical solution to extra year

=> Province Overijssel

References

BMS Learning Research Program Proposal 4

Background information

Project team
Architect(s): Mieke Boon
Thinker(s): Kasia Zalewska, Rainer Harms, Miles MacLeod, Jan van der Veen, Andrea Kottmann

Project title
Supporting interdisciplinary problem-solving skills (especially in engineering)
Measuring metacognitive skills for interdisciplinary problem-solving.

Keywords: modelling strategies, model-based-reasoning, (scientific) understanding,

Sector in which learning takes place
Higher education

Main theme to which this proposal is related
Adaptability/Flexibility

Problem: What kind of metacognitive skills are required for effective interdisciplinary problem-solving (socio-)technological problems? How can these skills be taught (= educational design based on appropriate pedagogical framework) & How can 'having acquired these skills' be measured (=operationalization of the concept and developing a methodology for measuring the skill)?

Hypothesis: In the history of science and technology, researchers and designers have developed strategies to collaborate effectively in problem-solving => we can learn from these strategies and aim to translate these to educational practices (rather than focus on teaching / understanding abstract theories first).
[Model by Chris: our focus is on interaction between Practice/experts versus Education/student/novice. One level lower within education: difference between more and less advanced, and between successful and less successful educational design for developing these interdisciplinary / metacognitive skills.
More focused hypothesis: modelling strategies (model-based-reasoning) & understanding modelling strategies is a first step to getting a grip on the strategies of developing, understanding and using knowledge; also, models and modelling is the hub for integrating knowledge from different sources.

Assessment and evaluation of mcog skills
Conceptual analysis of what mcog skills are
Operationalization for measuring mc skills Model-based-reasoning as a shed
Model-Eliciting Activities (see literature in EngEd)
Understanding (explicit understanding is not technically necessary) - none-shared partial understanding. [Michael Goreman & Mehalik]. Understanding for what it is necessary. Can you do ID without deep understanding (whereas it may work without really understanding in other cases). Teachers expect certain things about the level of understanding [normative versus practice].
"Other party is having a misconception of the world";
"Competing frameworks", or
"Each just see a small part of the world"

Duration of project (in months)
2 PhD's

Funding program with which this proposal is aligned
NRO

Funding targets
Personnel:
Material:

Research proposal

Summary (100 words)

How can we teach ID / problem solving? [Two levels: institutional and teaching/learning level.]

Societal relevance (500 words)

Complex socio-technological problems requires high-level, critical, reliable, effective interdisciplinary collaborations between (disciplinary experts). How can students (in academic / engineering) education be trained. It is not possible to be expert in all these field. Higher-order skills are needed to deal with this situation, in particular for cross- interdisciplinary communication

Problem: What kind of metacognitive skills are required for effective interdisciplinary problem-solving (socio-)technological problems? How can these skills be taught (= educational design based on appropriate pedagogical framework) & How can 'having acquired these skills' be measured (=operationalization of the concept and developing a methodology for measuring the skill).

Hypothesis: In the history of science and technology, researchers and designers have developed strategies to collaborate effectively in problem-solving => we can learn from these strategies and aim to translate these to educational practices (rather than focus on teaching / understanding abstract theories first).
[Model by Chris: our focus is on interaction between Practice/experts versus Education/student/novice. One level lower within education: difference between more and less advanced, and between successful and less successful educational design for developing these interdisciplinary / metacognitive skills.
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Assessment and evaluation of mcog skills
Conceptual analysis of what mcog skills are
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Model-Eliciting Activities (see literature in EngEd)
Understanding (explicit understanding is not technically necessary) - none-shared partial understanding. [Michael Goreman & Mehalik]. Understanding for what it is necessary. Can you do ID without deep understanding (whereas it may work without really understanding in other cases). Teachers expect certain things about the level of understanding [normative versus practice].
"Other party is having a misconception of the world";
"Competing frameworks", or
"Each just see a small part of the world"

Problem statement, theoretical base, research questions, methods (750 words)

