ESoE

SELF-ASSESSMENT REPORT OF THE ESOE RESEARCH PROGRAMME FOR THE PERIOD 2013-2018

EINDHOVEN UNIVERSITY OF TECHNOLOGY: EINDHOVEN SCHOOL OF EDUCATION

PREFACE

This self-assessment report has been written to help the Peer Review Committee of the Research Assessment 2013-2018 of the Eindhoven School of Education (ESoE), Eindhoven University of Technology, prepare for its site visit. The assessment report follows the guidelines of the Standard Evaluation Protocol for Research Assessments (SEP) in the Netherlands 2015-2021. It describes relevant aspects of the School's research management, main strategic choices made, research inputs and outputs, the PhD programme, and aspects of research integrity. The focus of ESoE's research programme in the assessment period was on preparing and supporting teachers for innovative STEM learning. We would like to express our gratitude to all ESoE's researchers and the wider academic and practitioner community for their valuable input to this report.

Prof. dr. Douwe Beijaard

Former Dean and Scientific Director of ESoE

Prof. dr. Jan Vermunt

Current Scientific Director of ESoE (2019 – date)

Dr. Maaike Koopman

Research Coordinator

Prof. dr. B. Pepin

Leader TU/e – 4TU Centre of Engineering Education

CONTENTS

AOS	Professional development school with research facilities in addition to facilities for teacher education
Brainport region	Eindhoven region where companies, educational institutions and regional governments collaborate on technological developments
Centre of Engineering Education	Centre of the four universities of technology in the Netherlands that initiates innovations, research and all kinds of activities regarding the education of future engineers
DUDOC	Programme for science/alpha teachers for doing a dissertation or a post doc study; ESoE participates in the DUDOC-science programme
ESoE	Eindhoven School of Education
ICO	Interuniversity Centre for Educational Research (national research school), formally recognized as such by the Royal Netherlands Academy of Arts and Sciences (KNAW)
Kennisnet	Former Dutch organization supporting the use of ICT in primary and secondary education
KNAW	Royal Netherlands Academy of Arts and Sciences
Master SEC	Master Science Education and Communication, i.e., the teacher education track of three technical universities in the Netherlands (TU Delft, TU Eindhoven, Twente University with only Delft also having a communication track)
Ministry of OCW	Ministry of Education, Culture and Science
NRO (Nationaal Regieorgaan Onderwijsonderzoek)	Netherlands Initiative for Educational Research, part of the Netherlands Organization for Scientific Research
NWO	Netherlands Organization for Scientific Research
NWO-PROO	Program Council for Educational Research (part of NWO until the emergence of NRO)
NWO PhD-scholarship for teachers (promotiebeurs voor leraren)	Scholarship for PhD candidates who teach in primary, secondary, vocational, or higher education
Post doc researcher	Graduated researcher (PhD) with research as main task
STEM	Science, Technology, Engineering, Mathematics
SURF	Dutch organization for ICT in higher education and research
Technasium	Secondary schools with a science-based research and development track
TU/e	Eindhoven University of Technology
VOR	National Organization for Educational Research
VELON	Organization for Teacher Educators in the Netherlands
VSNU	Association representing the Dutch research universities

1. INTRODUCTION

1.1 MISSION OF ESOE AND ITS RESEARCH

The Eindhoven School of Education (ESoE) is the centre of expertise of TU/e regarding the professional development of (student) teachers and educational innovation in the STEM domain (Science, Technology, Engineering, Mathematics) in secondary and higher education. ESoE's activities concentrate on:

1. Education of STEM teachers (i.e., preservice teacher education at bachelor and master level);
2. Continuous professional learning and development of STEM teachers in secondary schools and higher (university) education, particularly within TU/e;
3. Innovation in STEM education in collaboration with teachers at both classroom and school/institute level.

Leading is ESoE's vision on professional STEM teachers: innovative experts in their subject domain who design and develop (technologically) rich contexts for learning. They systematically reflect on their education, including their own role, and demonstrate an inquiry and learning attitude towards their subject and work as teachers. As such they are a role model for their students. In innovative contexts they act as agents of change together with colleagues inside and outside their schools and demonstrate professional leadership needed for this. ESoE wishes to educate these academic professionals in close cooperation with schools. The ultimate goal of the ESoE research program is to contribute to the education of more and better STEM teachers. In turn, more STEM students will be attracted.

The focus of the current research program of ESoE (enclosed as appendix G) is on secondary and higher STEM education, both as object and as context. Linked to and in line with their three-fold mission, ESoE's scientific research is practice-oriented. Its research programme starts from and connects with educational issues, problems, and questions in educational practice. Consequently, ESoE researchers strive for high quality research with much societal impact in the STEM domain of teaching and teacher education.

1.2 BACKGROUND TO THE SELF-ASSESMENT REPORT

This self-assessment report of ESoE's research covers the six-year period 2013-2018 and follows the components of the protocol for research assessments in the Netherlands (amended version, 2016). The preceding assessment of ESoE's research took place in 2013 and covered the period 2007-2012. The assessment then resulted in the following scores on a range of 1-5:

- Quality: 4
- Productivity: 4
- Relevance: 4
- Viability: 3

(4 = very good; 3 = good)

These scores were satisfying for ESoE given its start in 2007 with a research programme with broad focus; its topics ranged from primary education to all types of higher education and from different domain-specific topics to different general educational topics (see appendix J for the full report of the committee). This broad focus had its origin in ESoE as a joint institute of TU/e and Fontys University of

Applied Sciences. All Fontys research units[1] of different types of teacher education (n=10) participated in the programme. From 2010 and further, Fontys University of Applied Sciences withdrew from ESoE so that ESoE continued as an institute of TU/e. In view of viability, the assessment committee in 2013 advised ESoE to focus the research more on STEM and secondary and higher education, thus being more in line with the mission, goals, and education of TU/e and ESoE's Master SEC. This has resulted in the following measures: (1) allocating money for extra STEM research conducted by two colleagues (0,3 and 0,4 FTE from 2014; dr. de Putter-Smits and dr. Sanders respectively), (2) the appointment of a STEM/Mathematics education professor supported by the university from January 2015 (prof. dr. Pepin), and (3) a new research programme in which STEM education is focus and/or context of the research of ESoE (see appendix G).

A mid-term evaluation of the ESoE research took place in the autumn of 2017. The committee concluded that:

1. The research had become much more coherent;
2. The two lines in the research programme ('STEM' and 'teacher professionalization') complement each other well;
3. The visibility and involvement of ESoE in the university had increased substantially;
4. The expertise of ESoE researchers is much appreciated by the own university and schools in the region;
5. The supervision and education of the PhD students are well arranged and of good quality.

The mid-term committee strongly supported the policies of ESoE: to keep both expertises ('STEM' and 'teacher professionalization') at the level of a professor in view of retirement of prof. dr. Beijaard (realized by the appointment of prof. dr. Vermunt, December 2018), to ensure a good balance between both fields of expertise in recruiting new staff (in spring 2018 a full-time assistant professor in mathematics / STEM education, dr. Schüler-Meyer, was appointed), and to achieve a more balanced scientific workforce in the scientific staff (realized by the promotion of ESoE colleagues dr. Koopman and dr. van den Beemt from assistant to associate professor, summer 2019). See appendix K for the full report of the mid-term committee.

The following chapters make clear how the staff of ESoE dealt with more detailed issues raised by both committees. In Section 2.3.3 about the viability of ESoE's research, particular attention will be paid to the development of this programme since the foundation of ESoE in 2007.

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[1] Such a unit is called a 'Lectorate' and usually consists of a lector (in universities of applied sciences an equivalent for professor) and a group of teachers who jointly conduct practice-oriented research and/or participate in it. Such a research group fulfills an important bridging function between science and practice. Through practice-oriented research, these research groups contribute to the strengthening of education and the innovation of professional practice.

2. RESEARCH QUALITY, RELEVANCE TO SOCIETY AND VIABILITY

2.1 ORGANIZATION, COMPOSITION AND FINANCING

2.1.1 ORGANIZATION

The research unit is rather small and led by the scientific director[2] of ESoE, who is supported by the research coordinator. Both the general director of ESoE and the scientific director are accountable to the Governing Board that exercises authority over ESoE on behalf of the Board of the university. The ESoE Governing Board consists of deans or their representatives of the faculties Chemical Engineering and Chemistry, Applied Physics, and Mathematics and Computer Science (i.e., the subject areas in which ESoE provides teacher education), and two representatives from educational practice. The rector magnificus of TU/e is the chairman of the Governing Board[3]. The Board mandates both directors of ESoE to direct ESoE in all its affairs regarding education, research, and innovation, including financial aspects and human resources. Both directors are supported in their management duties by the managing director of ESoE. The Governing Board approves the research programme of ESoE in addition to, for example, other strategic plans, annual reports, ESoE's quality assurance and appointments.

Important is that each staff member is also a member of the national research school ICO. Becoming a member of ICO requires that they publish six articles in international scientific isi/ico-journals (of which one is allowed to be a peer-reviewed book chapter published by an internationally acknowledged publisher) in a period of five years. All these staff members also supervise PhD students. On the TU/e website, descriptions are given of ESoE staff members' research profile, academic background, and research output. These personal websites also give access to the Scopus profiles of the staff members[4] (see also appendix A for these staff members and the access to their personal websites; Section 2.3.1 contains additional information about the staff).

ESoE offers part-time PhD students and externally funded post docs (DUDOC) a so-called "guest declaration", implying that they have access to the university library, have a workplace at ESoE (for at least one day a week), are invited to participate in the ESoE colloquia that are held every six weeks, and can make use of a number of other facilities offered by the TU/e in general such as ICT facilities, access to scientific services and software but also courses concerning academic writing, statistics, and presentation skills.

The senior scientific staff of ESoE (cf. Table 2.1 and note 4) meets four times per year for discussing the progress of the PhD students and the actions that eventually should be undertaken (e.g., more supervision, specific support in writing English, reconsidering the work plan).

Every six weeks ESoE organizes colloquia for its scientific staff, PhD students and post docs. Also master students and colleagues from outside are – if of interest to them – invited to attend these colloquia. These colloquia are about specific topics related to the research programme of ESoE (e.g., what deep learning entails from both a domain-specific and a more general educational perspective), methods and

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[2] In the past, both director positions were assigned to one person. Since April 2018 these functions have been split up and allocated to two persons.

[3] The Governance of ESoE is precisely described in a so-called common regulation containing agreements on responsibilities, duties, and tasks.

[4] These staff members (by the end of 2018 and currently as well) are: prof. dr. Douwe Beijaard, prof. dr. Birgit Pepin, prof. dr. Jan Vermunt, dr. Ruud Taconis, dr. Maaike Koopman, dr. Antoine van den Beemt, dr. Gonny Schellings, dr. Lesley de Putter-Smits, dr. Marieke Thurlings, dr. Alexander Schüler-Meyer, and dr. Evelien Ketelaar (who had a 0.2 FTE appointment at ESoE and left autumn 2019).

methodology (e.g., how to do a review study or different types of design-based research), and the identity of a researcher (e.g., what it means to be a PhD student / post doc). Invited speakers (experts) are regularly asked to take part in the ESoE colloquia.

PhD students attend bi-monthly intervision sessions facilitated by two staff members. In these sessions the PhD's discuss about specific issues or topics regarding their research often in relation to one of their manuscripts in progress.

The PhD programme of ESoE is embedded both in the Graduate School of TU/e and ICO (the Dutch national educational research school) as will be explained further in Section 3.2.

2.1.2 COMPOSITION

ESoE's research programme aligns with its main tasks pertaining to teacher education (bachelor, master, and in-service) and innovation in secondary and higher education, as well as within TU/e itself. Most staff members of ESoE have tasks in all these working areas. Tenured staff members with an appointment of 0,8 FTE or more usually have a direct funding appointment of 0,4 FTE for research. Table 2.1 gives an overview of the scientific staff of ESoE with research tasks (research FTE and number of people involved). FTE fluctuations in the total research staff pertain to new appointments, growth into a higher function, change of job, employment elsewhere, and the duration of PhD or post doc projects.

Table 2.1: Scientific staff in FTE for research (research FTE and n people).

	2013		2014		2015		2016		2017		2018	
	FTE	n	FTE	n	FTE	n	FTE	n	FTE	n	FTE	n
Scientific staff (1)	2,5	7	2,9	9	4,1	9	3,7	10	2,5	10	3,0	10
Post docs (2)	0,8	2	1,9	3	1,7	3	1,1	2	1,1	3	2,4	5
PhD students (3)	3,3	5	2,5	4	0,8	1	0,8	1	0,8	1	1,6	2
Total research staff	**6,6**	**14**	**7,3**	**16**	**6,6**	**13**	**5,6**	**13**	**4,4**	**14**	**7,0**	**17**
Support staff	0,1	1	0,1	1	0,1	1	0,1	1	0,1	1	0,1	1
Total staff	**6,7**	**15**	**7,4**	**17**	**6,7**	**14**	**5,7**	**14**	**4,5**	**15**	**7,1**	**18**

(1) Includes full professors, associate professors, and assistant professors.
(2) Post docs do research funded by the Netherlands Organization for Scientific Research (NWO), the Netherlands Initiative for Educational Research (NRO, being part of NWO), and the Ministry of Education, Culture and Science (OCW, financing the DUDOC programme for science teachers for doing a dissertation or post doc study), or by contract research.
(3) Excluded are the part-time PhD students appointed elsewhere (other teacher education institutes and secondary schools) but doing their PhD study at ESoE. Their PhD projects are usually funded by their own institute, the DUDOC-programme, or the NWO PhD scholarship for teachers; both latter initiatives are funded by the Dutch government (OCW). Excluded are also the fulltime PhD students from China funded by the Chinese Scholarship Council (CSC). See Table 2.2 for an overview of these different categories of part-time PhD students: both in terms of research FTE and in absolute numbers.

Table 2.2 shows that ESoE had a relatively large number of external PhD candidates, particularly in the first half of the 2013-2018 assessment period. This was caused by the remainder of PhD students appointed at Fontys University of Applied Sciences doing their PhD study at ESoE, still funded by Fontys

as a result of the earlier and formally ended cooperation between TU/e and Fontys University of Applied Sciences in 2010 (see also Section 1.2).

Table 2.2: Part-time PhD students appointed elsewhere and the CSC PhD students.

	2013		2014		2015		2016		2017		2018	
	FTE	n	FTE	n	FTE	n	FTE	n	FTE	n	FTE	n
NWO PhD students with scholarship for teachers	0,4	1	1,2	3	1,2	3	1,6	4	1,6	4	1,2	3
PhD students in the DUDOC programme	0		0		0		1,2	2	0,6	1	1,2	2
PhD students from Chinese Scholarship Council CSC (1)	0,4	1	0,8	1	1,6	2	1,6	2	1,2	2	0,8	1
Other external PhD students	3,9	15	4,2	15	3,6	15	2,4	7	2,2	7	1,7	5

(1) These fulltime PhD students spend 0,8 FTE on research, 0,2 FTE on following education

2.1.3 FINANCING

ESoE receives direct funding for research from TU/e task-based. Per full-time staff member, allocation of the money is roughly 4:4:2 (education, research, management). This is evaluated every three years. The first column of Table 2.3 gives an approximation of this budget for the assessment period based on the research staff mentioned in Table 2.1.

The general policy within the TU/e is that research groups largely earn their own research budget by external funding. A closer look at Table 2.3 indicates that ESoE has succeeded in this for four of the six years and that this fluctuates, mostly positively with peaks in 2014 and 2017 and a low point particularly in 2018 due to a strong reduction of contract research in that year. *Contract research* refers to indirect funding such as projects financed by the Ministry of Education (OCW), the DUDOC programme, national network organizations like Kennisnet, the 4TU Centre of Engineering Education, the TU/e innovation funds, and secondary education schools for which ESoE performs contract research. *Research grants* refer to budgets obtained in the national scientific competition organized by the Netherlands Organization for Scientific Research (NWO) and the NRO (originated in 2013 as a part of NWO and coming out with the first call for educational research in 2014).

Appendix B gives a detailed overview of the research grants and contract research projects for the period 2013-2018.

Table 2.3: Financing of the research for the period 2013-2018.

	Direct funding (1)	Research grants	Contract research	Total external funding
2013	520.000	137.089	476.562	613.651
2014	605.000	94.583	749.541	844.124
2015	679.000	108.447	410.770	519.217
2016	570.000	174.000	412.029	586.029
2017	416.000	169.000	475.052	644.052
2018	656.000	115.000	244.088	359.084

(1) This budget is meant for personnel and other research costs (conference visits by the scientific staff, membership of PhD students of ICO for following courses and participation in spring and summer schools, and other work-related facilities such as guest declarations for external PhD students). The total of these costs is approximately € 60.000,- per year.

2.2 TARGETS AND STRATEGIES

ESoE's research is closely connected with its teacher education programme (named: master Science Education and Communication; abbreviated as master SEC). Research results not only find their way into student teacher education, the ways in which (student) teachers learn and further develop their teaching profession are also subject of research. In line with the educational programme of the master SEC, the research of ESoE encompasses both subject-specific oriented and more general educational research. The general aim of the ESoE research is two-fold: (1) to contribute to the scientific knowledge base and international discourse in the domain of teaching and teacher education and (2) to contribute to the improvement/innovation of educational practices and policies regarding teaching and teacher education. For the period 2013-2018 these two goals have been specified in the following targets and strategies to achieve them.

2.2.1 PERFORMING HIGH QUALITY RESEARCH

ESoE finds the following strategies relevant for achieving high quality of its scientific work:

- Publishing in isi-indexed scientific journals;
- Dissertations of PhD students based on peer-reviewed scientific articles (in general four per PhD study);
- Striving for all PhD students to be members of the national research school ICO;
- Allowing PhD students to enter our research programme only after their research plan has been approved (by the Scientific Committee of ICO or an equivalent thereof, such as NWO / NRO);
- Opportunities for staff, including PhD students and post docs, to go to conferences to present and share their work and getting feedback (ESoE has a separate budget for this);
- Regularly receiving or inviting visiting scholars as well as visiting scholars at universities abroad.

2.2.2 CONTRIBUTION TO EDUCATIONAL PRACTICE

As written in Section 1.1, ESoE strives for high quality research with much societal impact in the STEM domain of teaching and teacher education. ESoE researchers see the combination of doing both scientifically and societally relevant research as essential to their work. They are not seen as opposed to each other but as reinforcing each other, as also becomes clear in the examples given in Section 2.3.2

of this report. One and the same research project of ESoE makes it possible, for example, to publish in scientific journals and to present on scientific conferences on the one hand, and to collaborate with teachers in schools in the dissemination of results, in addition to publishing in professional journals for teachers and presenting conferences for practitioners on the other.

2.2.3 EDUCATION AND PROFESSIONALIZATION OF PHD STUDENTS

Central to the research programme is the training and supervision of PhD students to becoming researchers who are able to conduct independent research of high quality after their PhD. ESoE strives to deliver PhD students who are able to do both quantitative and qualitative research in their research projects, preferably a combination of both. For their PhD training and participation in a network, ESoE strives to ensure that as many PhD students as possible are members of the national research school ICO, including the part-time PhD students (see also Section 3.2).

Doing a PhD study, particularly by teachers who are also part-time PhD student, can have much impact on not only their personal professional development but also on the improvement of their schools in general[5]. Particularly when their schools have their own research and innovation agenda, which is increasingly the case in schools today. With their research projects, PhD students can play an important role in the (further) development and implementation of these agendas.

2.3.4 STENGTHENING RESEARCH COOPERATION WITH SCHOOLS AND THE TU/E

A programme like DUDOC and the NWO scholarship possibilities for teachers to do a PhD study aim at bridging the gaps between scientific research and educational practice. This also counts for the calls by NRO since 2014 for doing practice-oriented research in close cooperation – and later in the form of consortia – with teachers in schools (see appendix B for examples). Because of ESoE's teacher education programme, secondary schools have always been very relevant partners of ESoE. New research possibilities for teachers and playing a prominent role in this by ESoE researchers strengthens ESoE's partnerships with schools and, through that, the realization of the ESoE mission. ESoE finds it important to invest in networks with schools and to design practice-oriented research with schools and other partners involved in these networks (e.g., other teacher education and research institutes). For example, the scientific staff of ESoE provides workshops and lectures for teachers/schools, and supports teachers in schools in their development of knowledge and skills in the field of educational research, including the supervision of their research in their schools (see also appendix E). The strategy to strengthen the research cooperation with schools is supported by the report of the sectoral education sciences committee on the current state of affairs in educational research in the Netherlands and by the recommendations in the report to bridge the gap between educational research and educational practice, among other things[6].

ESoE's role in innovation projects of the Faculties of TU/e has grown gradually over the period 2013-2018. This is due to: (1) educational research and development projects initiated by the 4TU Centre of Engineering Education (CEE)[7], (2) the growing need for educational research that accompanies innovations or educational changes in the TU/e and the implementation of the Bachelor College and Graduate School at TU/e, and (3) ESoE's own personnel investment in participating in the educational innovations of TU/e. A good example of this latter type of investment pertains to the contribution of

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[5] Cf. Bakx, A., Bakker, A., Koopman, M., & Beijaard, D. (2016). Boundery crossing by science teacher researchers in a PhD programme. *Teaching and Teacher Education, 60*, 76-87.