Problem statement

Two current problems of interdisciplinary science and engineering education are 1) the identification and training of skills and knowledge relevant to interdisciplinary integration; 2) forms of assessment for measuring the acquisition of that skill and knowledge. With respect to (1), much of the current literature conceptualizes relevant knowledge and skills for integration as soft skills. Some research has suggested the importance of metacognitive skills to interdisciplinary problem-solving (for example…), but at present these suggestions remain generic and abstract, and are not tied to directly to goals of integration. At the same time assessment remains difficult. Learning goals of interdisciplinary education such as ability to integrate different fields or understand the structure of other fields remain hard to access, and it is not clear assessment of soft skill performance alone constructively aligns assessment with such goals. At present most educational scholars rely on their own intuitions of what is necessary for ID problem-solving or what they gauge from educational contexts alone with little attention to what is happening in real-world practices. <models>

Theory base

Theoretical underpinnings belong here.
Philosophy of science literature on modelling and on interdisciplinarity.
Educational research on teaching interdisciplinarity and metacognitive skills

Research questions

General question: What skills, how to teach them, and how to measure them?
This interdisciplinary project consists of three interrelated parts (partially cyclic):

(1) Investigation of (methodological, epistemological) strategies used in real (scientific) research and design practices (problem-solving) practices. This will be based on historical studies, and empirical studies of labs. Outcome of this study is a kind of catalogue and categorization of modelling strategies in diverse practices, and an explication of metacognitive skills that play a role in these strategies.

(2) Developing an educational design that aims at learning these strategies and skills (needs to be at different levels through bachelor, master and PhD).
(3) Developing a measurement tool for assessing to what extent students have acquired these metacognitive skills.

Methods
Institutional: 2-depth case studies involving different levels of institutions (staff teacher, educational professionals, students). Self-evaluation of problem-solving skills, indicators (dropout rates)
Teaching/learning: conceptual work (text work), mixed methods, evaluating existing ID programs/models, assessment of problem-solving skills (control group)

References

Appendix O. LWG retreat

LWG retreat agenda
January 18-19, 2018, Hotel de Broeierd

January 18
- 9:00-10:00: Discuss draft of project report, retreat goals, and how they relate to long term work
- 10:00-10:15: Revisit Chris's recommendations, explain today's writing tasks (see organizer), choose a theme to start with (depth/quality?)
- 10:15-10-30: break
- 10:30-12:30: Discuss/document theme (plenary) in relation to domain challenges, scientific contribution, societal impact and the infrastructure it requires
- 12:30-13:30: lunch
- 13:30-15:30: Pairs* discuss/document one remaining theme each (equity/inclusion, adaptability/flexibility, differentiation/personalization) in relation to domain challenges, scientific contribution, societal impact and the infrastructure it requires
- 15:30-16:00: break
- 16:00-17:00: Report back and fine tune outputs, put into organizer**

January 19
- 9:00-10:15: Reflections across themes (domain challenges): synergies and tensions, e.g. differentiation for inclusion? personalization versus equity?
- 10:15-10:30: break
- 10:30-11:30: Reflections on scientific contribution, societal impact
- 10:30-12:30: Strategic planning exercise regarding (human, material, structural aspects of) infrastructure
    - Brainstorm (include suggestions sent by Mieke Boon)
    - Categorize
    - Rank (most impact & quick wins)
    - Prioritize (short, mid and long range efforts)
- 12:30-13:30: lunch
- 13:30-14:30: New pairs* draft prose in google docs (domain challenges, scientific contribution, societal impact, infrastructure)
- 14:30-15:30: Trade and polish prose, highlight areas essential for short version
- 15:30-16:00: break
- 16:00-16:45: Check consensus on essential areas for short version
- 16:45-17:00: Discuss completion and timeline, inventory expectations and preferences for after report is submitted

*Given their education backgrounds, probably best if Maaike, Bernard and Susan are paired with others.