[6] Commissie Sectorplan Onderwijswetenschappen (2014). *Sectorplan Onderwijswetenschappen. Wetenschap voor het onderwijs.* Den Haag: VSNU. [Sector plan Educational Sciences. Science for education]

[7] For detailed information about the 4TU.CEE see: https://www.4tu.nl/cee/en/

prof. dr. Den Brok to TU/e's educational vision 2030 regarding the education of future engineers[8]. ESoE finds it important that its staff participates in different committees and task forces within TU/e related to education in the Bachelor College and Graduate School (see also appendix F for these activities in the period 2013-2018).

In sum, ESoE is increasingly seen as a relevant partner in innovations by schools and the TU/e faculties. In turn, these growing partnerships strengthen the realization of ESoE's mission. In view of viability of ESoE's research, ESoE will therefore continue and intensify investments in the cooperation with schools and the faculties of TU/e. This strategy is being strengthened in the appointment and promotion of academic staff at ESoE.

2.3 RESULTS

2.3.1 RESEARCH QUALITY

Research output

Table 2.4 presents the research output of ESoE for 2013-2018. The column 'Average period 2007-2012' makes it possible to compare the current with the previous evaluation of the output. There are some fluctuations with an increase and decline of refereed scientific articles in 2013 and 2016/2017 respectively. In turn, particularly 2016 shows a peak in dissertations and scientific book chapters. On average, the evaluation years 2013-2018 resemble the average of the years 2007-2012. Appendix C presents a complete list of the publications for this six-year period for each category of Table 2.4.

Table 2.4: Research output.

	Average period 2007 - 2012	2013	2014	2015	2016	2017	2018	Total period 2013 - 2018
Refereed scientific articles (1)	*21*	27	18	19	12	14	18	108
Other refereed scientific articles (2)	*3*	1	3	1	3	2	0	10
Scientific books (monographs)	*1*	0	0	1	1	0	0	2
Scientific book chapters (3)	*4*	5	7	3	8	4	4	31
subtotal	*29*	*33*	*28*	*24*	*24*	*20*	*22*	*151*
Dissertations	*4*	5	2	2	7	4	1	21
Conference papers (4)	-	11	11	30	14	20	17	103
Professional & other publications (5)	*14*	13	19	11	12	10	12	77
Other (inaugural lectures, keynotes)	-	1	0	6	3	0	2	12

(1) Articles in peer-reviewed journals either accepted by ICO (national research school in education) or published in ISI journals.
(2) Other peer-reviewed journal articles but not on the ISI or ICO list.
(3) Chapters accepted by ICO and published by internationally scientific publishers of which the authors can show two anonymous reviews.

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[8] Meijers, A.W.M., & Brok, P.J. den (2013). *Engineers for the future: An essay on the education at TU/e in 2030*. Eindhoven: TU/e.

(4) Including papers published in proceedings. This list gives an impression but is not complete. In combination with appendix C it primarily gives an indication of the kind of conferences ESoE staff is attending.

(5) Publications aimed at professionals in the public and private sector.

The following five refereed scientific articles are key publications of ESoE and illustrative for the research programme 2013-2018:

- Bergh, L. van den, Ros, A., & Beijaard, D. (2014). Improving teacher feedback during active learning: Effects of a professional development program. *American Educational Research Journal, 51*(4), 772-809.
- Leeferink, H., Koopman, M., Beijaard, D., & Ketelaar, E. (2015). Unravelling the complexity of student teachers' learning in and from the workplace. *Journal of Teacher Education, 66*(4), 334-348.
- Pepin, B., Gueudet, G., & Trouche, L. (2017). Refining teacher design capacity: Mathematics teachers' interactions with digital curriculum resources. *ZDM-Mathematics Education, 49*(5), 799-812.
- Putter-Smits, L.G.A. de, Taconis, R., & Jochems, W.M.G. (2013). Mapping context-based learning environments: The construction of an instrument. *Learning Environments Research, 16*(3), 437-462.
- Thurlings, M.C.G., & Brok, P.J. den (2017). Learning outcomes of teacher professional development activities: A meta-study. *Educational Review, 69*(5), 554-576.

Membership of editorial boards and scientific organizations

Members of the scientific staff were/are in this period in the editorial boards of several scientific journals, both in STEM education as well as in more general educational journals (see Table 2.5 for an overview of editorial activities). In addition, scientific staff are members of national and international scientific organisations like the VOR, ESERA, EARLI, AERA, ISATT, or NARST (see appendix D). They present their research results on the conferences of these and other organizations. This also applies to participation in national, more professional conferences like VELON, Woudschoten, and the annual NRO conference for practice.

Table 2.5: Membership of editorial boards for the period 2013-2018.

Staff-member	Journal / publication	Role	Period
Prof. dr. Beijaard	Teachers and Teaching: Theory and practice	Executive editor	2004-2015
	Teachers and Teaching: Theory and practice	Associate editor	2015-present
	Teaching and Teacher Education	International editorial board member	2010-present
	Sage Handbook of Research on Teacher Education (published in 2017)	Section editor	2014-2016
	Encyclopedia of Teacher Education, published by Springer	Section editor	2017-2019

Staff-member	Journal / publication	Role	Period
Prof. dr. den Brok	Learning Environments Research	European editor	2013-2017
	Educational Research and Evaluation	Associate editor	2013-2017
	The Open Education Journal	Associate editor	2009-present
	Teachers and Teaching: Theory and Practice	Associate editor	2007-present
	Asian-Pacific Journal of Educational Research and Synergy	Associate editor	2008-2014
	Book series Advances in Learning Environments Research, Sense Publishers	Editorial member	2012-present
Prof. dr. Pepin	ZDM- International Mathematics Education	Associate editor	2011- present
	Journal for Mathematics Teacher Education	Associate editor	2013- present
	Educational Review	International Editorial Board member	2014- present
Prof. dr. Vermunt	Learning and Instruction	Member of the International Editorial Advisory Board	2018-present
	Educational Research Review	Member of the Editorial Board	2005-present
	Empirical Research in Vocational Education and Training	Member of the Editorial Advisory Board	2008-present
Dr. Taconis	Tijdschrift voor Didactiek van de Bètawetenschappen	Editorial member	2008-2013
Dr. van den Beemt	International Journal of Games and Computer Mediated Simulations	Editorial review board	2007-present
Dr. Koopman	Teachers and Teaching: Theory and practice	Associate editor	2013-present
Dr. de Putter-Smits	Tijdschrift voor Didactiek van de Bètawetenschappen	Editorial member	2012-2013

Staff also reviews manuscripts for journals *not* listed in Table 2.5, most frequently for: Journal of Teacher Education, Research in Science Education, European Journal of Teacher Education, Learning Environments Research, International Journal of Science and Mathematics Education, Pedagogische Studiën, International Journal of Engineering Education, Cambridge Journal of Education, Journal of Research in Science Education, and Computers and Education.

Research cooperation

Research cooperation in the Netherlands in particular takes place through:

- So-called "NWO-interlinked research projects" which consist of interlinked PhD projects (usually three) often added with a Postdoc project. In the evaluation period 2013-2018 this

took place twice, one with Utrecht University and the University of Leiden and one with Erasmus University Rotterdam and the University of Leiden.

- Doing practice-oriented and more short-term research projects with colleagues from other universities and research institutes like ECBO and with schools in so-called 'consortia' (all funded by NRO).
- Participating in the supervision of PhD students from other universities. In the period 2013-2018, for example, PhD students at the Open University, University of Twente, and Wageningen University and Research Center.

International research cooperation of ESoE staff takes place through:

- Participation in an international research project. ESoE staff members participate in the international research project "Early Career Teachers' Professional Agency Across Four European Countries". The study is funded by the Finish Academy and administered and managed by a scientific research group in Finland and international participants from Sweden, the UK, and the Netherlands.
- Writing scientific publications with colleagues abroad, for example in the field of mathematics education with colleagues from France, the UK, and Germany (see also Appendix C).
- invitations as visiting professor at universities abroad, such as in Finland (Turku) and Australia (Sydney), and visits of ESoE PhD students to universities in Finland (Helsinki, Jväskylä).

International cooperation usually takes particularly place through different kinds of participation in scientific conferences (see also appendix D).

2.3.2 RELEVANCE TO SOCIETY

ESoE's scientific research is practice-oriented. The reason for giving examples in this Section to illustrate the impact or added value to society, i.e., educational practice are two-fold:

- They demonstrate that ESoE's research is practice-oriented. More specifically, they demonstrate that the research questions stem from educational practice and that much research happens in close cooperation with teachers, often in the context of innovation.
- They provide insight into ways in which ESoE's research products and outcomes of research are used for teachers' professional development and/or in supporting teachers and schools with the development and implementation of innovations.

Next to these examples, activities of the scientific staff of ESoE for societal parties will be summarized. These activities provide a more complete picture of how ESoE makes research results available to a wider audience in terms of publications for professionals in practice and different kind of outreach activities like workshops and lectures for practitioners. Finally, in order to realize the social relevance of ESoE's research, it is found essential that the staff is actively involved in educational practice. Staff members are therefore part of different committees, organizations and working groups that are important for education as will also be demonstrated in this Section.

Examples of societal relevance

EXAMPLE 1 - TEACHERS' PROFESSIONAL IDENTITY (DEVELOPMENT): Teachers' professional identity has been a research topic of D. Beijaard and several of his PhD students (e.g. M. Pillen[9] and A. van der

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[9] Pillen, M.T. (2013). *Professional identity tensions of beginning teachers*. Dissertation. Eindhoven: TU/e.

Want[10]) for many years. In teachers' professional identity, teaching and learning to teach are seen as complex activities of the teacher as a person and as a professional. Both these dimensions of becoming a teacher play a role. In their interplay they offer serious implications for professional development, often called 'identity work' in the literature (e.g. how to reconcile the personal and professional in becoming a teacher and how to cope with tensions between both and transform these into learning moments). In many teacher education programmes identity work is taking place nowadays, particularly related to workplace learning (i.e., students' internship). ESoE participates in a national four-year project on the development and implementation of induction programmes for beginning teachers. In the induction programme of the 'Eindhoven region' with 20 participating schools for secondary education, much emphasis is placed on beginning teachers' (further) professional identity development through identity work. This is done by so-called identity workshops and doing and discussing assignments in a digital platform, encouraging beginning teachers to reflect on and make sense of relevant aspects of their professional identity (developed by J. Mommers, G. Schellings, and D. Beijaard). As a result of ESoE's participation in the national project, knowledge has been developed and shared in the form of professional publications and contributions to scientific and practice-oriented conferences (see for example the book *"Begeleiding startende leraren" [Supporting beginning teachers]*[11] about the results of the project)[12]. The assignments are also used in ESoE's teacher education.

EXAMPLE 2 - LEARNING TO TEACH WITH AN EARLY FOCUS ON STUDENT LEARNING: It is a great challenge to have student teachers focus sooner and more on student learning during teacher education. This topic has been the object of research by the work of M. Swinkels (an ESoE PhD student)[13] and is increasingly perceived as very relevant by teachers and schools. The results of this research have been used in at least two manners. Firstly, these results – pertaining to deep and active learning, constructivism, and teacher education learning environments to enhance these kinds of learning – have been used as a strong basis of the current so-called 'leerateliers' (learning ateliers). Learning ateliers are professional learning communities in which student teachers (n=4-5), experienced teachers (n=4), and one teacher educator learn from each other and together develop lessons and curricula that emphasize and provoke student learning (based on a student learning perspective instead of a teaching-of-subject-matter perspective). After three years of experimenting, two of which co-financed by participating schools, teacher education institutes, and NRO, these learning ateliers have become a regular route for student teachers. In 2019, in total there are six of such ateliers in which more than 16 secondary schools of OMO participate (OMO is the abbreviation of "Ons Middelbaar Onderwijs", an association of a large number of secondary schools in the south of the Netherlands with one school board). OMO strongly believes in this perspective of teaching and learning to teach and on its impact on colleagues in schools[14]. The ESoE researchers on this topic are members of the project group that steers the learning ateliers, they co-develop the educational programme for the participants of the learning ateliers, act as guest speakers / lecturers in the learning ateliers, and investigate the effects of the learning ateliers on (student) teachers' learning and professional development. Secondly, the research on learning to teach with an early focus on student learning serves as an important source of inspiration for redesigning ESoE's own teacher education programme. This will result in a reformed curriculum that will be implemented in September 2021.

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[10] Want, A.C. van der (2015). *Teachers' interpersonal role identity.* Dissertation. Eindhoven: TU/e.

[11] Schellings, G., Helms-Lorenz, M. & Runhaar, P. (Red.) (2018). *Begeleiding startende leraren: Praktijk en theorie*. Antwerpen/Apeldoorn: Garant. [Supporting beginning teachers: Practice and theory]

[12] See also: http://www.begeleidingstartendeleraren.nl/

[13] Swinkels, M. (2017). *Learning to teach with a focus on student learning*. Dissertation. Eindhoven: TU/e.

[14] See also: https://www.omo.nl/werken-en-leren-bij/leren-bij/leerateliers/cDU572_Leerateliers.aspx

EXAMPLE 3 - PROFESSIONAL LEARNING COMMUNITY ON STIMULATING TALENT DEVELOPMENT BY MEANS OF INQUIRY-BASED LEARNING: In this professional learning community, STEM teachers from four different secondary schools were professionalized in designing inquiry-based learning environments for their students. Eight meetings per school year were held during three years. J. Doppenberg (former PhD student of ESoE) acted as facilitator and M. Vos (also former PhD student of ESoE) brought in domain-specific knowledge on inquiry-based learning. Their approach built on knowledge and experience from both their PhD projects (Doppenberg on collaborative teacher learning[15] and Vos on context-based STEM education[16]). In the meetings, teachers were confronted with different perspectives on inquiry-based learning, they exchanged ideas with experts, and shared experiences regarding designing inquiry-based learning environments and guiding students therein. Participating teachers first experimented with small-scale activities; in the following years they improved and extended these into lesson series or projects. They shared the knowledge and experiences they developed with colleagues in their schools. As from 2017, participating teachers from three of the four schools got a leading role in further implementing inquiry-based learning in their schools.

EXAMPLE 4 - CONTEXT-BASED SCIENCE EDUCATION: Within ESoE, two PhD studies (M. Vos and L. de Putter-Smits[17]) were conducted on context-based science education. The interest for this pedagogical approach stems from the new curricula for biology, chemistry, and physics that were implemented in 2013. Teachers in secondary schools were both curious and uncertain about this educational reform. Both during and after the PhD trajectories, workshops for teachers were organized by Vos and De Putter-Smits to aid teachers wanting to incorporate a more context-based approach in their science classes. A 'TEDtalk-like' video was made to convey the message from the PhD study to the teachers[18]. A part of the instrument used by De Putter-Smits to measure context-based learning environments is now used in the Master SEC of ESoE, to provide student teachers with an idea of how context-based their teaching is experienced by their students. Students from other teacher education institutes and (international) researchers use the instrument in their master theses and research as well.

EXAMPLE 5 - STEM TEACHERS' WORK WITH CURRICULUM RESOURCES AND TEXTBOOKS: In recent years, B. Pepin has been working work with master students, Dudoc PhD students and post docs focussed on "STEM teacher interaction with curriculum resources" (digital or non-digital). This has resulted in professional development activities in schools. The work has included analysis of existing materials and support for teachers to design and evaluate new materials for teaching. Crucial has been the notion of teacher design and the development of teacher design capacity in schools. In particular, the post doc (and Dudoc PhD) teachers have designed and tested new curriculum materials (including digital materials), first for their own classrooms and subsequently for their work with colleagues (who have used and evaluated them in their classrooms). For example, D. Gijsbers (Beekvliet Gymnasium)[19] has developed and evaluated (together with B. Pepin and L. de Putter-Smits) assignments for mathematics D work on differential equations, to show students the relevance of differential equations in other subject areas than mathematics (e.g. economics, biology, physics). Subsequently, this

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[15] Doppenberg, J.J. (2012). *Collaborative teacher learning: Settings, foci and powerful moments.* Dissertation. Eindhoven: TU/e.

[16] Vos, M.A.J. (2010). *Interaction between teachers and teaching materials: On the implementation of context-based chemistry education.* Dissertation. Eindhoven: TU/e.

[17] Putter-Smits, L.G.A. de (2012). *Science teachers designing context-based curriculum materials: Developing context-based teaching competence.* Dissertation. Eindhoven: TU/e.

[18] Also available online (https://www.youtube.com/watch?v=OfNFHsvZkgY).

[19] Gijsbers, D.A.H., de Putter-Smits, L. & Pepin, B. (2019). Changing students' beliefs about the relevance of mathematics in an advanced secondary mathematics class. *International Journal of Mathematical Education in Science and Technology.* DOI: 10.1080/0020739X.2019.1682698.

intervention was amended, enacted, and evaluated in collaboration with selected colleagues (in his and a neighbouring school), for their teaching of differential equations, and finally its relevance and practicality evaluated by a larger group. This work has now spread to neighbouring schools, and selected colleagues from other parts of the country (and their school boards) have asked for support with this topic area. Hence, Gijsbers has developed an educative curriculum module for practicing teachers on the topic of differential equations for mathematics D classes.

EXAMPLE 6 - OUTREACH AND STUDENT MOTIVATION IN THE K-12 STEM FIELD: TEACHERS' ROLES AND THE CONNECTION BETWEEN INDUSTRY AND SCHOOL: PhD student J. Vennix[20] has been conducting a study on how outreach activities can be used to make students in secondary education enthusiastic for STEM and careers in STEM. Outreach activities are in-field activities that are meant to give students a complete picture of possibilities in the field of STEM, initiated by the industrial and corporate world in close interaction with schools. In the study, motivational aspects related to outreach activities were investigated. Motivational profiles were created that can be used to confront students with activities they benefit most from, according to the characteristics of the profile they belong to. Thirty five schools were participating. Eventually, these schools should be able to provide outreach activities to their students customized according to their needs. An instrument to select students for a most beneficial activity in terms of motivation and attitude will be constructed in cooperation with Brainport-schools as a result from the study.

EXAMPLE 7 - STIMULATING DEEP LEARNING IN SECONDARY EDUCATION: Many schools and teachers in secondary education are striving to make education attractive and relevant for students. Several of the innovations schools are implementing put deep student learning at the forefront. A research project of M. Koopman together with teacher-researchers from six schools of the AOS Zuidoost Brabant (an academic professional development school) focussed on discerning and describing the characteristics of learning situations that succeed in stimulating students' use of deep learning activities. Participating schools have used the results of the research project to underpin and improve the initiatives they were already taking. Several learning ateliers (see example 2) have used the research project as a source of inspiration for their own research and design activities. Descriptions how deep learning can be enhanced in real teaching practice were published and shared via a booklet[21], the professional journal 'Didactief', and several conferences visited by teachers. Approximately 270 printed versions of the booklet have been shared with (student) teachers and teacher educators throughout the country.

EXAMPLE 8 - DESIGN-BASED RESEARCH FOR UTQ (UNIVERSITY TEACHING QUALIFICATION; IN DUTCH 'BKO'): Providing feedback is important for student learning, yet, teachers find it hard to provide effective feedback. As part of an innovation project within the four technical universities in the Netherlands (4TU Centre of Engineering Education – 4TU CEE), M. Thurlings, together with people from the educational support staff of TU/e ("DPO-teach") and the TU/e department of Industrial Design (M. van Diggelen, former PhD student of ESoE), developed materials to be used by TU/e teaching staff for providing feedback. The innovation project leaned on Design-Based Research. To better grasp current practices in providing feedback, academic teachers and educational directors from the nine TU/e faculties were interviewed. The interviews focused on their practical knowledge concerning learning and feedback, taking into account that reasoning from different learning theories would mean that

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[20] Vennix, J., den Brok, P., & Taconis, R. (2018). Do outreach activities in secondary STEM education motivate students and improve their attitudes towards STEM? *International Journal of Science Education*, *40*(11), 1263-1283.

[21] Koopman, M. (2017). *Diep leren: praktische handreikingen voor het bevorderen van diep leren bij leerlingen in het voortgezet onderwijs*. Eindhoven: TU/e. [Deep learning: practical guidelines for promoting deep learning among students in secondary education]

effective feedback has different characteristics. Analysing the data showed indeed a relationship between learning theories and feedback. In the interviews, the participants were additionally asked about their needs on professional development materials for providing feedback: what and how they would like to learn. The next phase in the project was to develop these materials, in an iterative process with a number of the interviewed teachers and educational directors participating in sounding board sessions. The materials leaned on Hattie and Timperley's (2007) model for feedback and the dissertation studies of M. Thurlings[22] and M. van Diggelen[23]. The final products were: (a) a self/peer assessment form with a manual that is used in UTQ courses and (b) a manual for for coaching individual academic teachers that aim to enhance their feedback skills. These products were also presented at conferences for practitioners.