** Organizer

Organizer	Depth/ Quality	Equity/ Inclusion	Adaptability/ Flexibility	Differentiation/ Personalization
Domain challenges				
Scientific contribution				
Societal relevance				
Infrastructure				

LWG retreat notes

Societal challenges

Depth quality - need to think/say more about what we mean by this could link to changing society (see also green)

<<Could use a higher level challenge here (like blue/green>>

- System coherence that can actively foster depth/quality, e.g.
  - E.g. Schools are frustrated with needing to spend 30% of their precious instructional time on assessment
  - Monitoring and maintenance, this requires measurement frameworks and tools
  - What is quality in the 21st century? What should be taught? (Content, skills, attitudes) – Curruclum.nu and implications higher education
  - International rankings (e.g. TIMMS, Pisa QS, Times)
  - Trends like MOOCs?
  - Constraints
- Supporting learning environment educators (primary, secondary, tertiary, informal, business, elderly care home etc.)
  - In their struggle to attain deep learning that facilitates application and use of new concepts in novel settings
  - Help teachers understand their own approaches.
  - Developing pedagogical content knowledge (vakdidactiek, including technology)
- Learner experience:
  - Motivation
  - Deep and prolonged attention
  - Hypertext/information firehose society
  - What is deep learning (humans, but also machines)? (e.g. understanding, applying, synthesizing, critical thinking, meta-cognition)

Equity/inclusion

<<Could use a higher level challenge here (like blue and green)>>

- System:
    - Developing (better) pathways to learning opportunities (broadening participation), includes sensitization, infrastructure
    - divides (e.g. digital, economic, education, generational etc.) and the role learning can play to mitigate these; in striving for excellence, whom do we leave behind?
- Educator: Inclusive pedagogies
    - Coping with challenges learners face
    - Being aware of and able to leverage diversity
    - Inclusion through
        - § technology
        - § differentiation
- Learner: Valued, recognized, connected, safe
    - Access, proactive, taking responsibility
    - diversity
    - Technology?
    - information literacy (source quality-fake news)
    - dealing with complexity, automation
    - non-learning and resistance – lack of interest
    - trust, connected
    - perspective, motivation
- Teachers/learners: Less educated people are less able to access information; in the US (later NL?) the (net neutrality);
- Global connections that are afforded by technology e.g. (s)MOOCs – implications for depth?

Adaptability/flexibility

Societal changes prompted by changes in: Climate, technology, political landscape, human interaction, demographics, globalization, etc.

- System: Accommodates the resulting need for (re/new/un-)learning
  (How to reward new initiatives in an old system ??, BPV)
- Educator: Understanding of learner (cognitive, emotional or physical) needs
  (Life long learning of teaching, BPV)
- Learner: Adjust own capacity (e.g. professional qualifications) to function in changing society
    - Understand, accept, motivation, skills, creativity, entrepreneurship, self-knowing, multidisciplinary cooperation, collaboration, mindset, …

Threats to depth brough by changing society

Differentiation/personalization

The age of customization brings opportunities and threats

O: Huge amount of data, improving learning opportunities for everyone (diagnosis, intervention, feedback etc can be better tailored), could improve equity/access, support talent development

T: Unintended consequences? Such as deskilling (e.g. navigation ability), self-worth/esteem, self-centeredness, social incompetence, if data are not protected (personal threats, big brother, commercial collapse)

- System: What is the future of learning institutions (e.g. universities)? How to make learning more efficient, cost-effective, deep, the future of qualifications systems institutions, omparability across countries, institutions

- Educator: How to leverage customization opportunities without being blind to potential unintended consequences? How is the profession changing (e.g. automation)?
    - How leverage opportunities: Role of teacher in personalized and competency-based learning? Making sense of data, efficiency
    - How mitigate threats: notice potential tradeoffs for learners (e.g. the physical process of note-taking has been shown to support learning more than typing or passive forms).
- Learner: Ability to meet own needed balance for fit-comfort-effort in customized learning
    - Effective-better targeted
    - Dopamine-effect (how to link short-term triggers to long term engagement, effort)
    - Risk of being inaccurately labelled
    - Risk of creating comfort zone bubble and reducing flexibility, open-mindedness