Reports, professional publications and outreach activities for societal parties

As can be concluded from the examples above, ESoE undertakes numerous activities to make research results available to societal parties. Moreover, products such as reports and articles in professional journals are written to make research results available to a broader public. In this section, we provide a more complete picture of our activities to make research results available to a wider audience, by categorizing these activities and giving some examples per category:

- Reports are written about innovation projects in secondary and higher education (see e.g. reports on projects related to the Centre of Engineering Education[24]).
- Professional publications, such as books and articles meant for teachers and other educational professionals (e.g. Beijaard's book "Weten wat werkt" in 2016 [*knowing what works*] for teacher educators, Van den Beemt's book "Leren met interactieve media" in 2016 [*Learning with interactive media*] for students in teacher education, Koopman's book "Diep leren: praktische handreikingen voor het bevorderen van diep leren bij leerlingen in het voortgezet onderwijs" in 2017 [*Deep learning: practical guidelines for promoting deep learning among students in secondary education*] for teachers and students in teacher education, and several publications in Didactief).
- Occasional workshops, lectures, and keynotes for teachers and other educational professionals (e.g. a short conference at the end of the "Leraren leren als gelijken" [*Teachers learning as equals*] project of Thurlings and Den Brok and presentations at the NRO, VELON and Woudschoten conferences).
- Training or professional development programmes for teachers (e.g. on 'fraction education', 'eliciting meaningful learning by Enriched Skeleton Concept Mapping, and 'making practical work more relevant').

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[22] Thurlings, M. (2012). Peer to peer feedback: A study on teachers' feedback processes. Dissertation. Heerlen: Open Universiteit.

[23] Diggelen, M.R. van (2013). *Effects of a self-assessment procedure on VET teachers' competencies in coaching students' reflection skills*. Dissertation. Eindhoven: TU/e.

[24] Some examples are:
- Diggelen, M. van, Thurlings, M., Weert, C. van, Morgan, C., & Tops, A. (2016). Opvattingen van docenten over leren, doceren en feedback in het Hoger Onderwijs. *Tijdschrift voor Hoger Onderwijs, 34*(1), 56-78. [Teachers' views on learning, teaching and feedback in higher education]
- Huijben, J.C.C.M., Wieczorek, A.J., Beemt, A.A.J. van den, Verbong, G.P.J., & Marion, M.H. van (2016). *Expedition energy transition: Lessons learned from an educational co-creation experiment*. Eindhoven: TU/e.
- Theelen, H., Willems, M.C., Beemt, A.A.J. van den, & Conijn, M.A. (2016). *Virtual internships in teacher education*. Eindhoven: TU/e.

- Training cohorts of secondary school teachers from (academic) professional development schools in doing practice-oriented research and supervising their research projects in their own schools.
- Participation in professional learning communities and/or so-called DOTs ('docentontwikkelteams' [teacher development teams]; e.g. on inquiry-based learning and stimulating students' creative thinking; either as expert, co-designer, or facilitator).

In Appendix E outreach activities of staff members of ESoE in the form of workshops and lectures are provided. Section 2.3.2 clearly illustrate that ESoE's societal relevance particularly pertains to the professional development and work of teachers in secondary and higher education, including teacher educators.

Membership of advisory boards and professional organizations

ESoE staff members take part in several advisory boards and professional organizations. Memberships of (civil and within university) advisory boards, taskforces, and committees are provided in Appendix F.

2.3.3 VIABILITY: DEVELOPMENT IN THE RESEARCH PROGRAMMME

As explained in Section 1.2, ESoE became operational in 2007 as a joint institute of the TU/e and Fontys University of Applied Sciences. The research of all teacher education institutes of Fontys and TU/e was brought together in the ESoE research programme. At the centre of the programme was teachers' professional development and the support of teachers in the development and innovation of their education. This first research programme covered teacher education and the further professional development of teachers offered by different types of teacher education institutes and spread over all sorts of school subjects and topics important to those institutes. The research programme had in common the focus on the professional development of teachers and doing practice-oriented scientific research. In 2010, Fontys decided to withdraw from the partnership with the TU/e and it was decided that ESoE would continue as an independent institute of TU/e. For ESoE, this meant completing the PhD projects of the staff of Fontys that were still ongoing and creating more focus in the research programme.

The first years of this transition period of ESoE's research programme (2012-2014) can be characterized by a change towards a focus on STEM teachers' professional learning and development in both secondary and higher education and supporting STEM teachers in the development and innovation of their teaching. ESoE implemented this change in a newly formulated research programme (see appendix G). A period with also new funding opportunities for research as well, especially for PhD studies by teachers and for practice-oriented research in both secondary and higher education including TU/e. The current research focus on both teacher professional development and STEM education aligns much with ESoE's teacher education programme, the expertise of the scientific staff, and the mission and vision of TU/e.

In the next research period from 2020 onward, the successful research strand on preparing and supporting teachers for innovative STEM learning will be continued. This research will be extended with two new developments. First, responding to increasing interest from our research environment, teachers in higher education will be included as a focus of this research much more than before. Innovations in higher STEM education like challenge-based learning raise many questions about the expertise university teachers need to be able to fulfil new roles in novel educational models. Second, questions about the optimal pedagogy of innovative STEM teaching and learning in secondary and higher education will be addressed more prominently in the future research program of ESoE. Good funding opportunities exist in both new directions. In these endeavours, research and development will

go hand in hand, aligned with ESoE's mission to contribute to both scholarly advancement as well as to improvement of educational practice. Such an approach resonates very well with the engineering education environment of the School.

3.1 ENROLMENT AND SUCCESS RATES

Table 3.1 gives an overview of the enrolment and success rates of the PhD students who got their PhD in the period 2013-2018 (n=21). This table presents all types of PhD students ESoE has: see Table 2.1 and 2.2. Furthermore, Table 3.1 excludes PhD students who stopped in the period 2013-2018; in this period four PhD students stopped: one after 3 years; two after 1 year; one after 4 months. Two of them could not combine their work as a teacher in secondary school with the work as PhD (one was meanwhile dealing with specific private circumstances which made it too much for her). One decided not to continue because of other job aspirations and the other one turned out to be insufficiently qualified for doing a PhD.

Table 3.1 shows a few outliers regarding the length of their PhD trajectory, due to maternity leave, having a full time job after their formal PhD time, change of job and/or of supervision team; they nevertheless finished their dissertation without extra allocated time. For the other PhD students, it can be concluded that they did their PhD study in acceptable timeframes given the fact that most of them were part-time PhD students with an appointment for research of 0.4 or 0.6 FTE respectively. Appendix H gives a complete overview of finished and ongoing PhD projects in the period 2013 -2018.

Table 3.1: Enrolment and success rates period 2013-2018.

Starting year	Enrolment			Success rates after…						
	Male	Female	Total (M/F)	4 years	5 years	6 years	7 years	8 years	9 years	10 years
2007	2		2			1			1	
2008	3	3	6		2	1		1		1
2009	3	2	5	2		1	1	1		
2010	3	2	5	1	1	2	1			
2011	0	1	1			1				
2012	0	1	0		1					
2013	1		1	1						
2014	1	1	2							
2015	2	0	2							
2016	2	1	3							
2017	0	0	0							
2018	3	3	6							

3.2 THE PHD PROGRAMME

3.2.1 SUPERVISION

Each PhD student is supervised by at least 1 promotor and 1 co-promotor (daily supervisor). On average, this whole team meets once a month; additionally, the PhD student and the daily supervisor meet each other – again on average – once in every two weeks. As such the PhD supervision follows the formal

guidelines of the Dutch research school ICO for supervising PhD students. Informally, the supervision is "on demand and tailor-made."

3.2.2 MEMBERSHIP OF THE NATIONAL RESEARCH SCHOOL ICO

Most PhD students are member of the Dutch research school ICO (see the ICO-website for extended information about ICO's organization, members, educational programme; etc.[25]). PhD students with an appointment of 0,6 FTE or more, are considered as regular member of ICO, those with a smaller appointment as irregular or part time member. Regular PhD students have to spend 600 hours of their research time to following courses (obliged are: the Introduction Course, the International Fall/Spring School, one national Fall/Spring School, and two thematic courses; the rest of the available education time, PhD students are free to choose other ICO-courses). Part-time PhD students are obliged to follow at least the Introduction Course and a Fall/Spring School; furthermore, they are free to choose other ICO-courses. ESoE PhD students often follow some additional courses not offered by ICO, such as the course 'academic writing', and statistical courses offered by TU/e or other universities.

To become a member of ICO, the PhD student's research proposal first has to be approved by the scientific committee of ICO. ESoE finds it important that its PhD students are member of ICO. In view of courses offered and network opportunities, ICO has much added value for them. Recently this has been acknowledged by the evaluation committee in its report on the research review of pedagogical Sciences and Educational Sciences 2011-2017. The committee concluded that:

- ICO fulfils a crucial role within doctoral education (quality);
- ICO offers opportunities to learn about social impact and valorisation strategies (societal relevance);
- The value of the ICO network to the breadth and depth of research training and its cost-effectiveness for the participating institutions are substantial strengths[26].

3.2.3 INFORMATION GUIDE FOR PHD STUDENTS

ESoE has developed a "Guide for PhD students" (available at the ESoE website) in which PhD students can find all the information needed (facilities, regulations, ICO, supervision, etc.). This guide for PhD students has been regularly updated, the last time in 2018[27].

3.2.4 MONITORING QUALITY OF EDUCATION AND SUPERVISION

ICO monitors the PhD students' satisfaction with their supervision, and the quality of the courses offered. Every two years ESoE is doing this for its own PhD students as well, with a focus on the quality

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[25] See: https://ico-education.nl/. ICO is led by a research director and educational director who are supported by a fulltime secretary. The Scientific Committee of ICO approves research plans of the PhD students and also functions as the examination committee. The Educational Committee of ICO discusses course evaluations and provides advice for course improvements and changes. The management team of ICO meets four times per year to discuss issues regarding the courses, meetings for PhD students, all kinds of other relevant issues and policies regarding research. Representatives of all the universities affiliated to ICO are member of this management team, one of them is also chair of the management team.

[26] Report on the research review of Pedagogical Sciences and Educational Sciences 2011-2017. A number of Dutch general universities participated in this review, including ICO, that took place according to the SEP protocol 2015-2021.

[27]See:
https://assets.tue.nl/fileadmin/content/universiteit/Over_de_universiteit/Eindhoven_School_of_Education/Onderzoek/Promovendi%20Gids%20ESoE%202018%20def.pdf

of the supervision of the PhD students. In general, ESoE PhD students are very satisfied about their supervision. In more detail, it can be concluded that, based on the last evaluation in February 2018:

- The PhD students graded their appreciation of their supervision with a 8,00 on a 10-point scale (was 7,64 in 2016);
- The scores on the 5-point supervision scales were (rather) high, varying from just below to far above 4,0;
- There were no significant differences in these scores among the PhD students regarding gender, type of PhD project, available time for research, and research phase; the results also count for the Chinese PhD students at ESoE based on an evaluation interview with them;
- There were no significant differences between the evaluation results of 2018 and those of 2014 and 2016.

It should be noted that some ESoE supervisors have been nominated regularly for and subsequently have won the "best supervisor prize" awarded at the annual conference of the VOR (the national educational research association).

3.2.5 EMBEDDED IN THE TU/E GRADUATE SCHOOL

ESoE's PhD programme is part of the TU/e Graduate School. This Graduate School officially started in September 2014. The Graduate School also offers schooling possibilities for TU/e PhD students. For ESoE PhD students these meetings are voluntary, except for the one-afternoon session about scientific integrity which is obligatory for all PhD students of TU/e and a course about Open Science (including Research Data Management). The TU/e Graduate School currently develops policy regarding the monitoring of the progress of PhD students, research integrity, and data management. Since 2017, steps have been taken regarding data management at ESoE (see Chapter 4).

3.2.6 PHD STUDENTS' CAREER DESTINATION

After their promotion, PhD students follow different career paths. Of the 21 PhD students who graduated in the period 2013-2018 these paths are the following:

- Most external PhD students (n=12) have taken on a leadership role in their own institute (university of applied sciences or secondary school) with responsibilities for specific task areas including doing practice-oriented research.
- Others (n=6) continued their work or were appointed at TU/e or at another research university respectively.
- Some (n=2) have become lector/professor in a university of applied sciences.

For one older external PhD student it is unclear what his promotion brought him. He was primarily intrinsically motivated to do his PhD study. In general it should be noted that the external PhD students' scientific development often exerted much influence on their colleagues in their own institutes already during their dissertation trajectory.

4. RESEARCH INTEGRITY AND DIVERSITY

4.1 INTEGRITY

4.1.1 CODES OF CONDUCT

Everyone involved in education and research at TU/e bears personal responsibility for observing and maintaining scientific integrity. At TU/e strict compliance with the overall principles of professional scientific conduct is required in all cases. ESoE adheres to three codes of conduct. That is, the Netherlands Code of Conduct for Research Integrity and its predecessors (KNAW/NFU/NWO/Netherlands Association of Universities of Applied Science/TO2 Federation/VSNU, 2018[28]), the Code of Scientific Conduct of TU/e (the most recent version became effective on January 31, 2019), and the code of conduct of the Dutch Educational Research Association (VOR) for doing scientific research. The TU/e Code fulfils the need for a more concise version. It also clarifies certain elements of the VSNU Code in the light of the specific characteristics of scientific activities at a technical university[29]. The VOR code applies specifically to conducting educational research[30].

4.1.2 INFORMED CONSENT AND ETHICAL REVIEW

Since the European Union GDPR became effective in May 2016, researchers at ESoE conducting research that involves personal data, such as data collected with teachers and students, are obliged to explicitly inform their participants and obtain their consent[31]. Via informed consent letters, teachers and students (and, if they are below 16 years of age, their parents) are informed that they participate in a research project, about the aims of the project, the manner in which data are collected, how their privacy and anonymity is guaranteed, and data storage. Teachers and students are explicitly informed that participation in the research project is completely voluntary and that they only participate in ESoE research when they give consent. All researchers at ESoE are informed about using these informed consent letters, different templates for informing different types of participants are made available, and the ESoE research coordinator can assist researchers in correctly filling out these templates. Information about obtaining informed consent was discussed in several meetings.

A TU/e ethical board for doing research involving human participants or recognizable data of individuals has recently been established. This board will check whether the expected gain of the research is in balance with the burden it puts on the participants. Important aspects in this balance are human dignity and protection of vulnerable groups and individuals. From January 1st 2020, ESoE researchers are obliged to make use of this ethical committee when personal data are collected. Before potential participants are approached to take part in their research study, they have to complete an ethical

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[28] See
https://www.vsnu.nl/files/documents/Netherlands%20Code%20of%20Conduct%20for%20Research%20Integrity%202018.pdf
[29] See https://www.tue.nl/en/research/scientific-integrity/
[30] See https://www.vorsite.nl/nl/content/gedragscode
[31] Before GDPR, at ESoE participants in interview and observation studies were generally informed during informal conversations with the researcher; participants in questionnaire studies were mostly informed via the invitation for filling out the questionnaire. Only in specific cases, for example when video data of lessons (including images of students) were gathered or when schools asked for written consent, written informed consent of the students or their parents was obtained. Since this does not suffice anymore, from 2016 onwards more strict procedures were developed by the ESoE research coordinator, assisted by the TU/e data steward, Chief Information Security Officer, and legal department.

review form (see appendix I) to be approved by the ethical board of TU/e. In December 2019, one of the ESoE staff members has become a member of this TU/e board.

4.1.3 DATA MANAGEMENT

Since 2016 NWO demands that researchers include a section on data management in applications for research projects. Also, making available research data to other researchers is encouraged. Based on these developments and the implementation of GDPR, ESoE has established a policy document on handling research data. This document has been shared with all researchers in 2017 (an update of this document is added as appendix L). Since then, data are generally stored in the personal SURFdrive environment of researchers, so that data are stored on secure servers in the Netherlands. Sharing data with researchers from other universities, for example when more parties are involved in a research project, is also possible via SURFdrive. Sometimes storage capacity of SURFdrive is not sufficient; in that case TU/e Zadara (a secure personal network environment) is being used. In the period 2013-2016, some small-scale experiments with data archiving and sharing have been conducted involving ESoE researchers and the TU/e Information Expertise Centre. Since 2018, data archiving facilities are available for all research projects that have been finished within ESoE itself. If ESoE researchers also want to share their data outside TU/e, the facilities of the 4TU.Research Data Centre are recommended. In 2018 all computers and laptops were encrypted by means of Bitlocker. Hands-on training on working safely was provided to all researchers in November 2019.

4.1.4 REFLECTION ON THE ROLE OF THE RESEARCHER

In some research projects at ESoE the researcher takes up different roles, for example combining the roles of designer of an intervention (such as a learning environment or a professional development programme), teacher or facilitator in an intervention, and researcher. In these cases, researchers are encouraged to construct a log or a process document. This can be used to check reliability of the data collection and analyses, for example by an audit procedure. Also, such a log stimulates reflection on the possible effects of combining multiple roles, as such contributing to objectivity.

4.2 DIVERSITY

TU/e strives for diversity in its community of students and staff. It is believed that diversity of nationality, gender, social background and cultural heritage adds to the success and pleasure in education and research, and that it broadens TU/e's research scope and enhances the quality of education of TU/e[32]. In ESoE's teacher education programme master SEC this diversity is not as fully reflected as in TU/e in general: most student teachers have a Dutch nationality becoming teachers in Dutch speaking schools in the Netherlands. Nevertheless, almost every year there are some students in the master SEC with a non-Dutch background. In addition, there is a possibility of following an international teacher education track.

ESoE's workforce is rather diverse, culturally, in disciplinary backgrounds, and in terms of gender. Members of the scientific staff, post docs, and PhD students come from different countries (next to the Netherlands these are: Greece, China, Germany, Colombia, Turkey, and United Kingdom). ESoE's staff differs in their disciplinary backgrounds, ranging from having a master's and doctoral degree in a specific STEM subject to a master's and doctoral degree in general educational sciences. These differences are reflected in ESoE's PhD students. They differ in support needs, but also benefit from each other's expertise, for example when designing a professional development programme for

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[32] See: https://www.tue.nl/en/our-university/about-the-university/diversity-and-inclusion/

teachers in the science subjects or when creating or using social-scientific tools and instruments for the collection and analysis of data.

The workforce of ESoE is diverse in gender, though with somewhat overrepresentation of men in the highest positions. This also counts for diversity in age: the top of ESoE as an organization consists of people with a fairly high seniority. Striving for balance in gender and age in ESoE's workforce is a point of attention when hiring new staff for the positions of associate and full professors or in the promotion of assistant professors as part of their tenure track.

5. SWOT ANALYSIS AND BENCHMARK

5.1 SWOT ANALYSIS

Strengths

- *Being seen by secondary and higher education institutes as a good partner where their teachers can do their research projects.* This has resulted in a number of teachers becoming a PhD student at ESoE (cf. DUDOC and the PhD scholarship for teachers) as well is in research projects together with or on behalf of schools (via NRO and through contracts with schools).

- *Doing practice-based scientific research.* Through this 'type' of research ESoE succeeds in: (1) publishing in highly ranked scientific journals in the domain of teaching and teacher education, (2) being nationally as well as internationally recognized as relevant scientific work by researchers with good reputations in their fields of expertise, and (3) having much impact on or added value for educational practice, including the own teacher education programme of ESoE and other teacher education institutes. This is also reflected in the balance between scientific publications and publications for the educational practice, including other valorisation activities like lectures and workshops for teachers/schools and on conferences for practitioners.

- *Research cooperation with other universities.* For example, in interlinked research projects financed by NRO, in the context of the DUDOC programme financed by the Ministry of Education, and in the national four-year lasting project on beginning teacher induction, in which universities and secondary schools have developed and investigated support programmes for beginning teachers in their first three years of their career as school teacher (financed by the Ministry of Education).

- *The ability and quality to combine or connect (educational and domain-specific) expertises in complex research and development projects.* This is due to the background and qualifications of the staff working at ESoE. For example, the project on supporting secondary school teachers to implement inquiry learning in their STEM education (see example 3 in Section 2.4.1) was led by an ESoE colleague with general educational expertise and an ESoE colleague being a subject expert with subject-specific educational expertise. Another example pertains to the four-year lasting 4TU.AMI project on blended learning, a combination of face-to-face education in mathematics and education supported by digital tools in the Bachelor College of TU/e. In this project, ESoE colleagues being subject experts with subject specific educational expertise worked together with subject experts from the faculty of Mathematics and Computer Science. In the context of educational innovations and accompanying research, the ESoE staff is highly adaptive to and skilled in working in multidisciplinary teams.

Weaknesses

- *Size of the research group.* The research group is relatively small with many other tasks and responsibilities leading to much work pressure when it comes to writing proposals, supervising research projects of temporarily appointed post docs and researchers next to their supervision of PhD students. ESoE's resources are limited, particularly with regard to funding opportunities that require much effort in relatively short periods of time.

- *Number of external PhD students.* ESoE's financing and execution of research depend much on external (part-time) PhD students, with its drawbacks such as flexibility in meetings and irregular influx of money due to annual fluctuations in the number of PhD graduates.

- *Seniority gap.* This gap exists between the associate professors and full professors. As said in Section 4.2, this is a serious point of attention when hiring new staff.

- *Structural dependency position with regard to financing from the TU/e.* There is a guarantee for a basic financing from innovation funds of the TU/e of approximately 1 FTE at assistant professor level. More funding, however, has to be acquired in competition as is also the case for additional funding of the faculties for their educational innovations. Reducing this kind of dependence may contribute to the stability of the workforce of ESoE and the possibility of more flexible deployment of its staff.

Opportunities

- *Research possibilities.* There are a number of (new) possibilities for research funding:
  - Within TU/e due to educational innovation agenda of TU/e in both its Bachelor College and Graduate School, for example with regard to challenge-based learning and learning analytics.
  - Within the 4TU Centre of Engineering Education (CEE) initiated educational innovations with accompanying research, for example regarding learning in innovation spaces and authentic learning in educating future engineers.
  - The increase of ESoE's collaboration with schools provides possibilities for research and development projects in schools, often with teachers as participants in so-called consortia and financed by NRO and the Ministry of Education (see Section 2.4.2 for examples); this collaboration also bridges gaps between research and educational and enables the valorisation of research results.
  - The governmental focus on teachers doing research and developing research skills and a research attitude as being important for their work in schools, which offers opportunities for teachers doing PhD and post doc research (DUDOC PhD/post doc, NWO PhD-scholarship).
  - Increase of possibilities for practice-oriented research on higher education and domain-specific education by NRO/NWO. For example, NWO/NRO recently selected ESoE to lead a large research consortium on teachers' professional learning and development in higher education. The consortium consists of representatives of several research universities and universities of applied sciences in The Netherlands. Members are a mixture of researchers, teacher-researchers and other educational professionals and the research to be undertaken will be practice-oriented in nature.
- *The potential of doing and actively participating in interdisciplinary projects by the staff of ESoE.* This is particularly relevant in projects with staff from the TU/e faculties. For example, recently a two-year project has started with the faculty Mechanical Engineering on supporting the staff to enhance their students' ownership of what and how they learn in project groups (see also the last point mentioned under strengths for more examples).

Threats

- *Much competition and limited budget to get scientific research funded.* As a consequence, it is difficult to realize continuity in acquiring funding. It often happens that very strong research proposals submitted to NRO/NWO cannot be funded, despite their very high quality rankings.
- *Increase in part-time PhD students and decrease in fulltime PhD students.* This makes the need of operating as a PhD group difficult with regard to participation in ESoE's core activities such as colloquia and other more formal and informal ESoE meetings that are important for being part of an organization.
- *Research projects in collaboration with TU/e faculties and schools are often not continuous.* When a project ends the collaboration often ends also, particularly with faculties of TU/e; it is difficult to realize long-lasting and productive collaborations with faculties.

For the period 2013-2018 ESoE has succeeded in implementing a more coherent research programme when compared to the previous one. More specifically, The ESoE staff considers themselves successful in:

- Publishing its research results in highly ranked scientific journals (appendix C);
- Being member of and participating actively in national and international scientific organizations in the domain of teaching and teacher education (appendix D; see also Table 2.5);
- Supervising PhD students and the realization of dissertations (appendix H);
- Establishing good collaborations for educational innovation and research with schools and increasingly with faculties of TU/e through participation in different kinds of internal and external consultative bodies and activities (appendix F);
- Valorising research results (appendix C and appendix E).

For benchmarking purposes, we analyzed our research output in the period 2013-2018 and compared it to the research output of three other research groups in the Netherlands. We selected these three groups based on the following criteria: (a) they were university teacher education institutes doing educational research, (b) they were separate organizational units within their university with a research programme related to teachers and teaching (i.e. no general educational science groups were included), and (c) they were comparable to ESoE in size (# of full professors, associate professors, and assistant professors).

SciVal was used to compare the four groups. SciVal is a web-based analytics tool that provides access to the research performance of research institutions and their associated researchers. SciVal allows for visualization of research performance and benchmarking relative to peers (http://scival.com). SciVal analyses are based on Scopus data. For the groups' research staff (full/associate/assistant professors[33]) publications, the total number of citations of those publications (excluding self-citations), mean citation score, field weighted citation impact, the extent to which publications are present in the top 5%, 10% or 25% of the most cited publications, and the average number of citations received by publications that have national or international co-authorship[34] were calculated and compared (see Table 5.1).

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[33] Groups were created based on information regarding their composition in December 2018; for ESoE excluding prof. dr. Vermunt (who started working at ESoE that month) and including prof. dr Den Brok (who left ESoE in 2017; see also appendix A).

[34] Please note that we have avoided the use of journal metrics as across the sector; it is advised to no longer use journal based metrics for research evaluation and decision-making purposes (e.g. DORA: https://sfdora.org/).

Table 5.1: Benchmarking research output 2013-2018

	# Pubs [1]	TCS [2]	MCS [3]	FWCI [4]	Top 5% Pubs [5]	Top 10% Pubs [6]	Top 25% Pubs [7]	Nat coll Imp [8]	Int coll Imp [9]
ESoE (n=11)	109	914	8,4	1,84	13%	30%	47%	10	11
Research group A (n=9)	58	231	4	0,8	1%	5%	25%	6	9
Research group B (n=10)	153	1442	9,4	1,71	13%	24%	47%	12	9
Research group C (n=7)	84	591	7	1,36	4%	11%	47%	7	7

(1) # Pubs = number of publications
(2) TCS = total number of citations, excluding self-citations
(3) MCS = mean citation score, equal to the average number of citations per publication (excluding self-citations)
(4) FWCI = field weighted citation impact. The ratio of citations received relative to the expected world average for the subject field, publication type and publication year. The Field-Weighted Citation Impact applies to a current plus 3 year citation window (including self-citations)
(5) Top 5% Pubs = indicates the extent to which an entity's publications are present in the most cited percentiles of a data universe: how many publications are in the top 5% of the most cited publications, self-citations are not taken into account; the calculation is field weighted
(6) Top 10% Pubs = indicates the extent to which an entity's publications are present in the most cited percentiles of a data universe: how many publications are in the top 10% of the most cited publications, self-citations are not taken into account; the calculation is field weighted
(7) Top 25% Pubs = indicates the extent to which an entity's publications are present in the most cited percentiles of a data universe: how many publications are in the top 25% of the most cited publications, self-citations are not taken into account; the calculation is field weighted
(8) Nat coll impact = average number of citations received by publications that have national co-authorship (i.e. across Dutch universities)
(9) Int coll impact = average number of citations received by publications that have international co-authorship.

The analyses show that the mean number of citations per publication at ESoE is comparable to that of research group B (8,4 versus 9,4) and higher than that of research group A (4) and C (7; see Table 5.1). The field weighted citation impact of ESoE's publications is higher than that of the other three research groups. The field weighted citation impact is an article-level metric that calculates citations received by an output divided by the expected citation rate for outputs of similar age, subject and publication type. For example, a value of 2 indicates that an output has achieved twice the expected impact relative to the world literature.

The top 5%, 10%, and 25% publications represent the extent to which the research groups' publications are present in the most cited percentiles of the field in which these are published. Table 5.1 shows that, compared to the other three research groups, a relatively large percentage of ESoE's publications are amongst the most cited in our field. For example, 13% of our staff's publications are in the top 5%, 30% are in the top 10%, and 47% are in the top 25%. This is largely comparable to Research group B.

Regarding our national and international collaboration in terms of publishing with researchers of other research groups, publications of ESoE co-authored by national researchers from other institutions have received 10 citations on average and publications co-authored by international researchers have received 11 citations on average.

Overall, the SciVal analyses show mostly positive results for the ESoE group. In particular, the field - weighted citation impact seems satisfactory in comparison to the other groups.

Role	Name (if mentioned: year start/end appointment)	FTE for research	Personal page on TU/e website
Full professor	Douwe Beijaard	0.4	https://www.tue.nl/en/research/researchers/douwe-beijaard/
	Perry den Brok (…-2017)*	0.4	https://research.tue.nl/en/persons/perry-j-den-brok
	Birgit Pepin (2015- …)	0.4	https://www.tue.nl/en/research/researchers/birgit-pepin/
	Jan Vermunt (2018-…)*	0.4	https://www.tue.nl/en/research/researchers/jan-vermunt/
Associate professor	Michiel van Eijk (✝2014)	0.4	
	Ruurd Taconis	0.4	https://www.tue.nl/en/research/researchers/ruurd-taconis/
Assistant professor	Antoine van den Beemt (2014-…)	0.4	https://www.tue.nl/en/research/researchers/antoine-van-den-beemt/
	Evelien Ketelaar	0.2	https://research.tue.nl/en/persons/evelien-ketelaar
	Maaike Koopman	0.4	https://www.tue.nl/en/research/researchers/maaike-koopman/
	Lesley de Putter-Smits (2014-…)	0.3	https://www.tue.nl/en/research/researchers/lesley-de-putter-smits/
	Wendy Sanders (2014-2016)	0.4	https://research.tue.nl/en/persons/wendy-tm-sanders
	Gonny Schellings (2014-…)	0.4	https://www.tue.nl/en/research/researchers/gonny-schellings/
	Alexander Schüler-Meyer (2018-…)	0.4	https://www.tue.nl/en/research/researchers/alexander-schueler-meyer/
	Marieke Thurlings	0.4	https://www.tue.nl/en/research/researchers/marieke-thurlings/

* Professor Den Brok was appointed as full professor at Wageningen University and Research Centre (WUR) in 2017. Up till now, he has a so-called "guest declaration" at ESoE. We therefore included him in our self-assessment regarding the period 2013-2018. Professor Vermunt was appointed full professor at ESoE in December 2018 and therefore we did not include him in our self-assessment.

RESEARCH GRANTS

Title /topic	Applicant	Fund provider	Duration	Total amount
PhD project on "Teachers' interpersonal role identity", being part of a larger research project on "Development of teacher competence during the professional career	P. den Brok	NRO	2009-2014	€ 226.843
Post doc project "The role of the teacher in improving education in the fractions domain: Teacher cognitions, teacher behaviour and student outcomes", being part of a research programme on primary mathematics education	K. Gravemeijer	NWO-PROO	2011-2015	€ 240.246
Review study "Leraren leren als gelijken" [*Teachers learning as equals*]	P. den Brok	NRO	2013-2014	€ 49.135
Research project "E-didactiek" [*E-didactics]*	A. van den Beemt	NRO	2015-2016	€ 49.500
Review study "Sociale media in de klas: Vloek of zegen" [*Social media in the classroom: Curse or blessing*]	A. van den Beemt	NRO	2015-2017	€ 45.984
Research project "Samen werken aan onderwijskwaliteit" [*Working together on educational quality*]	J. Doppenberg	NRO	2015-2018	€ 82.080
Post doc project "Teacher interactions in professional learning communities", being part of a research programme on "Professional learning communities in pre-vocational secondary schools: Effects of interdependency on differentiated teaching"	P. den Brok	NRO	2015-2020	€ 297.571
Research project "Excelleren als creatief technisch vakman" [*To excel as a creative technical professional*]	E. Ketelaar	NRO	2015-2020	€ 65.947
Research project "Systematisch en groepsgewijs differentiëren binnen beroepsgerichte lessen Techniek & Vakmanschap"	J. Doppenberg	NRO	2015-2016	€ 73.000

Title /topic	Applicant	Fund provider	Duration	Total amount
[*Systematic and group differentiation within profession-oriented lessons Technology & Craftsmanship*]				
Research project "Het bevorderen van diep leren in het voortgezet onderwijs" [*Promoting deep learning in secondary education*]	M. Koopman	NRO	2016-2017	€ 99.993*
Research project "Pilot werkplaatsen Onderwijsonderzoek" [*Pilot Educational research workplaces*]	D. Beijaard	NRO	2017-2019	€ 28.128

*Of which € 73.737 for teacher researchers in schools

RESEARCH CONTRACTS

Title /topic	Applicant	Fund provider	Duration	Total amount
PhD project "Science education for diversity"	M. van Eijk	FP7	2010-2013	€ 219.320
Serious gaming	R. Taconis	SLOA	2012-2013	€ 47.380
De technologische mavo in bedrijf [*The technological mavo in operation*]	R. Vink	KLOO	2013	€ 66.443
Betamentality Bachelor College	R. Taconis	Bachelor College TU/e	2013	€ 1.000
Schoolscience	D. Beijaard	Knooppunt W&T	2013-2014	€ 28.000
Tussentoetsen en activerende werkvormen in de propedeuse van het Bachelor College [*In-between tests and activating teaching methods in the propaedeutic phase of the Bachelor College*]	P. den Brok / D. Beijaard	Bachelor College TU/e	2013-2014	€ 25.920
Instructiebijeenkomsten als onderdeel van de leeromgeving [*Instruction meetings as part of the learning environment*]	D. Beijaard	Bachelor College TU/e	2013	€ 30.000
Afstandsleren VO [*Distance learning in secondary education*]	P. den Brok	Stichting Kennisnet	2012-2013	€ 45.760
Project "Non satis scire"	R. Taconis	SURF	2012-2014	€ 27.505
Galaxy: evaluation of a "blended learning" environment	P. den Brok	AO Metalelektro	2012-2014	€ 60.000
Implementatie van het concept Vakcollege [*Implementation of the concept of "Vakcollege"*]	J. Doppenerg / D. Beijaard	VSLPC	2013	€ 40.000

Implementatie van het Technasium [*Implementation of the Technasium*]	M. van Diggelen / P. den Brok	VSLPC	2013	€ 26.443
Kwalitatieve feedback leren vragen [*Learning to ask for qualitative feedback*]	R. Taconis	Innovation Fund TU/e	2013	€ 30.000
Project Video cases	R. Taconis	Kennisnet	2013	€ 30.792*
Tussentoetsen en begeleide zelfstudie in de propedeuse van het Bachelor College [*In-between tests and guided self-study in the propaedeutic phase of the Bachelor College*]	D. Beijaard	Bachelor College TU/e	2013-2014	€ 30.000
Science teaching and student diversity	M. van Eijk	VTB Pro / Platform Bèta Techniek	2013-2014	€ 40.000
Gamification	R. Taconis	Gemeente Eindhoven	2014-2015	€ 25.598
Professional Learning community "Talentontwikkeling door middel van onderzoekend leren" [*Talent development through inquiry-based learning*]	J. Doppenberg / D. Beijaard	OCW	2013-2018	€ 50.000**
Induction of beginning teachers	D. Beijaard	OCW	2013-2017/2019	€ 150.000***
Interdisciplinary engineering education	P. den Brok	CEE	2014-2016	€ 455.675
Peer review at TU/e	D. Beijaard	Bachelor College TU/e	2015	€ 20.000
Persoonlijk leren met ict: Didactiek, opbrengsten en professionele ontwikkeling [*Personal learning with ICT: Didactics, results and professional development*]	P. den Brok	Kennisnet	2015-2016	€ 71.000
E-didactiek: Flankerend onderzoek [*E-didactics: guided research*]	A. van den Beemt	Kennisnet	2015-2016	€ 15.000
Blended Master in embedded systems/EIT Digital	A. van den Beemt	EIT/Horizon	2015-2017	€ 80.000
Reducing classroom anxiety	A. van den Beemt	CEE	2016	€ 26.300
Evaluation of "De Nieuwste School" [*The Newest School*]	M. Koopman	OMO	2016-2017	€ 127.323
AMI (Applied Mathematics Institute) "Students' use of resources in first year university	B. Pepin	AMI & CEE	2016-2019	€ 140.000

mathematics education" (part of "Blended learning" project)				
Platoo Lab	M. Bekker	SURF	2016-2017	€ 30.000
Pedagogical support for mooc development	A. van den Beemt	EIT cross KIC	2018	€ 15.000
PhD project "In between testing in the Bachelor College of TU/e"	P. den Brok	TU/e	2013-2019	€ 200.000
PhD project "USE and Learning in the Bachelor College of TU/e"	B. Pepin	CEE	2018-2022	€ 200.000

*Total budget was € 70.166 of which 30.792 available for research

**Total budget was € 200.000 of which € 150.000 for participating teachers from schools

***Total budget was € 1.200.000 of which € 1.000.000 for development and training activities and for the participants from schools and partner institute Fontys University of Applied Sciences in this project

2013

Refereed scientific articles (isi / ico)

Akkerman, S. F., & Eijck, van, M. W. (2013). Re-theorising the student dialogically across and between boundaries of multiple communities. *British Educational Research Journal, 39*(1), 60-72. DOI: 10.1080/01411926.2011.613454.

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2016

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Dissertations

Gresnigt, H. L. L. (2018). *Integrated curricula: An approach to strengthen science & technology in primary education* Eindhoven: Technische Universiteit Eindhoven

Conference papers

An, P., Bakker, S., Ordanovski, S., Taconis, R., & Eggen, B. (2018). ClassBeacons: Designing distributed visualization of teachers' physical proximity in the classroom. In *TEI 2018 - Proceedings of the 12th International Conference on Tangible, Embedded, and Embodied Interaction* (Vol. 2018-January, pp. 357-367). New York: Association for Computing Machinery, Inc. DOI: 10.1145/3173225.3173243

Beijaard, D., Mommers, J., & Schellings, G. (2018). *Identity work in the context of an induction program for beginning teachers.* Paper presented at the Earli SIG Teaching and Teacher Education conference. Norway, Kristiansand.

Bombaerts, G. J. T., Doulougeri, K. I., Spahn, A., Nieveen, N. M., & Pepin, B. E. U. (2018). The course structure dilemma: Striving for Engineering students' motivation and deep learning in an ethics and history course. In R. Clark, P. Munkebo Hussmann, H-M. Järvinen, M. Murphy, & M. Etchells Vigild (Eds.), *Proceedings of the 46th SEFI Annual Conference 2018: Creativity, Innovation and Entrepreneurship for Engineering Education Excellence* (pp. 79-87). Brussels: Societe Europeenne pour la Formation des Ingenieurs (SEFI).

Heldens, H. P. F., Bakx, A. W. E. A., den Brok, P. J., & Van Waes, S. (2018). *Samenwerkingsnetwerken: Drie portretten van lerarenopleiders en hun netwerken voor samenwerking*. Paper

presented at the Onderwijs Research Dagen. The Netherlands, Nijmegen.

Hendrickx, M., Thurlings, M., & den Brok, P. (2018). *Docent-interacties binnen professionaliseringsactiviteiten: een review van analysestrategieën*. Paper presented at the Onderwijs Research Dagen. The Netherlands, Nijmegen.

Kock, Z. D. Q. P. (2018). Models of electricity in physics textbooks: Enabling or constraining inquiry based instruction? In O. E. Finlayson, E. McLoughlin, S. Erduran, & P. Childs (Eds.), *Electronic Proceedings of the ESERA 2017 Conference. Research, Practice and Collaboration in Science Education, Part 1* (pp. 212-223). Dublin, Ireland: Dublin City University.

Kock, Z. D. Q. P., & Pepin, B. E. U. (2018). Student use of resources in Calculus and Linear Algebra. In V. Durand-Guerrier, R. Hochmuth, S. Goodchild, & N. M. Hogstad (Eds.), *Proceedings of the Second Conference of the International Network for Didactic Research in University Mathematics (INDRUM 2018, 5-7 April 2018)* (pp. 347-356). Kristiansand, Norway: University of Agder and INDRUM.

Kock, Z-J., & Pepin, B. (2018). First year engineering students' selection and use of resources to learn mathematics. In H-G. Weigand, A. Clark-Wilson, A. Donevska-Todorova, E. Faggiano, N. Grønbæk, & J. Trgalova (Eds.), *Proceedings of the fifth ERME topic concference (ETC 5) on Mathematics Education in the Digital Age (MEDA)* (pp. 317-318). Copenhagen, Denmark: University of Copenhagen.

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Koopman, M. (2018). *Enhancing deep learning in secondary education: A multiple case study*. Paper presented at the Earli SIG Teaching and Teacher Education. Norway, Kristiansand.

Pepin, B., & Kock, Z. (2018). First year engineering students' use and orchestration of resources to develop actual student learning paths: The cases of Calculus and Linear Algebra. In R. Clark, P. M. Hussman, H-M. Jarvinen, M. Murphy, & M. E. Vigild (Eds.), *Proceedings of the 46th SEFI Annual Conference 2018 (SEFI 2018, 17-21 September 2018)* (pp. 357-364). Copenhagen, Denmark: Technical University of Denmark.

Schellings, G., Beijaard, D., Koopman, M., & Mommers, J. (2018). *Teacher's professional identity: configurations of personal and contextual factors.* Paper presented at SIG Professional Learning and Development. Geneva, Switzerland.