Scientific contribution

Depth/quality

- System
    - Substantive: What knowledge is of most worth (to learn)?
    - Technical: How should (specific content/skills) be learned?
    - Socio-political: Interdependence on (inter)national developments
    - How to measure quality (e.g. definitions, frameworks, operationalization, instruments, …)?
- Learning environment (implications for educators):
    - What are the human, material and structural aspects of infrastructure that support (teacher) learning? (Could be applied to data literacy, teaching higher-order skills, …)
- Learners
    - How do (specific kinds of) learners learn, even when they are educators?
    - What inputs (by learners themselves, others, or the environment) can influence learning processes and outcomes (including physical movement)?
    - Why are some learners (in/ex) motivated and others not?

Equity/inclusion

- System: How can participation in learning be broadened to leverage diversity?
    - Testing/… is often in relation to an average/norm, and may discourage diversity?
- Educator: How can technology support educators to improve access, diversity, equity and inclusion?
- Learner: Enriched understanding of self in relation to (learning) environment?
    - What am I good at? What do I need? How do I learn? Why should I learn?
    - How does the experience of the disenfranchised shape that of others? Vice versa?

Adaptability/flexibility

How can we enhance learning in a constantly changing society?

- System: To what extent are system actors (policymakers, boards, advisors) sensitized to the (future) needs for (re/new/un-)learning in a given context? How can we develop qualification systems that are resilient to changes (so that we rate performance based on criteria that are currently needed, not just yesterday)?
- Educator: When, why and how do educators respond to changing demands?
- Learner: How to inculcate, adaptivity, flexibility, and the capacities that serve them?

Differentiation/personalisation

- System: What are the societal impacts of personalization (e.g. memememe, potential cognitive benefits with psychological/physical loses?)
    - What are pro- and anti-social forms of (de-)personalization?
    - Which data really support learning (systems) and why?
    - Which organizational models support the kinds of learning (institutions) that are required in the age of customization?
    - What are the characteristics of a qualification system that appreciates individual talent but allows comparison?
- Learning environment: What are the characteristics of learning environments that leverage opportunities for customization (e.g. big data) yet mitigate potential pitfalls (technical, misuse?
    - How to develop smart and adaptive learning environments? (System adaptation to user is amenable to refinements to make the system more accurate, e.g. the system draws premature conclusions, "learns" from this and adjusts itself accordingly)
    - How to (support teachers in) making pedagogical use of hard and soft (even intuitive) inishgts (e.g. aggregate data for use in authentic setting classroom, training etc, implications for physical classroom layout).
    - When is machine teaching preferable to human teaching (also vice versa) and why?
- Learner:
    - Which learners (in which contexts) benefit from which balance of (tools for) customization and not?
    - Self-regulation versus machine/external regulation: support vs. deskilling/disempowering?
    - Which learning tasks can be automated (by humans, by machines)?
    - Near and far transfer (often helped by authentic, whole tasks)

Societal impact

Depth/quality

- System: Contributed to system mechanisms, e.g. national wetenschapsagenda and curriculum.nu, European other, policy (quality) measures
- Educator: Empowered educators, e.g. lower work pressure, higher self-efficacy, improved collaborative/supportive structures
- Learner: Capacity of individuals to contribute to addressing (societal, personal, professional) concerns/issues/problems (e.g. interdisciplinary working, domain knowledge, requisite skills like information literacy, e,g, ability tp engage in societal issues)

Equity/inclusion

- System: Contribute to mitigating divide(s)
- Educator: (Improved) capacity to employ inclusive pedagogies