Taconis, R., Bekker, T., Bakker, S., & van der Sande, A. (2018). Developing the teach21 online authoring tool supporting primary school teachers in designing 21st century design based education. Paper *CSEDU 2018 - Proceedings of the 10th International Conference on Computer Supported Education* (Vol. 1, pp. 91-98). SCITEPRESS-Science and Technology Publications, Lda.

Thurlings, M. C. G., Hendrickx, M. M. H. G., & den Brok, P. J. (2018). *Samen (leren) differentiëren in het vmbo: Interacties tussen docenten in professionele leergemeenschappen.* Paper presented at the Onderwijs Research Dagen. The Netherlands, Nijmegen.

Thurlings, M. C. G., Hendrickx, M. M. H. G., & den Brok, P. J. (2018). *Samen (leren) differentiëren in het vmbo: Interacties tussen docenten in professionele leergemeenschappen*. Paper presented at the Onderwijs Research Dagen. The Netherlands, Nijmegen.

van den Beemt, A. A. J., Thurlings, M. C. G., & Willems, M. C. (2018). *Sociale media in de klas: Vloek of zegen?* Paper presented at the Onderwijs Research Dagen. The Netherlands, Nijmegen.

Zhang, Z., Bekker, M. M., Markopoulos, P., & den Brok, P. J. (2018). *Children's reflection-in-action during collaborative design-based learning.* Paper presented at the *ICL2018 − 21th* International Conference on Interactive Collaborative Learning. Greece, Kos*.*

Professional and other publications

Bouchée, T., & de Putter - Smits, L. G. A. (2018). Quantummechanica: Een abstracte uitdaging in natuurkundig filosoferen? *Nederlands Tijdschrift voor Natuurkunde*, *84*(11), 28-31.

de Beer, H. T., Gravemeijer, K. P. E., & van Eijck, M. W. (2018). Exploring instantaneous speed in fifth grade. *Educational Designer*, *3*(10), [18].

de Voogd, D. H., Schellings, G. L. M., & Quant, E. (2018). Het vlees verkleurt: Wat nu? Creatief denken gesteund door TRIZ-principes. *Terugkoppeling*, *27*(2), 19-21.

Dietzenbacher, Y., Voets, J., & de Putter - Smits, L. G. A. (2018). Een recept om van je kookboekpracticum af te komen. *Nederlands Tijdschrift voor Natuurkunde*, *84*(1), 26-28.

Helms-Lorenz, M., Koffijberg, J., Schellings, G. L. M., van der Wolk, W., Aarts, R., Runhaar, P., ... Flens, P. (2018). De driejarige begeleiding van startende leraren in Nederland. In S. de Vos, J. de Wilde, & S. Beausaert (Eds.), *Start to teach: Inspiratiegids over aanvangsbegeleiding in het onderwijs* (pp. 55-77). Antwerpen: Garant.

Koopman, M. (2018). *Evaluatieonderzoek De Nieuwste School: 2016-2017*. Eindhoven: Technische Universiteit Eindhoven.

Lawrenz, F., Gravemeijer, K., & Stephan, M. (2018). Correction to Epilogue (International Journal of Science and Mathematics Education, (2017), 15, S1, (125-128), 10.1007/s10763-017-9816-4). *International Journal of Science and Mathematics Education*, *16*(8), 1635. DOI: 10.1007/s10763-018-9920-0

Lawrenz, F., Gravemeijer, K., & Stephan, M. (2018). Correction to Introduction to this Special Issue (International Journal of Science and Mathematics Education, (2017), 15, S1, (1-4), 10.1007/s10763-017-9815-5). *International Journal of Science and Mathematics Education*, *16*(8), 1633. DOI: 10.1007/s10763-018-9919-6

Louwers, M., & de Putter - Smits, L. G. A. (2018). Speciale relativiteitstheorie via dynamisch visualiseren. *NVOX: Tijdschrift voor Natuurwetenschap op School*, *43*(9), 490-491.

Sanders, W. T. M., & de Putter - Smits, L. G. A. (2018). Een escaperoom gebaseerd op stereoisomerie: Gamification meets samenvattingsles. *NVOX : Tijdschrift voor Natuurwetenschap op School*, *43*(april), 210-211.

Schellings, G. L. M., & de Putter - Smits, L. G. A. (2018). Ervaringen uit de bètalerarenopleiding. *VELON: Tijdschrift voor Lerarenopleiders*, *39*(3), 63-70.

Thurlings, M. C. G., Vinke, A. A., & van de Watering, G. A. (2018). Peer review in het hoger onderwijs: Praktische tips om peer review effectief in te zetten. *Onderzoek van Onderwijs*, *47*(1), 23-28.

Inaugural lectures, key notes

Beijaard, D. (December 2018). *Hoe verder na de lerarenopleiding?* Key note t.g.v. het afscheid van Martin Jacobs. TU Delft.

Taconis, R. (February 2018). *STEM teacher education in open realistic STEM projects*. UTS, Sydney, Australia.

Staff member	Professional organization*	ICO Staff member
Prof. dr. Beijaard	AERA, EARLI, ISATT, VOR, VELON	Yes
Prof. dr. den Brok	AERA, VOR	Yes
Prof. dr. Pepin	AERA, BERA, BSRLM, ERME, IGPME, NoRME, VOR, Agder Academy of Science, KIVI-Niria	Yes
Prof. dr. Vermunt	EARLI, BERA, AERA	Yes
Dr. Taconis	AERA, EARLI, NARST, NVON, ESERA, VOR	Yes
Dr. van den Beemt	DIGRA, EARLI, VELON, VOR	Yes
Dr. Koopman	AERA, EARLI, VOR	Yes
Dr. de Putter-Smits	VELON, ESERA	-
Dr. Schellings	EARLI, VELON, VOR, EAPRIL	Yes
Dr. Thurlings	AERA, EARLI, VOR, VELON	Yes
Dr. Ketelaar	-	-
Dr. Schüler-Meyer	GDM, IGPME	-

*Explanation of the abbreviations of the professional organizations:
AERA = American Educational Research Association; *BERA* = British Educational Research Association; *BSRLM* = British Society for Research in Learning Mathematics; *EAPRIL* = European Association for Practitioner Research on Improving learning; *EARLI* = European Association for Learning and Instruction; *ERME* = European Society for Research in Mathematics Education; *ESERA* = European Science Education Research Association; *GDM* = Gesellschaft für Didaktik der Mathematik; *IGPME* = International Group for the Psychology of Mathematics Education; *ISATT* = International Study Association on Teachers and Teaching; *KIVI-Niria* = Professional Organization for Engineers in the Netherlands; *NARST* = National Association for Research in Science Teaching (Canada); *NoRME* = Nordic Society for Research in Mathematics Education; *NVON* = Association for Science Education in the Netherlands; *VELON* = Organization for Teacher Educators in the Netherlands; *VOR* = National Organization for Educational Research.

Staff member	Contribution type	Title/occasion/date
Prof. dr. Beijaard	Key note	Opleiden van leraren: Een vak apart. Key note on the occasion of the farewell of prof.dr. A. Aelterman, Gent, Sept. 2013 [*Educating teachers: A profession in its own right*]
		Hoe professioneel is de identiteit van de lerarenopleider? Keynote VELON Conference, Nov. 2015 [*How professional is the teacher educator's identity?*]
		Professionalisering van docenten: Perspectieven vanuit onderzoek. Key note OMO Career days. Den Bosch, Nov. 2015 [*Professionalization of teachers: Perspectives from research*]
		Hoe verder na de lerarenopleiding? Key note on the occasion of the farewell of M. Jacobs. TU Delft, Dec. 2018 [*How to continue after teacher training?]*
	Workshops and lectures	Induction of beginning teachers. Workshop 3TU meeting, Nov. 2013
		De inhoud van de academische lerarenopleiding. Workshop annual ICL/VSNU Conference, Nov. 2014 [*Content of academic teacher education*]
		Students as agents of change: Fiction or reality? Workshop for the 100th anniversary of OMO, Nov. 2016
		Development of professional identity. Guest lecture master SEC, Delft, June 2014
		The role of identity in teacher professional development. Lecture University of Turku, Oct. 2014
		Leren van aanstaande en beginnende docenten. Masterclass in the context of the Eindhoven induction project, Dec. 2014 [*Learning of prospective and starting teachers*)
		Ontwikkeling van professionele identiteit. Masterclass in the context of the Eindhoven induction project, Jan. 2015 [*Development of professional identity*]
		Rol van onderzoek binnen een AOS. AOS-ZO inspiration afternoon lecture, Jan. 2015 [*Role of research within an AOS*]
		Professional identity: Research and its role in teacher development & Teacher' professional learning and development: Results from research. Two lectures in a two-day masterclass for PhD students at the University of Oslo, Sept. 2016
		Teachers' professional identity. Annual guest lecture in the ICO-masterclass Teaching and Teacher Education (…,2013,2014)
		Samen opleiden en leren in leerateliers. Workshop annual ICL/VSNU Conference, Dec. 2017 [*Educating and learning together in learning workshops*]

		Samenwerken en leren in leerateliers: Waarom doen we dit? Lecture for the opening of the academic year for students and teachers in the context of the "Learning Workshops". Oisterwijk, Sept. 2018 [*Working together and learning in learning workshops: why do we do this?*]
		Identity learning in teacher education: What does it add? Lecture for the joint meeting DUDOC and VOR division STEM. Nijmegen / Lent, Jan. 2018
		Teacher profession and teacher education "on the crossroads". Double masterclass for the AOS conference OMO: The teacher, profession for the future. Tilburg, nov. 2018
Prof. dr. den Brok	Workshops and lectures	The Future of Engineering Education and the case of TU/e. Lecture for the Rotary Club Asten-Someren, april 2016
		Teacher educator supervision of research projects: Research methods and analyses. Workshop for Fontys Special Education (OSO). 's Hertogenbosch, July 2016
		Student teacher and beginning teacher professional identity, tensions, stress, burnout and attrition: An overview of research at ESoE. National Teachers' Day, Ankara, Middle East Technical University, Sept. 2013
		Future STEM education and learning environments. Lecture Annual meeting of the division Domain Specific Education of the Dutch Educational Research Association (VOR). Eindhoven, May 2014
		Contemporary education for the future labour market and university careers. Lecture Lorentz Casimir Lyceum. Eindhoven, Oct. 2015
		Creating a roadmap for ICT in education. Workshop for Pleinscholen Groep, OMO. Eindhoven, Dec. 2016
		Writing a research plan. Workshop DUDOC PhD programme. Utrecht, Nov. 2016
		Student intrinsic motivation and attitudes towards school subjects. Lecture Pleinscholen Groep, OMO. Eindhoven, Sept. 2014
		Toekomstgericht en studentgestuurd Onderwijs aan TU/e. Lecture for study-advisors. Breda, March 2015 [*Future-oriented and student-driven education at TU / e*]
		Onderwijs en ICT op de Pleinscholen. Eindhoven, Feb. 2017 [*Education and ICT at the Pleinscholen*]
		Future engineering education: Consequences for teaching and learning in Mathematics and Computer Sciences. Lecture TU/e, June 2017
Prof. dr. Pepin (from 2015)	Keynotes	From traditional to digital curriculum resources: New opportunities for "teacher design". REVEA conference at ENS de Lyon. Lyon, France, may 2016
		The shift from traditional to digital "resources": Implications for mathematics teachers' work and professional development.

		Panama (mathematics education) conference. Veldhoven, jan. 2016
		Des manuels aux ressources « vivantes »- Un regard sur le travail de l'enseignant de mathématiques avec/pour les ressources. National Mathematics Education Research Conference, Sherbrooke University. Canada, May 2015
		Mathematics teachers as designers. Resources Conference. Lyon, May 2018
	Workshops and lectures	Mathematics teachers working as "designers": Developing operational knowledge and enhancing mathematical-didactical design capacity. University of Evora. Portugal, Nov. 2016
		"Re-sourcing" teachers' work: New opportunities for reclaiming teacher design and enhancing mathematical-didactical design capacity. DZLM, Humboldt University. Berlin, Sept. 2016
		Re-sources in mathematics education. TU Dortmund. Dortmund, May 2017
		Digital resources in mathematics education. University Essen-Duisburg. Essen, June 2017
		Teacher resourcing in mathematics teacher professional development. University of Rochester. Rochester, USA, July 2017
Dr. Taconis	Keynotes	STEM teacher education in open realistic STEM projects. Keynote at UTS, Sydney, Australia, Febr. 2018
	Workshops and lectures	'STEM identities'. Invited seminar at UTS, Sydney, Australia, Febr. 2018
		'STEM identities @ ESoE'. Seminar at University of Groningen, April 2018
Dr. van den Beemt	Key notes	Stimuleren van leren met ICT in po, vo en mbo. KIEN-ICT. Dordrecht, nov. 2016 [*Stimulating learning with IT in primary, secondary and vocational education*]
	Workshops and lectures	Netwerkers, Gamers en Producenten: interactieve media in het onderwijs. University of Amsterdam, oct. 2014 [*Networkers, Gamers and Producers: interactive media in education*]
		Professionele ontwikkeling leraren ICT voor de student anno nu. University of Amsterdam, may 2014 [*Professional development of ICT teachers for today's student*]
		Serious Games in the classroom. BetaBody & Brains seminar, may 2014
		Interdisciplinary engineering education. 3TU innovation day, oct. 2016
		Investigating Interdisciplinary engineering education. CDIO conference. Delft, jan. 2016
		Interdisciplinary engineering education. Workshop on the occasion of the inaugural speech of B. Pepin, nov. 2015
		Scientific writing for PhD's. Workshop ORD pre-conference, june 2015

		ICT in het praktijkonderzoek van leraren, june 2016 [*ICT in teachers' practical research*]
		Workshop Scrum, honors programme, april 2017
		Interdisciplinary Engineering Education. Workshop ESA teacher support. Eindhoven, march 2018
		Learning Analytics voor het leren van leraren. Lecture VOR division Teachers and Teacher Education, nov. 2018 [*Learning Analytics for teacher learning*]
Dr. Koopman	Workshops and lectures	Workshop about PhD research. VMBO-conference, Jan. 2013
		De meerwaarde van een hedendaagse vernieuwingsschool: Resultaten van een evaluatie-onderzoek op De Nieuwste School. Lecture trainees in education, April 2015 [*The added value of a current innovation school: Results of an evaluation study at the "Nieuwste School"*]
		Teaching fractions in primary education: Teachers' knowledge and behaviour and effects on student proficiency. Workshop on the occasion of the inaugural speech of B. Pepin, Nov. 2015
		Diep leren bevorderen. Lecture OMO Learning Workshops, Sept. 2016 and sept. 2017 [*promoting deep learning*]
		Diep leren bevorderen. OMO conference, Nov. 2016 [*promoting deep learning*]
		Op naar rijkere breukenlessen. NRO conference for practice, Nov. 2015 [*Towards richer fractions lessons*]
		Het bevorderen van diep leren in het voortgezet onderwijs. Slot-conferentie NRO project, Oct. 2017 [*Promoting deep learning in secondary education*]
		Zo wordt leren betekenisvol: voorbeelden van initiatieven om diep leren te bevorderen uit het voortgezet onderwijs. Presentation NRO conference for practice, Nov. 2017 [*This makes learning meaningful: examples of initiatives to promote deep learning from secondary education*]
		Maak de leerling actief: Diep leren en zelfsturing in het voortgezet onderwijs. Toetsrevolutiecongres, April 2018 [*Make the student active: Deep learning and self-regulation in secondary education*]
		Resultaten evaluatieonderzoek De Nieuwste School. Presentation for parents at the "Nieuwste School", April 2018 [*Results of the evaluation research on the "Nieuwste School"*]
		Leren op De Nieuwste School: Resultaten van een wetenschappelijk evaluatieonderzoek. Presentation for school leaders OMO, April 2018 [*Learning at the "Nieuwste School": Results of a scientific evaluation study*]
		Deep learning in secondary education. Presentation for international cooperation regarding "Future skills" (teachers, student teachers, and students from the Netherlands, Flanders, Germany and Finland, among others). Tilburg, Nov. 2018

Dr. de Putter-Smits	Workshops and lectures	Flipping the Classroom. WND conference, 2014
		Moderne Minnaert (natuurkunde van het zwemmen). WND conference, 2015 [*Modern Minnaert (physics of swimming)*]
		Van kookboek practicum tot onderzoekspracticum. WND conference, 2016 [*From cookbook practicum to research lab*]
		Context-onderwijs voor onderwijsprofessionals. BetaBody & Brains seminar, may 2014 [*Context education for educational professionals*]
Dr. Schellings	Workshops and lectures	Series of identity workshops for beginning teachers. TU/e Eindhoven, 2014, 2015, 2016
		Professionele identiteit: "Stories to live by" in het professionele landschap. Lecture Inspiration day Learning Workshops. Tilburg, Jan. 2018 [*Professional identity: "Stories to live by" in the professional landscape*]
Dr. Thurlings	Workshops and lectures	Op naar rijkere breukenlessen. NRO conference for practice, Nov. 2015 [*Towards richer fractions lessons*]
		Teaching fractions in primary education: Teachers' knowledge and behavior and effects on student proficiency. Workshop on the occasion of the inaugural speech of B. Pepin, Nov. 2015
		Werken aan rijkere reken-wiskundelessen: opzet en effecten van een nascholingtraject. BetaBody & Brains seminar, May 2014 [*Working on richer mathematics lessons: design and effects of an inservice trajectory*]
		Een leergemeenschap van betadocenten. BetaBody & Brains seminar, May 2014 [*A learning community of beta teachers*]
		Leraren leren als gelijken: Wat werkt?, Sept. 2014 [*Teachers learning as equals: What works?*]
		Teachers learning as peers. Weblecture for Didactief & Eduseries, Oct. 2014
		Leraren leren als gelijken: Wat werkt? Contribution to study day of network "Stichting Technasium", March 2015 [*Teachers learning as equals: What works?*]
		Teaching fractions. Seminar for Fontys mathematics teacher educators. Tilburg, March 2016
		Feedback. Seminar for AUTIQ teachers. University of Twente, May 2017
		Educational research for student teachers in Learning Workshops. Tilburg, Jan. 2018
		Educational research about teacher learning. Seminar VOR division Teachers and Teaching, Nov. 2018
Dr. Ketelaar	Workshops and lectures	Docenten en innovaties. Masterclass for trainees in education. Utrecht, 2014, 2015 [*Teachers and innovations*]

		A-level: taking it to the next level. Excellentie bij SintLucas. Workshop CVI Conference, April 2016 [*A-level: taking it to the next level. Excellence at SintLucas*]
		A-level: taking it to the next level. Excellentie bij SintLucas. Workshop day for teachers BTG ICT&CI, March 2017 [*A-level: taking it to the next level. Excellence at SintLucas*]
		Onderzoek naar excellentie in creatief-technische vakscholen. Workshop CVI Conference, April 2016 [*Research into excellence in creative-technical vocational schools*]
		Diverse perspectieven op excellentie. Onderzoek naar excellentie bij creatief-technische vakscholen. Workshop Conference on Excellence in mbo-schools, Nov. 2017 [*Various perspectives on excellence. Research into excellence at creative-technical vocational schools*]
		Excellentie: vakscholen als inspiratiebron. Onderzoek naar excellentie in creatief-technische vakscholen. Presentation NRO conference for practice, Nov. 2017 [*Excellence: vocational schools as a source of inspiration. Research into excellence in creative-technical vocational schools*]
Dr. Schüler-Meyer	Workshops and lectures	Lernprozesse im Übergangsraum Schule / Hochschule. University of Duisburg-Essen, Germany, Oct. 2017 [*Learning processes in the transition space school / university*]
		Lernprozesse in Brückenkurse – welche Ressourcen haben Lernende in der Oberstufe für hochschulmathematisches Denken? University of Bremen, Germany, Febr. 2018 [*Learning processes in fraction courses - what resources do high school learners have for university mathematical thinking?*]

Staff member	Role
Prof. dr. Beijaard	**External Committees / Board Memberships /other:** • Member Interuniversity Committee for University Teacher Education (ICL, VSNU) (2009-2015 and from 2017-2019) • Board member of the ICO research school (2015-2019) • Member of the ICO scientific committee (2015-2019) • Member of the committee Sector plan Educational Sciences (2013-2014) • Visiting professor at the University of Turku in 2014 and 2015 • Member of the steering committees of the AOS-NO (2013-2019) and the AOS-ZO (2013-2019) • Member of the steering committee "Leerateliers" (2015-2019) [i.e., professional learning communities of school teachers and student teachers] • Member and chair of accreditation committee for Flemish teacher education master programs (fall/winter 2018)
	Internal TU/e Committees: • Member of Committee of programme directors of the Graduate School TU/e (2011-2014) • Member of the advisory board of ICT projects Faculty of Mathematics & Computer Science • Chair 4TU UTQ Supervisory Committee (2011-2018) (UTQ = University Teaching Qualification) • Member program committee course "Educational Leadership" (2018-2019)
	Reviews: • Member of review committees NRO/NWO for several calls • Reviewer for the Flemish Association for Educational Research (yearly) • Reviewer of lectorates (of the Universities of Applied Sciences in Utrecht and Amsterdam) • Reviewer of master programmes (of the University of Applied Sciences Amsterdam and the University of Twente) • External defense committee member in approximately 5 PhD defenses per year • Member of promotion committees of PhD projects (approximately 3 per year) • Member of the evaluation committee for applications for research projects for the Finish Academy in Helsinki (2018)
Prof. dr. den Brok	**TU/e committees/taskforces:** • Author of TU/e vision on education 2030 (with A. Meijers) (2013) • Chair TU/e Taskforce ICT in Education 2.0 TU/e (2014-2015) • Program leader TU/e ICT in Education (2014-2015) • Member TU/e steering committee Digital Assessment (2015) • Member TU/e steering committee Learning Management System (2015) • Member TU/e steering committee Student Information System TU/e (2014) • Member TU/e steering committee for improving education of the department of Built Environment (2013-2017)

	- Member TU/e Taskforce Senior Qualification in Education/Advanced Academic Teaching (2012-2013) - Member TU/e Advisory Board Bachelor College (2012-2014)
	Other committees: - Member Interuniversity Committee for University Teacher Education (ICL, VSNU) (2015-2017) - Member Committee for the Implementation of the 'Sector plan Educational Sciences' (2016-2017) - Board member of the ICO research school (2010-2015) - Member Advisory Committee 'Cooperating OMO schools' (Eckart, van Maerlant, Sint Joris, Bisschop Bekkers) (2009-2016) - Member Advisory Committee 'Brainport Schools' (12 secondary education schools in Eindhoven region; 2015-2017) - Member advisory Board IVA Education (2012-2017) - Member steering committee 'NRO Agenda for research on teachers' (2016-present)
	Conference organization and professional organizations: - Member organizing committee ISATT (2013) - Chair SIG Learning Environments AERA (2011-2013) - Chair division Teaching and Teacher Education VOR (2013-2016) - Member board VOR (2013-2016)
	Reviews: - Member of review committees NRO/NWO for several calls (2012-present) - Reviewer of proposals for associations in other countries: Czech Association for Educational Research, Flemish Association for Educational Research, Polish Association for Educational Research - Reviewer of Lectorates (of the Universities of Applied Sciences Zuyd, De Kempel, CHE Ede, Fontys, and Interactum) - External defense committee member in approximately 5 PhD defenses per year
Prof. dr. Pepin	**Internal TU/e committees:** Member of committees for appointment of professors: TU/e, September 2016
	External committees /other: - Evaluation of Vienna university teacher education department, November 2016 - Advisory board member of the German DZLM (Deutsches Zentrum fur Lehrerbildung Mathematik) - Member of the Agder Academy of Sciences and Letters, University of Agder, Grimstad/Kristiansand (2009-present) - Invited stay as 'Research Professor' at the ENS (Ecole Normale Superieure) de Lyon with Prof. L. Trouche in 2014 and 2016 - Member of the NRO/NSF group on STEM education & inclusion
	Conference organization and professional organizations: - Convenor of CERME (Congress of European Research in Mathematics Education), Topic Working Group 22- "Curricular Resources and Task Design in Mathematics Education" - Member of scientific committee of ICME13 (International Congress on Mathematics Education- every four years) in 2016, of ICMT1 (International Conference on mathematics research and development) in 2014 (and of ICMT 3 in 2020); and NORMA (2014) - Honorary member (since 2017) and Network convenor (2008-2014) of EERA network "Mathematics Education Research"

	Reviews:
	• Member of several promotion committees since 2017: at TUD, UU, ENS de Lyon (2x)
Dr. Taconis	**External Committees / Board Memberships /other:** • Member steering committee "NATK4ALL" • Member steering committee AOS-NO Brabant (2011-2013) • Board member VOR, 2013-present • Chair and founder of the VOR Division Domain Specific Education and theme-group Béta & Technology
	Internal TU/e Committees: • Board member Education Directors Bachelor College • Board member Program Directors Graduate School • Board member managers Education and Student Affairs • Member steering group "International classroom" (since 2018) • Member steering group "Re-design USE basis" (since 2018)
	Conference organization and professional organizations: • Chair and organizer of the "β&T spring symposium" (2014) • Chair and organizer of the "Beta body brains" symposium (2015) • Chair symposium of the shared DUDOC/VOR/ESERA symposium on "Identities in STEM education", Nijmegen, 26 January 2018
	Reviews: • External member of approximately 2 PhD promotion committees per year • Trial visitation of BSc and MSc Mechanical Engineering and Automotive Technology, 29 nov. 2018
Dr. van den Beemt	• Member of board of examiners Aeres Master Learning and Innovation • Supervisory board Jan Lighthart group, Tilburg (2014-present) • Member organising committee Networked Learning Conference • Chair VOR division Education and Training
Dr. Koopman	• Member board VOR division Learning and Instruction (2008-2017) • Member of the review committee NRO PROBO for policy-oriented research on the innovation of VMBO schools (2016) • Replacement Board member of the ICO research school (since 2015) • Member UTQ-committee Faculty IE&IS of TU/e (2013-2014) • External member of promotion committee • Member of committee "Review of PABO knowledge bases – Validation" (2017)
Dr. Schellings	• Advisory board for the accreditation of AOS-NO (2015) • Reviewer of research proposals of teachers for practitioner research made possible by fundings of the AOS-NO (2016)
Dr. Thurlings	• Member editorial board 'Script!' (2014-present) • Member of review committee NRO for long-lasting practice-oriented research projects on the theme formative testing (2014-2015) • Member of board of examiners Aeres Master Learning and Innovation • Trial accreditation of AOS-ZO (2015)

	•	Member of board of VOR division Teachers & Teacher Education (since 2018)
	•	Member NRO review committee "Review studies" (2017)
Dr. Schüler-Meyer	•	Member of examination committee for PhD Taha Kuzu, Dortmund
	•	Interim Professor at University of Bremen (01 April till 14 August 2018)

Preparing and supporting teachers for innovative STEM learning

Research Program 2015-2019 of the Eindhoven School of Education

Version 7/2/2016

Mission of ESoE

The Eindhoven School of Education (ESoE) is the educational expertise center of the Eindhoven University of Technology (TU/e). ESoE's mission is three-fold:

1. STEM teacher education (pre-service teacher education);
2. STEM teachers' continuous professional learning and development: school & university;
3. STEM innovation in education in collaboration with teachers at both classroom and school/institute level.

Leading is ESoE's vision on professional STEM teachers: innovative experts in their subject domain who design and develop (technologically) rich contexts for learning. They evaluate their education, including their own role, and demonstrate an inquiry and learning attitude towards their subject and work as teachers. As such they are a role model for their students. In innovative contexts they act as agents of change together with colleagues inside and outside their schools and demonstrate professional leadership needed for this. ESoE wishes to educate these academic professionals in close cooperation with schools. The ultimate goal of the ESoE research program is to contribute to the education of more and better STEM teachers. In turn, more STEM students will be attracted.

The research program on/in STEM education can be regarded as a permeating strand (linked to the three-fold mission). The program's focus is STEM education (Science, Technology, Engineering, Mathematics), both as object and as context of research in secondary and higher education.

There is now ample evidence that preparing students for becoming and being active participants of an innovative society goes well beyond preparing them for science-related professions. Regarding the STEM domain: new roles are required from engineers, as the world faces grand challenges, which in particular pertain to the domains of health, energy and environment, mobility and safety. These "new" engineers and scientists must be professionals capable of thinking critically and independently, to keep developing and renewing their expertise, to use state-of-the-art technology, to contribute to solving societal problems, but also to create new opportunities and the ability to think interdisciplinary and to work in teams (Meijers & den Brok, 2013). Many of these skills are also mentioned so-called 21st century skills (Thijs, Visser & van der Hoeven, 2014). The new educational imperative is to equip a critical mass of workers and citizens with the skills to thrive in innovative societies (Mavareck & Kramarski, 2015).

This places high demands on teachers and their professional development in both secondary and higher/university education. Continuous professional development (CPD) throughout teachers' career is needed in order to keep pace with societal and educational developments and changes.

More than ever before teachers are required to foster deep and meaningful learning with their students and develop appropriate learning environments for this (Martinez & McGrath, 2014). Meanwhile they have to take into account:

1. The influence of technology and interactive media on teaching and learning: it is often claimed that today's learners are "new millennium learners" who have different expectations about education (OECD, 2012). Students' use of technology and interactive media is transforming the ways they learn (cognitive skills development), their social values and lifestyles (e.g., Van den Beemt, Akkerman & Simons, 2011). An important factor here appears to be that they require competencies of careful selection of relevant information, and of judgment about the value of such information (cf. Ito et al., 2009; Walraven, 2008).
2. Changes with respect to their audience: in their classrooms and courses, teachers will face a greater diversity of students, with respect to ethnic background, values and beliefs, learning experiences, learning orientations, and engagement (e.g., Sierens, 2007; Leeman & Wardekker, 2013).

It is ESoE's conviction that some of the most crucial skills necessary for students and future workers in the STEM domain are formed and developed through:

1. Effective science and engineering education, for example: giving shape to deep and meaningful learning through types of design-based and inquiry-oriented learning and making use of ICT (e.g., Gomez, van Eijck & Jochems, 2014). At a more general level, "new learners" will need to be able to constantly adapt in their future work and lives and must therefore learn to become more self-directive and life-long learners.
2. Motivating students for science and engineering education, for example: making instruction more context-based ('concept-context education'),

cooperating with companies, undertaking outreach activities, and doing justice to different bèta motivations as well as bèta identities (e.g., de Putter-Smits, Taconis & Jochems, 2013). At university level, it is important to create education trajectories that are attractive, engaging, and flexible in order to realize the higher and more diverse student population in science courses.

3. Integrative or interdisciplinary science education within the STEM domain and with other domains as well.

New competencies of teachers are required for both teachers in secondary and higher education, such as the following:

1. The expertise to adapt their curricula, resources, and learning environments to new insights and new teacher roles as coaches and facilitators of learning, for example when students do a design or research project (teachers as adaptive experts; cf. Bohle Carbonell et al., 2014). Teachers' role needs more than now be one of "teaching for learning". For teacher education this means a shift towards learning to teach from a student-centered learning perspective instead of a teacher-centered teaching perspective (Swinkels, Koopman & Beijaard, 2013).

2. The ability to effectively utilize existing curricular resources to design instruction (Brown, 2009). Teachers' interaction with tools/resources is clearly a participatory (two-way) process, in which teachers and resources interact (Pepin, Gueudet & Trouche 2013). Making sense of and using these tools/resources to design and enact instruction places a demand on teachers' beta-didactical design capacity (Pepin, 2015). This implies that teachers need to base their decisions on subject knowledge, knowledge of how to make subjects teachable and knowledge of how to evaluate curricula.

3. Teachers must be capable to organize, implement and monitor change, thus becoming managers of innovation and change (van der Heijden, Geldens, Beijaard & Popeijus, 2015).

New teacher competencies as those mentioned above are the basis for ESoE's vision on professional teachers as expressed in the beginning of this research program under "mission".

RESEARCH QUESTIONS

ESoE is committed to addressing the challenges for STEM education, both in secondary schools as well as in higher/university education. Since ESoE educates student teachers in the academic master "Science Education and Communication", findings from research are thus of direct relevance to its own teaching and professional development activities and also to innovative work in schools. Furthermore, as one of the roles of ESoE is to take an active part in supporting other TU/e departments in instigating and investigating educational innovations, findings from the research are directly relevant to the departments, and TU/e at large. In order to realize these aims, research projects within the research program will be anchored in, and link to, the following research questions:

1) *What ways of STEM learning and learning environments contribute to preparing learners for the challenges of the 21st century?* This research

question pertains to elements of these learning environments that play an important role in this, e.g.: shared vision by teachers, tasks or assignments, curriculum materials, tools, resources.

2) *What characterizes a professional STEM teacher's professional identity in innovative contexts and schools and what are relevant issues that need to be addressed in teacher professional learning and development?* First, this question refers to the teacher as coach, using interactive media, dealing with diverse classrooms, and designing/developing curricula. Second, it refers to professional qualities (teacher knowledge, skills, and dispositions) needed for developing environments that foster deep learning and how teachers can be prepared for/supported in that in close collaboration with schools.

3) *How can teachers' professional development for these challenges (see question 2) be stimulated and supported?* One important way of doing this is to engage teachers in design- based research. Other ways pertain to teachers participating in professional learning communities and carrying out specific interventions.

4) *What are the various effects of (student) teachers' professional development/learning processes?* These effects may be discerned in classroom practices, departmental/school professional learning cultures, and eventually student learning/outcomes.

The research program of ESoE will investigate the above questions in contexts ranging from lower/upper secondary to higher/university education, covering the whole STEM domain.

ESoE research

All projects of the ESoE research program have been designed to have practical orientations. To explain, the criteria are the following:

1. For ESoE it is important that the research questions and topics often find their origin in practice, even though the research may take various forms: e.g. PhD or post-doc projects (often supported by grants); master thesis projects in teacher education; teacher practice- based research projects in school-based learning communities with researchers from ESoE; and innovation research projects (evaluative studies of current practices or new interventions). Studies may be performed by researchers, teachers, or other practitioners involved in research – often of their own classroom context – or teams consisting of both.

2. Where possible, research projects are characterized by collaboration with other partners. These partners may consist, in particular, of other TU/e departments; the 3TU Centre of Engineering Education; other academic universities and universities of applied science; (research-based) professional development schools and other schools, amongst them "technasium" and "brainport" schools.

3. Studies may be large or small scale, and can use different research methodologies, depending on the research questions central to the study. These may range from qualitative to quantitative, and from more traditional instruments such as paper or electronic surveys and interviews, to more specific and innovative methods such as electronic data collection apps, eye-

tracking devices, networking instruments and data analysis tools, or real-time observation instruments. While designs may vary, many projects will have an intervention- or design-based character. Despite their varied forms, a crucial feature of studies conducted by ESoE is that they are of highly scientific – academic quality.

For more information about publications and research projects by staff, master and PhD students of ESoE: see www.tue.nl/esoe

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FINISHED PROJECTS

Title dissertation: Effects of a self-assessment procedure on VET teachers' competencies in coaching students' reflection skills
PhD student: Migchiel van Diggelen
Promotors: prof. dr. Douwe Beijaard & prof. dr. Perry den Brok

Title dissertation: Facilitating the use of recorded lectures: Analysing students' interactions to understand their navigational needs
PhD student: Pierre Gorissen
Promotor: prof. dr. Wim Jochems
Co-promotor: dr. Jan van Bruggen (Open University / Fontys University of Applied Sciences)

Title dissertation: Teacher feedback during active learning: The development and evaluation of a professional development programme
PhD student: Linda Keuvelaar-van den Bergh
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Anje Ros (Fontys University of Applied Sciences)

Title dissertation: Professional identity tensions of beginning teachers
PhD student: Marieke Pillen
Promotors: prof. dr. Douwe Beijaard & prof. dr. Perry den Brok

Title dissertation: Scripted collaborative enriched skeleton concept mapping to foster meaningful learning
PhD student: Ton Marée
Promotor: prof. dr. Wim Jochems
Co-promotor: dr. Jan van Bruggen (Open University / Fontys University of Applied Sciences)

Title dissertation: Design-based learning: Exploring and educational approach for engineering education
PhD student: Sonia Gómez Puente
Promotor: prof. dr. Wim Jochems
Co-promotor: dr. Michiel van Eijck

Title dissertation: Measuring effectiveness of synchronous coaching using Bug-In-Ear device of pre-service teachers
PhD student: Nele-Sofie Coninx
Promotor: prof. dr. Wim Jochems
Co-promotor: dr. Karel Kreijns (Open University / Fontys University of Applied Sciences)

Title dissertation: Relationships between students' interest in science, views of science and science teaching in upper primary and lower secondary education
PhD student: Ralf van Griethuijsen
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Michiel van Eijck

Title dissertation: Teachers' interpersonal role identity
PhD student: Anna van der Want
Promotor: prof. dr. Perry den Brok & dr. Douwe Beijaard

Title dissertation: On teachers' visual perception and interpretation of classroom events using eye tracking and collaborative tagging methodologies
PhD student: Niek van den Bogert
Promotor: prof. dr. Wim Jochems & prof. dr. Douwe Beijaard
Co-promotor: dr. Jan van Bruggen (Open University / Fontys University of Applied Sciences)

Title dissertation: Exploring instantaneous speed in grade 5: A design research
PhD student: Huub de Beer
Promotor: prof. dr. Koeno Gravemeijer & prof. dr. Birgit Pepin
Co-promotor: dr. Michiel van Eijck

Title dissertation: Towards physics education in agreement with the nature of science: Grade 9 electricity as a case
PhD student: Zeger-Jan Kock
Promotor: prof. dr. Koeno Gravemeijer & prof. dr. Birgit Pepin
Co-promotor: dr. Ruurd Taconis & dr. Sanneke Bolhuis (Fontys University of Applied Sciences)

Title dissertation: Teaching robotics in primary school
PhD student: Lou Slangen
Promotor: prof. dr. Koeno Gravemeijer & prof. dr. Birgit Pepin
Co-promotor: dr. Hanno van Keulen (Fontys University of Applied Sciences)

Title dissertation: Leren van aanstaande leraren op en van de werkplek [Prospective teachers' learning at and from the workplace]
PhD student: Han Leeferink
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Maaike Koopman

Title dissertation: Exploring geography teaching in primary education: Perspectives of teachers, teacher educators and pupils
PhD student: Gert-Jan Bent
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Anouke Bakx (Fontys University of Applied Sciences)

Title dissertation: Images of numeracy. Investigating the effects of visual representations of problem situations in contextual mathematical problem solving
PhD student: Kees Hoogland
Promotor: prof. dr. Birgit Pepin
Co-promotor: dr. Arthur Bakker (Utrecht University)

Title dissertation: Meaning-oriented learning in Dutch academic primary teacher education
PhD student: Stella van der Wal-Maris
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Gonny Schellings & dr. Jeanette Geldens (De Kempel University of Applied Sciences)

Title dissertation: Teacher educator collaboration: Activities, networks and dynamics
PhD student: Henderijn Heldens
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Anouke Bakx (Fontys University of Applied Sciences)

Title dissertation: Teachers who make a difference: An investigation into teachers as change agents in primary education
PhD student: Monique van der Heijden
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Jeanette Geldens (De Kempel University of Applied Sciences)

Title dissertation: Learning to teach with a focus on student learning
PhD student: Maartje Swinkels
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Maaike Koopman

Title dissertation: Integrated curricula: An approach to strengthen Science & Technology in primary education
PhD student: Rens Gresnigt
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Ruurd Taconis & dr. Hanno van Keulen (Fontys University of Applied Sciences)

Title dissertation: Using digital video in teacher education and in professional development activities to stimulate teaching for active learning in Cambodia
PhD student: Leandra Lok
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Gonny Schellings

ONGOING PROJECTS

Project title: Analyzing the effectiveness of online in-service training programs for science teachers
PhD student: Nan Li
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Ruurd Taconis
Finished; defence 8 January 2020

Project title: Outreach activities and motivation for science in secondary education: on the role of the teacher and the learning environment
PhD student: Annemieke Vennix
Promotor: prof. dr. Perry den Brok
Co-promotor: dr. Ruurd Taconis
Defence first half of 2020

Project title: Professional development of technology teachers: a language oriented approach
PhD student: Elly Wildeman
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Maaike Koopman

Project title: Effects of frequent in-between assessment on learning and teaching in higher education.
PhD student: Bram Vaessen
Promotors: prof. dr. Perry den Brok & prof. dr. Lex Lemmens
Co-promotor: dr. Antoine van den Beemt
Defence 19 March 2020

Project title: Student teachers in primary education using videos from their own lessons for learning mathematics teaching.
PhD student: Hanneke van Doornik-Beemer
Promotor: prof. dr. Birgit Pepin
Co-promotors: dr. Alexander Schüler-Meyer & prof. dr. Anouke Bakx (Radboud University Nijmegen / Fontys University of Applied Sciences)

Project title: Chinese and Dutch teacher educators' professional development
PhD student: Cui Ping
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Gonny Schellings
Defence: first half of 2020

Project title: Developing preservice primary teachers pedagogical skills in science and technology education through data feedback
PhD student: Peter Bom
Promotor: prof. dr. Douwe Beijaard
Co-promotor: dr. Maaike Koopman

Project title: Designing a digital learning environment for learning and teaching quantum mechanics at upper secondary school level
PhD student: Tim Bouchée
Promotor: prof. dr. Birgit Pepin
Co-promotors: dr. Lesley de Putter-Smits & dr. Marieke Thurlings

Project title: Allocating students in secondary education in the context of annual teacher meetings
PhD student: Janneke Sleenhof
Promotor: prof. dr. Douwe Beijaard
Co-promotors: dr. Maaike Koopman & dr. Marieke Thurlings

Project title: Developing the language for mathematical learning through blended professional development: the case of reasoning-and-proof in analytic geometry
PhD student: Farran Mackay
Promotor: prof. dr. Birgit Pepin
Co-promotors: dr. Alexander Schüler-Meyer & dr. Marieke Thurlings

Project title: Didactics for risk assessment courses in higher education: a design based research project
PhD student: Ab Bertholet
Promotor: prof. dr. Birgit Pepin
Co-promotor: dr. Nienke Nieveen

Project title: Authentic learning, exploring an educational approach for Higher Engineering Education, at the interface between technical knowledge, social sciences and humanities
PhD student: Kostis Karanasios
Promotor: prof. dr. Jan Vermunt
Co-promotor: dr. Günter Bombaerts (TU/e Department of Industrial Engineering and Innovation Sciences)

Project title: Developing scientific literacy: online professional development of chemistry teachers
PhD student: Rianne van Dinther
Promotor: prof. dr. Birgit Pepin
Co-promotor: dr. Lesley de Putter-Smits

Project title: The development of an instrument for online guidance of reflective blocks
PhD students: Marcel Graus
Promotor: prof. dr. Douwe Beijaard
Co-promotors: dr. Antoine van den Beemt & dr. Paul Hennissen (Fontys University of Applied Sciences)

Project title: Developing a professional development programme for online guidance by teacher educators
PhD students: Ankie van den Broek
Promotor: prof. dr. Douwe Beijaard
Co-promotors: dr. Antoine van den Beemt & dr. Paul Hennissen (Fontys University of Applied Sciences)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable data and should be submitted before potential participants are approached to take part in the research study.