- Learner: Empowered to ensure participation

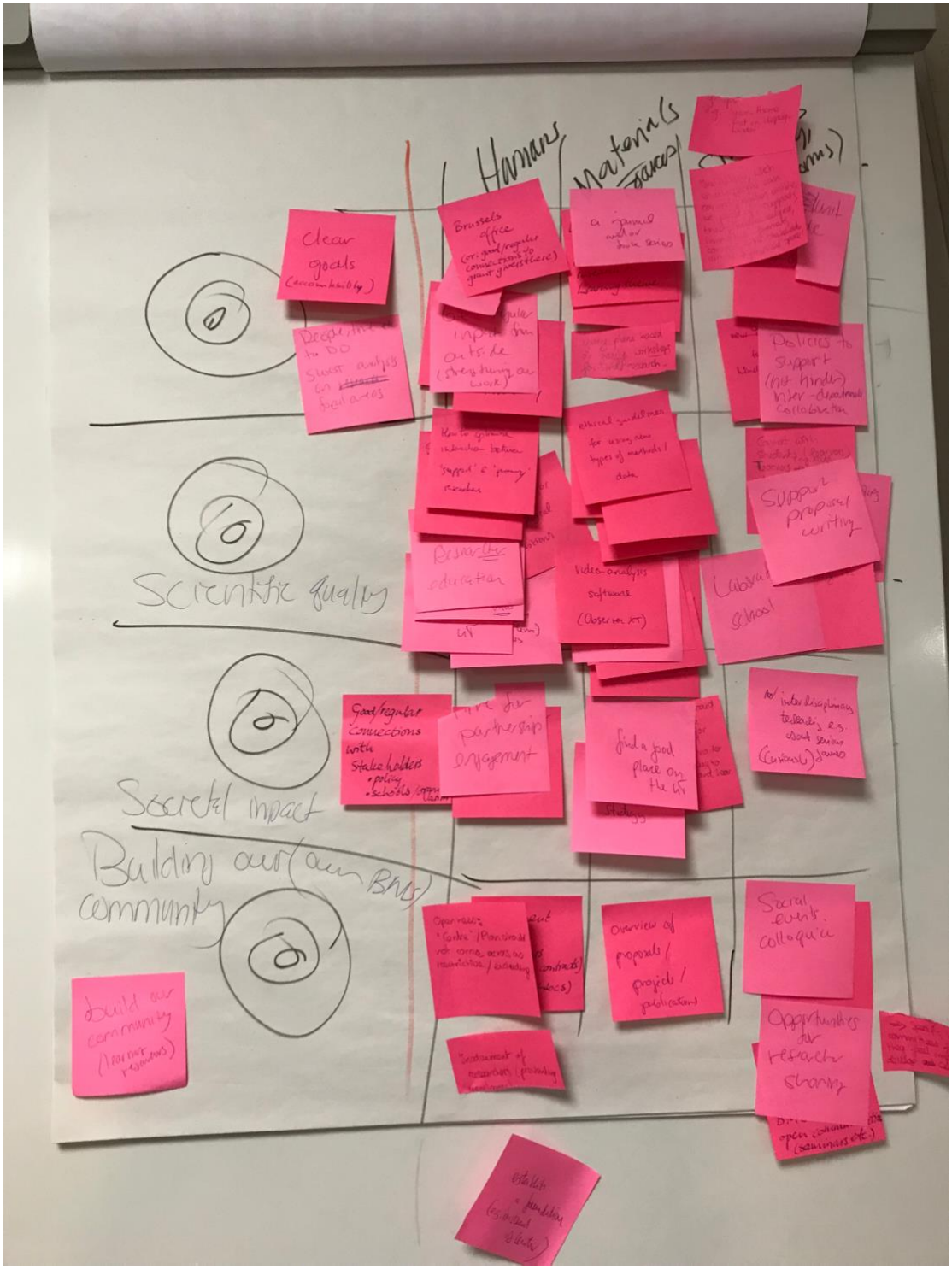
Flexibility/adaptability
- System: Responsive to the continuously changing learning needs of its participants
- Educator: Educators are supported to engage in debate surrounding changing needs of learners and especially how to meet them
- Learner: Resilient citizens and professionals