Part 1: General Study Information

#		
1	Project title and project number	
2	Researcher name and email	A. Researcher
3	Supervisor(s)	dr. A. Researcher
4	Faculty/department	
5	Research location	
6	Research period (start/end date)	
7	Funding agency	
8	[If Applicable] Study is part of an educational course with code:	
9	[If Applicable] Proposal already approved by external Ethical Review Board: Add name, date of approval, and contact details of the ERB	
10	Short description of the research question	
11	Description of the research method	For example: Survey Design, Longitudinal Study, Randomized Experiment, in-depth interview, focus groups, first in man, pilot study, observation, etc.
12	Description of the research population, exclusion criteria	For example: We will randomly select participants from the JSF participant database who have good vision and are older than 18 years.
13	Description of the measurements and/or stimuli/treatments	For example: Participants will perform task A and see pictures from database B, and we measure validated Scale 1.
14	Number of participants	
15	Explain why the research is socially important. What benefits and harm to society may result from the study?	
16	Describe the way participants will be recruited	
17	Provide a brief statement of the risks you expect for the participants or others involved in the research or educational activity and	

		Yes	No
	explain. Take into consideration any personal data you may gather and privacy issues.		

Part 2: Checklist for Minimal Risk

		Yes	No
1	Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g. children, people with learning difficulties, patients, people receiving counselling, people living in care or nursing homes, people recruited through self-help groups)		
2	Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children or own students)?		
3	Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in non-public places)		
4	Will the study involve actively deceiving the participants? (e.g. will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study)		
5	Will the study involve discussion or collection of personal data? (e.g. name, address, phone number, email address, IP address, BSN number, location data) or will the study collect and store videos, pictures, or other identifiable data of human subjects?. Please check the FAQ's on the intranet. If yes: please follow the procedure. Make sure you perform a Data Protection Impact Assessment (DPIA) and make a Data Management Plan if necessary and let the data steward check it. Please attach these documents with this form (see part 5; enclosures)		
6	Will participants be asked to discuss or report sexual experiences, religion, alcohol or drug use, or suicidal thoughts, or other topics that are highly personal or intimate?		
7	Will participating in the research be burdensome? (e.g. requiring participants to wear a device 24/7 for several weeks, to fill in questionnaires for hours, to travel long distances to a research location, to be interviewed multiple times)?		
8	May the research procedure cause harm or discomfort to the participant in any way? (e.g. causing pain or more than mild discomfort, stress, anxiety or by administering drinks, foods, drugs)		
9	Will blood or other (bio)samples be obtained from participants (e.g. also external imaging of the body)?		
10	Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants?		

11	Will the experiment involve the use of physical devices that are not 'CE' certified?		

Important:
If you answered all questions with ''no'', you can skip parts 3 - 4 and go directly to part 5. Check which documents you need to enclose and continue with signature and submission.
If you answered one or more questions with "yes", please continue with parts 3 – 5.

Part 3: Study Procedures and Sample Size Justification

1	Elaborate on all boxes answered with "yes" in part 2. Describe how you safeguard any potential risk for the research participant.	
2	Describe and justify the number of participants you need for this research or educational activity. Also justify the number of observations you need, taking into account the risks and benefits	

Part 4: Data and Privacy Statement

1	Explain whether your data are completely anonymous, or if they will be de-identified (pseudonymized or anonymized) and explain how.	
2	Who will have access to the data?	
3	Will you store personal information that will allow participants to be identified from their data? See VSNU draft.	☐ No ☐ Yes, and I declare I will follow the general data protection regulation (GDPR).
4	Will you share de-identified data (e.g., upon publication in a public repository)?	☐ No ☐ Yes, and I will inform participants about how their data will be shared, and ask consent to share their data. I will, to the best of my knowledge and ability, make sure the data do not contain information that can identify participants.

	Part 5: Closures and Signatures	
1	Enclosures (tick if applicable): ☐ Informed consent form; ☐ Informed consent form for other agencies when the research is conducted at a location (such as a school); ☐ Text used for ads (to find participants); ☐ Text used for debriefings; ☐ Approval other research ethics committee; ☐ The survey the participants need to complete, or a description of other measurements; ☐ Any other information which might be relevant for decision making by ERB; ☐ Data Protection Impact Assessment checked by the privacy officer ☐ Data Management Plan checked by a data steward	
2	Signature(s) Signature(s) of researcher(s) Date: Signature research supervisor (if applicable) Date:	

Research Review Eindhoven School of Education

CONTENTS

1. The review committee and the review procedures

Scope of the assessment
The Review Committee was asked to perform an assessment of the research programme of Eindhoven School of Education (EsoE) of Eindhoven University of Technology. This assessment covers the research in the period 2007-2012. In accordance with the Standard Evaluation Protocol 2009-2015 for Research Assessment in the Netherlands (SEP), the Committee's tasks were to assess the quality of Eindhoven School of education and its research programme on the basis of the information provided by the Eindhoven School of Education and through interviews with the management, the research leaders, researchers and PhD students, and to advise how this quality might be improved.

Composition of the Committee
The composition of the Committee was as follows:

- Prof. dr. J.J.H. Jan) van den Akker, Director General of SLO (Netherlands Institute for Curriculum Development) and professor emeritus of Curriculum Design and Implementation, University of Twente, the Netherlands, Chair;
- Prof. dr. C. (Christopher) Day, professor Emeritus of Education, University of Nottingham, UK;
- Prof. dr. E. (Elke) Sumfleth, professor of Chemistry Education, Duisburg-E ssen University, Germany.

A profile of the Committee members is included in Appendix 1.

Drs. G.M. (Marielle) Klerks was appointed secretary to the Committee by QANU (Quality Assurance Netherlands Universities).

Independence
All members of the Committee signed a statement of independence to safeguard that they would assess the quality of Eindhoven School of Education and its research programme in an unbiased and independent way. Any existing personal or professional relationships between Committee members and the programme under review were reported and discussed in the Committee meeting. The Committee concluded that there were no unacceptable relations or dependencies and that there was no specific risk in terms of bias or undue influence.

Data provided to the Committee
The Committee has received detailed documentation consisting of the following parts:

1. Self-evaluation report of the unit under review, including all the in fo1mation required by the Standard Evaluation Protocol (SEP), ·withappendices.
2. Copies of five key publications of the research programme.

Procedures followed by the Committee
The Committee proceeded according to the Standard Evaluation Protocol 2009-2015 (SEP). Prior to the first Committee meeting, all Committee members independently formulated a preliminary assessment of the programme. The final assessments are based on the documentation provided by Eindhoven School of Education, the key publications and the interview s with the management and with the leaders and researchers of the programmes. The interviews took place on 19 June 2013 (see the schedule in Appendix C) in Eindhoven.

Preceding the interviews, the Committee was briefed by QANU about research assessment according to SEP, and the Committee discussed the preliminary assessments and decided upon a number of comments and questions. The Committee also agreed upon procedural matters and aspects of the assessment. After the interviews the Committee discussed the scores and comments. The texts for the Committee report were finalised through email exchanges. The final version was presented to Eindhoven School of Education for factual corrections and comments. The comments were discussed in the Committee. The final report was printed after formal acceptance.

The Committee used the rating system of the Standard Evaluation Protocol 2009-2015 (SEP). The meaning of the scores is described in Appendix B.

2. Research review Eindhoven School of Education

Programme:	**Professional Learning**
Programme leaders:	Prof. Dr. P. den Brok (research director),
	Prof. Dr. D. Beijaard (dean)
Research staff 2012:	1.76 fte tenured, 5.78 total fte
Assessments:	Quality: 4
	Productivity: 4
	Relevance: 4
	Viability: 3

Since at Eindhoven University of Technology (TU/e) all educational research is conducted within an institute with one single programme, the Committee decided to integrate the assessment at the institute and programme level. Accordingly, the following assessment covers both levels.

1A. The institute

Eindhoven School of Education (ESoE) is a centre of expertise that links educational research with practice. Its mission is 'to contribute to both the education and professional development of (in-service) teachers and the support of educational innovation(s), by providing empirically supported knowledge and expertise'. The mission builds on the central idea that the teacher is a determining factor for the quality of education.

ESoE distinguishes three core tasks, which follow directly from its mission: (i) Research, (ii) Teacher education, and (iii) Educational innovation (botl1 within the TU/ e as well as for external partners).

Within teacher expertise, ESoE focuses on the professional development of teachers in general and in the domain of Science, Technology, Engineering, and Mathematics education (STEtv1) in particular. The institute's mission has been translated in its research programme *Professional Learning* (cf. section 1B).

ESoE was established in May 2006 as a joint institute of both TU/e and Fontys University of Applied Science and operated as such until December 2010. The collaboration was a result of the decision of Fontys to invest in PhD students in order to strengthen its research profile and the quality of its personnel. During this period, ESoE supervised Fontys PhD students and provided for both PhD training in education and the training of upper secondary education teachers in science and mathematics.

In January 2011, Fontys ended its participation in ESoE..As a result, ESoE became a full part of TU/ e, operating as a semi-independent unit of the university. Another consequence was a significant loss of resources. Currently, the institute resides under the Department of Mathematics and Computer Science.Head of ESoE is the dean, who is responsible for all ESoE staff and activities. The dean is advised and guided by a governing board, consisting of the rector magnificus of TU/e, the dean of the Department of Mathematics and Computer Science, one other TU/ e professor from one of the four school subject domains in which ESoE trains teachers and two representatives from secondary education institutes. The daily administration of ESoE is coordinated by a management team, consisting of the dean, the financial director and the directors of education and research. The research programme and research staff are coordinated by the research director.

Assessment

The institute (and the research programme) seems to be in a transitional stage, facing

several challenges. The Committee learned that after the termination of collaborating with Fontys, the funding of the institute became very modest, resulting in a small sized tenured staff. Also, not too long ago, there was a change of leadership after the retirement of two full professors, who had been leading the programme from its start in 2007 until 2010. It is clear to the Committee that the new leaders (since 2011) are searching for a new balance that combines the interests of the various staff members with the various expectations of different external stakeholders. The Committee also noted that the institute intends to maintain a rather broad scope in view of different, much needed, funding options. So far, the leaders seem rather cautious in making restricting decisions. At the same time, the Board of TU/ e, through its Rector Magnificus, underlines the relevance of ESoE's mission to innovate and improve education in secondary schools, but also wishes ESoE to become more involved in the improvement of teaching and learning within the university itself. This would also imply additional funding for a joint Center of Excellence through the 3TU partnership (with Delft and Twente).

The Committee concludes that it will be challenging to strike a proper balance between the different options for mission, tasks, organization and adequate funding to build the necessary human resource capacities. Obviously, deliberations on how to reach this balance have not yet been finalized within ESoE. However, for the focus, coherence and viability of the research programme, the Committee advises to accelerate this decision making, as choices seem urgently needed.

1B. The programme
ESoE's research programme *Professional Learning* claims to focus on teachers' professional learning and innovation, specifically paying attention to the domain of STEM education. The guiding concept is that of the teacher as a professional. The central aim of the programme is 'to understand and promote teacher learning and professional development as well as to understand the roles that teachers play in educational innovations, and the effects that such learning and roles have on their competencies and the ways they implement innovations'.

Assessment
The Committee has noted that the programme is quite ambitious in its broad range of research themes and approaches, which is partly inevitable due to the tendency to be responsive to the many claims of various stakeholders. However, the Committee is of the opinion that the rather wide scope makes the research profile also somewhat diffuse and vulnerable, as it makes it rather difficult to develop a clear core. To contribute to effective professional development or support programmes of teachers, the programme claims to study teacher (professional) learning during the entire career from both a general educational perspective as well as a more specific ST E M-based perspective. The evidence in support of this is, however, not conclusive. The majority of research is with less experienced teachers. Moreover, although the specific focus is in line with TU/ e's domain (science and engineering) and respond s to the high demand for STEM teachers and STEM educated people in the region, there is a need for greater effort and more focus in this respect.

The programme does not yet fulfil its claim to focus on professional learning over a career. The variation is quite broad in that respect. More coherence across different types of research would be helpful. This research pattern is also related to the transitional stage of the institute as a whole, with various strategic issues to be resolved.

2. Quality and academic reputation

The institute strives after quality improvement through several measures:

- Regular meetings organised at the different levels of organisation;
- Four meetings each year ('kwartaaloverleg') to discuss current developments in all core tasks of the institute;
- Four meetings per year with the senior research staff of ESoE to discuss PhD supervision and PhD output, research grant applications and research policy;
- Monthly meetings in which staff and PhD students discuss their research together and/or receive researchers from other universities or countries ('ESoE colloquia');
- Finally, at the level of the PhD students, meetings are organised in which PhD students discuss specific issues concerning their PhD trajectory ('promovendi overleg').

The self-evaluation report provides several indicators of the academic reputation of the research staff. A small number of ESoE staff members fulfil(led) several leadership positions in both national and international organisations, contribute(d) to the organisation of several national and international meetings and symposia in the domain of teaching, teacher education and science education, perform(ed) reviewer roles and se1-ve in the editorial boards
, of several scientific journals and/or book series in their fields, present(ed) their research in several national and international organisations and are regularly invited to speak at national and international meetings, both aimed at audiences of scholars as well as practitioners. Moreover, ESoE staff members and PhD's have received several awards during the review period. Finally, there have been regular staff exchanges between ESoE and other international institutes, with ESoE PhD students paying work visits to foreign institutes and ESoE receiving visiting scholars from foreign institutes.

Assessment
Overall, the general academic quality is (very) good and the commitment of staff and students is impressive. The size and composition of the research group, together with a diversity of interests, does, however, mean that there is considerable variation within the levels of quality. Output, for example, ranges from papers published in highly ranked international journals (e.g. International Journal of Science Education, Teaching and Teacher Education, Teachers and Teaching: Theory and Practice) to those in less well ranked and Dutch language journals. Although all key publications are published in respected journals, the significance of the contribution to knowledge of the field varies considerably.

The Committee feels that it is important that this variation is acknowledged, since it relates to the tensions in the current programme between diversity of individuals' research interests and the need for a clearer collective focus. The presentation of the research citations (citation analysis by Google scholar) in the ESoE self-evaluation documents illustrates the variation in focus and quality well. Of eight 'key findings' from the programme few would be recognized by the international community as contributing new knowledge.

It is clear to the Committee that the programme as a whole has established a strong (inter)national reputation in research into professional learning, but not yet convincingly or comprehensively in STEM. Relatively few individuals currently active within the programme can claim to have an established reputation in the STE M domain. This can be concluded from the rather limited number of invitations to provide keynotes at

international conferences, chapters for research handbooks, service on editorial boards of ranked journals or international scholarly bodies. This last observation might be seen as surprising in a university which specialises in science and technology, but it probably has to do ·with the relatively modest and late investments in senior staff with specific STEM expertise.

On the theme of teachers' lives and work, there is clear evidence of international standing in relation to research on teacher identity and early career professional development. Individuals in these areas have received recognition from the American Educational Research Association and other prestigious prizes. It is the publications of these same individuals which are regularly well cited.

In summary, the Committee recognises that the research of ESoE is in a phase of transition. At present, although some do, not all researchers in ESoE operate at an international level or publish in high ranking journals. Despite this, it is clear that, as a whole, ESoE is 'punching above its weight', given the loss of the Fontys connection, the small size of the research and teaching team and the range of its research (and development) activities, including service work with local schools, emerging partnerships with other universities in. The Netherlands and abroad and the development of research within the university into teaching and learning in higher education. The Committee commends the leadership of ESoE for this. However, the Committee believes that the portfolio is too broad and varied as it stands, given the size of the unit. If it is to develop the quality of its programme over the next period, it needs to:

    i)   Create more coherence across the twin themes of professional learning and STEM education. This requires an increased and more proactive steer from ESoE's leadership;

    ii)   Align itself more closely, within the university, to professional learning, training and development in higher education, with particular reference to STEM education and, within this, engineering education, and including investments in related research;

    iii)   Continue to provide a service to local schools, preferably in relation to research on (i).

If these developments are to be achieved, further investment by the university will be required. Also, timely recruitment of a new full professor (in view of the future retirement of one of the programme leader s), preferably with a strong STEM expertise, is recommended.

3. Resources

The development of research staff numbers and total funding rates over the review period 2007-2012 is reflected in the tables presented in the self-evaluation report. The tables provided the necessary information and enabled the committee to come to conclusions.

Table 1. ESoE Research staff in number of people per category 2012-2017

	2007	2 008	2009	2010	2011	2012
Full professor	4	4	4	4	4	3
Associate professor	**1**	1	1	1	2	2
Assistant professor	3	3	3	2	2	0
Postdoc	0	0	1	2	2	2
PhD	3	4	5	7	7	7
Grand total	**11**	**12**	**14**	**16**	**17**	**14**
PhD extem al	*19*	*29*	*32*	*29*	*24*	*21*

Table 2. ESoE research staff in fte 2007-2012

	2007	2008	2009	2010	2011	2012	Total 2007-2012
Tenured staff	1,73	2,70	2,67	2,60	2,20	1,76	13,66
Non-tenured staff	0,00	0,00	0,10	0,40	0,60	0,80	1,90
PhD	0,67	2,28	3,05	4,82	5,08	3,22	19,12
Total staff	**2,40**	**4,98**	**5,82**	**7,82**	**7,88**	**5,78**	**34,68**

Over the review period staff numbers at ESoE's research programme have increased from 11 persons in 2007 to 17 persons in 2011. From 2011 onwards, staff numbers decreased to 14 persons in 2012. This pattern is reflected in the number of research staff fte's, which increased from 2.40 fte in 2007 to 7,88 fte in 2011 and then decreased to 5,78 fte in 2012.

While the increase in research fte numbers concerns all types of staff, the drop in research fte numbers from 2011 onwards only concerns the tenured and PhD staff. Non-tenured staff fte numbers have slightly increased from 2011 onwards from 0,60 fte to 0,80 fte in 2012. The decrease in staff, PhD numbers and research fte is a direct consequence of Fontys' decision to end the collaboration with ESoE.

Table 3. ESoE research funding: 2007-2012 in percentages of total funding

Funding	2007	2008	2009	2010	2011	2012	Average
Direct funding	91%	72%	62%	57%	56%	63%	**67%**
Research grants	6%	9%	12%	16%	25%	34%	**17%**
Contract research	3%	19%	26%	27%	19%	3%	**16%**
Total funding	**149,8 k€**	**339,6 k€**	**398,7 k€**	**473,9 k€**	**438,9 k€**	**354,1 k€**	**359,2 k€**

The increase/decrease pattern shown by the staff numbers, is paralleled by a similar pattern in the total funding rates. Total funding increased to€ 473.900,00 in 2010. From 2010 onwards total funding decreased to € 354.100,00 in 2012. The ratio between direct funding, research grants and contract research also shifted during the review period. While the share of direct university funding in the programme's annual budget has declined from 91% in 2007 to 63% in 2012, the share of research grants within the annual budget increased: from 6% in 2007 to 34% in 2012. The share of contract research in the annual budget, on the other hand, first increased from 3% in 2007 to 27% in 2010 and then declined dramatically to 3% in 2012. This decline has had a significant impact on the total funding rates since 2010. The Committee learned that the decline was due to the ending in 2010 of the temporary funding of the KWTZ (Kenniscentrum Wetenschap en Techniek Zuid), a centre of expertise for innovation and research in the domain of science and technology in primary education in which ESoE participated with research. Over the review period, funding of the programme was on average 67% via direct university funding, 17% via external research grants and 16% via contract research.