Differentiation/personalisation
- System: Establish and norms and practices for responsible customization (e.g. data use) for learning
  Provide society with tools to understand and work with personalised learning certificates
- Learning environment: Understanding, resources, and practices that leverage opportunities for customization and mitigate risks for potential pitfalls
- Learner: Self-awareness and agency of learners to see/create/determine/choose own learning (pathways)

Infrastructure
- institutional unit (with really cool acronym)
  - BMS with strands – link to CTIT/institite
  - Students as glue (e.g. ATLAS)
  - Teaching and learning
  - Outreach – RPPs
  - Attractive location (Boerderij, design lab, other…)
- Leadership/Scientific director > initially 1-3 years (interim)
  - HGL, insider, well-networked, proactive, vision, affinity for outreach
  - Formal fte: 2-3 days/week
  - Budget for travel, networking (especially scientific communities), visibility
- Management team/coordination, liason, organization, outreach work
  - Business director: monitor, networking (especially funders), proactive
  - Team or all-arounder: secretary/project assistant/curator/finances/communications and social media
  - Good (grant, press release etc) writer(s)
  - Bring in new blood/networks
  - Total fte: 3-5
- To do the work well, we need opportunities to learn, e.g. about
  - Our themes, our stakeholders (system actors, educators, learners), pedagogies, research approaches, inspiring/unconventional projects, …
- To help us engage in public debate, we need
  - Events where we feel comfortable
  - Media/communications support with substantive expertise
  - An environment/routine/structures to welcome people on campus (boerderij)
- Living lab
- Connections to cutting edge stuff on campus that will teach us about (imminent) changes in society
- Design lab, BMS lab, other designer groups on campus

- RPPs: Long-standing connections with educators who are experiencing the changes first hand (CELT, Partner Schools, professional associations that offer courses, training, etc.)
- Community-building: Researchers are stimulated to share expertise and develop activities

LWG retreat strategic planning results



Goals	Humans	Material	Structures
Articulate overarching goals, and SWOT analysis.	Commitment of individuals Leadership. Steering group (with stakeholders). Lobbying on funding (e.g. Brussels). Critical friends (for advice and suggestions).	Business plans (Explore whether to establish a foundation is helpful (to attract money). Yearly plan. Funding to do all this.	Institutional unit (e.g., Centre), including support for leadership & management Institutional (BMS) support (e.g. policies that support, not hinder collaborations). New supportive measures to get and use research/project money. Jaarcyclus (e.g. recurring annual things, such as strategic workshops). Support to lobbies. Strong branding (e.g., visiting scholar program, colloquia, prizes, show-case of work like yearbook, 'vision on who we are').
Building community	Engage the juniors. Involve people. Openness, inviting, welcoming to people	Online environment. Overview of research proposals and projects.	Policies that stimulate (do not hamper) ID collaborations. Opportunities for researchers to exchange (e.g. joint colloquia). Shared leadership (e.g. have tasks ínvented and adopted by people). Social events.
Scientific quality	Access to expertise (methodological, programming, ..). International fellowships. Establish inter- and multi-disciplinary research collaborations. Outreach to other groups at UT.	Data lab (e.g. tools for social design). Methods lab (video analysis software). Tools (e.g. software) to manage research. Environment to digitally collaborate with external researchers (e.g. Video facilities). Ethical guidelines for data collection and use. Simulation room for studying learning. Connections with resources outside UT, vice versa.	Helpdesk for methodological question. International fellowships funding. Institutional support for connecting with students, teachers etc. Establish mechanisms and support for ID collaborations. Workshops (e.g., proposal writing). Opportunity for researcher's learning. Laboratory / simulation school.
Societal impact	Awareness of abilities of others (social capital). Productive / active connections with stakeholders & partnership engagement. People-power to liaison with partners. Outreach. Strong scientific network.	Vehicles for information dissemination (e.g.Blog for engaging others and invite other views, such as 'bij nader inzien', which has an editorial board). Attractive meeting-place. Display (e.g. exhibition space in Boerderij).	Make use of existing and new structures for outreach (like Curious U, Summer schools).