Assessment

From the information presented in the self-evaluation report and the interviews during the site visit, the Committee learned that ESoE's financial resources have become unduly limited. This has resulted, among other things, in tenured and non-tenured research staff which, in the view of the committee, is too small to sustain the contributions demanded by the university and the professional learning knowledge community more generally. The Committee considers the size of the staff critical, especially in relation to ESoE's many and quite varied assignments. PhD student numbers, for instance, have been and still are high:

there were only 7 tenured and non-tenured research staff members (2,56 fte) for the supervision of 28 PhD students (internal and external together) in 2012. It seems obvious, that only limited time remains available for conducting own research and writing grant proposals. In fact, the Committee noted that the programme has indeed obtained a relatively limited number of grants. At the same time, the Committee took note of the fact that both leadership and staff are very conscious of the importance of obtaining grants in order to increase the institute's financial resources, although the non-commercial context in which the programme operates, brings limited opportunities to obtain grants or sponsorships from business and industry. The perceived pressure for the need to bring in money seems to make the researchers involve themselves in projects which are more, but also less, in line with the programme's objectives but are attractive from a financial point of view. Although this may not be the major reason for the lack of coherence in the programme's research activities, the Committee is convinced that it certainly contributes to it.

The Committee praises the programme leaders and other staff for their efforts in making the best of the situation. However, it recommends that investments in quantity and quality of the research staff are made so that the programme can meet more effectively the various existing and new expectations. The Committee therefore advises ESoE's leaders and the TU/ e Board to search together for more realistic financial arrangements.

4. Productivity
The self-evaluation report provides information on the number and type of output of the programme's researchers.

Table 4. ESoE research output in publications 2007-2012

	2007	2008	2009	2010	2011	2012	Totals
Refereed articles total	18	18	16	22	33	21	128
Other scientific articles	5	1	4	2	3	1	16
Scientific book chapters	6 (2 ico)	4	1	7 (1 ico)	3	5 (5 ico)	26
Monographs	-	2	-	1	1	2	6
PhD - theses	1	2	3	7 (1 duo"	3	7	23
Professional & other publications	11	16	21	16	13	5	82
Total publications	**41**	**43**	**45**	**55**	**56**	**41**	**281**

During the review period the research staff of the programme produced 170 academic publications (i.e. refereed articles, other scientific articles and scientific book chapters). The total academic output per year shows a rather versatile image, numbers oscillating between 21 and 39 academic publications yearly, which is rather consistent with the fluctuations over the years in fte's total research staff. Over the review period the programme produced on average
4.9 academic publications per fte total research staff per year.

The programme has produced 128 refereed articles over the review period, which equals an average of 3.7 refereed articles per fte total research staff yearly. Furthermore, the programme has produced 82 professional and other publications in total over the review period, which equals a yearly average of 2.4 professional and other publications per fte total research staff. A total of 23 PhD -theses was produced over the review period. This means that there was an average of 1.7 PhD-theses per fte tenured staff.

Assessment
Although there are some (understandable) fluctuations over the years, the Committee assesses the productivity of the group as high, especially in comparison to other research programmes in the field of teacher education. Relatively many publications appeared in

international journals, produced by relatively few staff. In addition, during the entire period, the number of PhD-theses is high, especially in view of the limited supervision capacity (currently two full professors and two to three associate/ assistant- professors). In relation to this positive judgment on productivity, it should also be noted that the wide variety of research topics (partly due to the many PhD-trajectories of Fontys) may have prevented even higher levels of productivity because it is easier to accumulate publications with a more focused programme. In summary, the view of the Committee is consistent with the self-evaluation evidence that the existing staff have been relatively productive, but that such productivity has been diverse. The Committee believes that the level of the programme would be raised, especially in relation to STEM, with the appointment of additional staff matched to a plan for strategic development agreed with the TU/e board.

5. Societal relevance

The focus of the programme on development and learning of teachers, especially in the STEM domain, connects well to both the Dutch and European policy agendas, in which raising the number of teachers in the STEM domain as well as raising the quality and innovative capacity of teachers are core priorities.

More specifically, the societal relevance of tl1e programme is claimed to be illustrated by several factors. Firstly, the programme's research findings are incorporated in the curriculum of the (3TU) Master of Science Education and Communication and the minor Communication and Education coordinated by ESoE. Reportedly, they are also used in the teacher education programme and in professional development activities.

The involvement of the programme in innovation projects and contract research conducted for schools as well as for the TU/e (e.g. research on ICT in education (Kennisnet), evaluation of school curricula and innovations of school (OMO schools), etc.) also illustrates its impact on society.

The societal relevance of the programme is also expressed through participation in several policy advisory boards and educational task-forces, evaluation or accreditation committees and research evaluation panels.

Finally, the programme's research results are disseminated at scientific and professional conferences, during lectures or presentations or in workshops with teachers and through scientific and professional journals, books or brochures for practitioners and university or local newspapers.

Assessment
At one level, there is an impressive dissemination of the work carried out by ESoE. However, it is not immediately apparent to the Committee whether it is the result of a coordinated policy or of a number of individual efforts. Whilst it is clear that there is on-going and productive interaction with both academic and user groups in schools, there is yet modest evidence available of the impact of the interaction upon these groups, for example in terms of ESoE's influence on understandings of science education, teachers' knowledge, professional learning or classroom practices. In reaching this conclusion, the Committee again highlights the wide diversity of activity which may detract from efforts to provide significant influence for change and improvement in the understandings and work of users from outside the university. The Committee also notes that there is little evidence at this point of the influence of ESoE within the university community of staff and students. The Committee recommends that urgent attention is given by the leadership of the programme both to the development of more explicit, focused strategies for societal influence and contributions to the university. These may include developing leadership of

other existing university units.

6. Strategy for the future

One important factor contributing to the viability of the research programme, is the fact that ESoE is often approached as research partner by expertise centres of universities of applied science or by teachers aiming for a PhD, given its experience with external PhD trajectories. ESoE's long-term partnerships with schools and school networks makes large and long-term project s possible, providing opportunities for PhD studies. It is expected that this asset will keep on attracting external PhD students in the future.

Other strengths identified in the programme's S\VOT-analysis comprise the programme's profile combining both general educational studies and more subject-specific studies and covering the whole education domain from primary education to higher education, its reportedly promising research results, its national and international research network, the strong connection between the research programme and the teacher education programme, its innovation activities, the reportedly high number of PhD graduations and few discontinuations of PhD project s and the satisfaction rate of its PhD students with the quality of the supervision and the facilities.

On the other hand, there are also some weaknesses. Firstly, there are the programme's small staff and the staffs' limited time to spend on conducting research and writing grant proposals. This has resulted in a limited number of grants obtained from NWO and the EU. At the same time external research funding by the Dutch government, EU and international organisations is decreasing and becoming more competitive due to the financial crisis. Moreover, the non-commercial context in which the programme operates and the TU/ e atypical domains on which it focuses, limit the possibilities for obtaining grants from TU/e and sponsorships from companies. In general, there is little funding available for research on teaching and teacher education, in particular science education, anyways. These factors make the programme highly dependent on the continued recruitment of external PhD students. No11nally, it might be expected that the pressure on the staff s supervision capacities would decrease with the decline of the number of PhD students, as a result of the discontinuation of the collaboration with Fontys. However, given existing time pressures, this is unlikely to be the case in this instance. It is unlikely, therefore, in the view of the committee, that there will be more time to spend, for example, on writing grant applications. Increased support is, we believe, necessary for the staff to be explicitly stimulated. Within this, if strategies of ESoE to obtain more grants are to meet with more success, the current programme needs to be adjusted, tuning it in more to contemporary themes in the domain of STEM teaching and teacher education (e.g. curriculum development, ICT in education, excellence in learning/teaching, new teaching and learning environments, and effective professional development programmes) and strengthening its science education component. It is expected that this will make it easier to connect with (inter)national partners, as well as with TU/ e departments. The recent appointments of two associate professors in the field of science education aim at bringing more continuity in the expertise in this domain.

Moreover, ESoE plan is to make its strengths and expertise more visible within the context of TU/ e, in order to generate more work within the university (advisory work or conducti ng research for departments and policy makers for instance). Furthermore, next to advisory work. ESoE attempts to do research, including PhD research, in several expertise centres of primary teacher education institutes regarding professional learning of student teachers, in which it participates.

A specific opportunity identified in the SWOT-analysis, is the fact that the Dutch government invests extra funding in the quality of teaching and teacher education, especially within the

domain of STEM, which is in line with ESoE's profile. This may result in new research opportunities.

Assessment
The Committee appreciates the SWOT-analysis of ESoE and generally agrees with it. However, the Committee thinks that to become really successful in realising the potential opportunities, the research programme would need to be larger in size, with a sharper profile, more robust funding and a more pro-active strategy in making clear choices for relevant audiences in policy and practice. The Committee believes that, in its current shape, the programme may not be competitive enough to acquire new funding from outside. The profile needs especially sharpening in the aforementioned "contemporary themes" that are seen as promising by the Committee. Throughout the report arguments and recommendations are provided that make a case for this conclusion.

A timely succession of the dean (within a few years) might be seen as an opportunity to strengthen the STEM part of the research programme

7. PhD-training and supervision
ESoE has developed a set of procedures, regulations, duties and rights regarding PhD-training and supervision. Next to their research plan, all ESoE PhD-students need to write a supervision and education plan. The core training of ESoE's PhD-students is constituted by the close supervision by staff members and sometimes external supervisors. Also, the institute has the policy that PhD-students with more than 0,4 fte research time become a member of the research school ICO, which offers domain specific PhD-courses, summer schools and other activities. Students who do not meet the ICO criteria (often contract students) can still participate in methodological ICO courses and thematic "master classes". Furthermore, PhD- students can follow the general skills programme PROOF offered by TU/e's Graduate School. Apart from ICO and PROOF, all PhD -students can take other relevant courses after
approval of their supervisors and the ESoE research director. In addition, each year a summer and a winter school are organized within the context of the "Joint Researcher Training". The
"Joint Researcher Training" initiative is a collaboration of ESoE with colleagues of the
University of Duisburg-Essen, the University of Helsinki, the University of Northwestern Switzerland and FontD (the Swedish Research School on Science, Mathematics and Technology Education), which aims at intensifying and enhancing education of graduate students with respect to international standards in the field of science education. PhD-students visit the summer and winter school t'\vice during their PhD-trajectory and are stimulated to present and discuss their work during these meetings and to participate in workshops on various relevant topics. Apart from the summer and winter school, PhD-students also have the opportunity to visit the annual conference of the Netherlands Educational Research Association, as well as two international conferences, during their PhD - trajectory. Finally, ESoE occasionally organizes in-house sessions on various relevant topics.

Out of the 34 PhD -students that enrolled between 2004 and 2008, 15% had graduated after four years. After five years another 29% had graduated, and another 18% after six years. 29% have not yet finished their projects, while 6% of the total of 34 PhD-students dropped out.

According to the self-evaluation report, all PhD-students found a job after graduation with various employers, also including ESoE and Fontys, or remained with their current

employer in case of contract PhD-students.

As a consequence of the discontinuation since 2011 of the collaboration between ESoE and Fontys, PhD numbers are expected to decrease as the PhD-student influx from Fontys will cease.

ESoE monitors the quality of its PhD-supervision in various ways. In yearly performance evaluations ('Resultaat en ontwikkelingsgesprekken'), PhD-students and staff are asked to give their opinion on the quality of the supervision and to provide suggestions for further improvement. The results are discussed in management and research staff meetings.

Furthermore, every few years a survey is held in which PhD-students are asked to comment on the supervision process in a more anonymous fashion. Finally, progression of PhD- students and issues concerning supervision are discussed four times a year by the senior research staff. The self-evaluation repo rt includes a table presenting the satisfaction rates on various supervision elements. The table shows that on all criteria the satisfaction of PhD- students with the supervision has increased from 2009 to 2012. On a scale from 1-10 the overall satisfaction grade increased from 7.43 in 2009 to 8.08 in 2012.

Assessment

The Committee assesses the PhD -training and supervision as excellent. The success rate is very good, the doctoral students have the possibility to participate in different courses and summer schools, as well as in national and international conferences. The full professors are very much involved in supervision and their work is very much appreciated by the doctoral students. This was clearly underlined by the doctoral students. The doctoral students finish their theses in a reasonable amount of years and they get jobs in different fields. Altogether, this is a very strong component of ESoE.

8. Conclusion

Overall, the Committee appraises the research programme as solid, and the research team as capable and very dedicated. Besides, throughout this repo rt, the remarks of the Committee address some persistent issues. They can be summarised in the following recommendations:

- create more focus in research themes (and perhaps also approaches);
- invest in developing a few, rather than many, themes that really distinguish the programme from others;
- increase the number of staff to reach sufficient "critical mass";
- strengthen the STEM component.

These developments are urgent if ESoE is to build on its strengths and remedy its existing limitations. The Committee recommends, therefore, that ESoE's leaders develop a clear strategy which identifies priorities in mission, tasks and funding of the research programme.

Appendices

Appendix A: Curricula vitae of the committee members

Jan van den Akker is Director General of SLO (Netherlands Institute for Curriculum Development). Also, he is Professor emeritus at the University of Twente, where he served for many years as Chair at the domain of Curriculum Design and Implementation. Some other roles include: Chairman of the Scientific Advisory Board of ICO (the Netherlands Interuniversity School for Educational Research); Member of the Dutch National Unesco Commission; Board Member (Past President) of CID REE (Consortium of Institutions for Research and Development in Education in Europe). He has a broad international orientation, including supervision and consultancy for many R&D pro jects in various continents (Europe, sub-Saharan Africa, Asia, Latin America). His main areas of expertise in teaching, research, publications and consultancy are: curriculum policy making; curriculum development in interaction with teacher learning and school development; design and evaluation of curriculum materials; and methodology of design research in education.

Elke Sumfleth is full professor of Chemistry Education at the University of Duisburg-Essen, Germany. After gaining her doctoral degree in Organic Chemistry at the University of Hamburg she started her research in chemistry education with a stro ng focus on empirical research in the field of teaching and learning of chemistry, from the very beginning. After her habilitation she got a professorship in Chemistry Education at the University of Essen. In 2004 she got the full professorship at the University of Duisburg-Essen. During the last ten years she got two further offers, a professorship in Science Education at the Stockholm Institute of Education and a second one at the University of Hamburg which she declined. She led several research projects and was for ten years the chair of the DFG research training group "Teaching and Learning of Science". She is author of many papers and articles, member of several editorial boards and of different national and international scientific review or advisory boards. In 2010 she got the honorary medal of the Gesellschaft für Didaktik der Chemie umd Physik awarding her contributions to research in chemistry education.

Christopher Day is Professor of Education at the School of Education, University of Nottingham. His particular concerns centre upon the continuing development of teachers, teacher effectiveness, teachers' lives and work, successful school leadership, and the management of change. He leads the Teachers' \Xl or k and Lives and School Leadership Research groups in the Centre for Research in Schools and Communities. He has worked, as a schoolteacher, teacher educator and local authority schools adviser. He has extensive research and con sultan cy experience in England, Europe, Australia, South East Asia, North America and with the OECD in the fields of teachers' continuing professional development, school leadership and change. He is the Editor of 'Teachers and Teaching: Theory and Practice'; and founding Director of the 20 country longitudinal research project, 'Successful School Principalship'(http://www.ils.uio.no/english/research/project/isspp/). Recent publications include The International Handbookot1 Continuing Professional Development (co-editor and contributor, Open University Press, 2004); A Passion for Teaching (Routledge-Falmer, 2004); Teachers Matter: connecting work, lives and effectiveness (lead author, Open University Press, 2007); Successful Principalship in Times of Change: International Perspectives (lead - editor and contributor, Springer, 2007); The New Lives of Teachers (Routledge, 2010); School Leadership and Pupil Outcomes: L inking Learning and Achievement (Open University Press, 2011); The International Handbook on Teacher and School Development t (Routledge, 2012); and Resilient Teachers, Resilient Schools: Building and sustaining quality in testing times (Routledge, 2014)

Appendix B: Explanation of the SEP scores

Exellent (5)	Research is world leading. Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.
Very good (4)	Research is nationally leading. Research is internationally competitive and makes a significant contribution to the field.
Good (3)	Research is internationally visible. Work is competitive at the national level and makes a valuable contribution in the international field.
Satisfactory (2)	Research is nationally visible. Work adds to our understanding and is solid, but not exciting.
Unsatisfactory (1)	Work is neither solid nor exciting, flawed in the scientific and/or technical approach, repetitions of other work, etc.

Quality is to be seen as a measure of excellence and excitement. It refers to the eminence of a group's research activities, its abilities to perfo1m at the highest level and its achievements in the international scientific community. I t rests on the proficiency and rigour of research concepts and conduct; it shows in the success of the group at the forefront of scientific development.

Productivity refers to the total output of the group; that is, the variegated ways in which results of research and knowledge development are publicized. The output needs to be reviewed in relation to the input in terms of human resources.

Societal relevance covers the social, economic and cultural relevance of the research. Aspects are:
- societal quality of the work. Efforts to interact in a productive way with stakeholders in society who are interested in input from scientific research, and contributions to important issues and debates in society.
- societal impact of the work. Research affects specific stakeholder s or procedures in society.
- valorisation of the work. Activities aimed at making research results available and suitable for application in products, processes and services. This includes interaction with public and private organisations, as well as commercial or non-pro fit use of research results and expertise.

Vitality and feasibility. This dual criterion regards the institute's ability to react adequately to important changes in the environment. It refers to both internal (personnel, research themes) and external (developments in the field, in society) dynamics of the group. On the one hand, this criterion measures the flexibility of a group, which appears in its ability to close research lines that have no future and to initiate new venture projects. On the other hand, it measures the capacity of the management to run projects in a professional way. Policy decisions and project management are assessed, including cost-benefit analysis.

Appendix C: Programme of the site visit

Wednesday, 19 June, 2013

Time	Topic/committee	Members (tentative)
8.30 - 9.00	Reception of committee members (and getting them installed)	Prof. dr. Perry den Brok, prof. dr. Douwe Beijaard, administration office
9.00 - 10.00	Preparation committee, study of materials and documents, internal discussion of committee	
10.00- 10.30	Embedding of ESoE and its research within TU/ e; Start, evolution and future of the research of ESoE; ESoE research in relation to teacher education and innovation	Prof. dr. Hans van Duijn (rector Magnificus TU/ e & chair of advisory board of ESoE)
10.30 - 10.45	Coffee Break / internal discussion panel	
10.45 - 11.30	Research management and programme leaders	Pro f. dr. Douwe Beijaard (dean) Prof. dr. Perry den Brok (research director)
11.30 - 11.45	Coffee Break / internal discussion panel	
11.45 - 12.30	Research Staff & Postdocs	Dr. Ruurd Taconis (associate professor) Dr. Maaike Koopman (postdoc / assistant professor) Dr. Ellen Rohaan (post doc)
12.30 - 13.30	Lunch Break and discussion panel	
13.30-14.15	(Ex) PhD students	Drs. .Anna van der Want (internal) Dr. Migchiel van Diggelen (internal) Dr. Evelien Ketelaar (Fontys) Drs. Monique van der Heijden (external) Dr. Ton Maree (external)
14.15-15.30	Coffee Break; Opportunity to ask (clarifying) questions to management/programme leaders; Drawing conclusions by committee	Prof. dr. Douwe Beijaard (dean) Prof. dr. Perry den Brok (research director)
15.30 - 16.00	Report of preliminary findings to staff, management and PhD students	
16.00- 16.30	Drinks and snacks	

ESoE Midterm

November 2017
Prof.dr. ir. Fred Janssen (Leiden University), Prof.dr. Paulien Meijer (Radboud University Nijmegen)

The review committee has been asked to perform a midterm assessment of the research programme for the period 2013-2016. For this purpose, the committee used the self-evaluation report and discussions with the ESoE research management, scientific staff, PhD students and post docs, and representatives from practice. These discussions took place at November 27th 2017 in Eindhoven. In the assessment and the report, the SEP protocol 2015-2021 has been used.

Brief description of research unit's strategy and targets
The research programma of ESoE has been assessed in 2013 (period 2007-2013). The results of this assessment were positive, but a number of important recommendations were formulated: more coherence in the research programme; larger involvement in university education; strengthening the cooperation with schools concerning research. With a relatively small scientific staff (3.7 FTE in 2016) ESoE has taken important steps in realizing this. The institution works from a more coherent research programme. The visibility and involvement within the university have increased. The specific expertise of ESoE is not only recognized and appreciated within the university but also by schools.

Research quality
A coherent research programme has been developed aimed at the professionalization of STEM teachers. Given the expertise present at ESoE, the local context, and national and international developments, this is a strategically well-decided choice. For the last two years, in cooperation projects, research projects and publications, the integration of the two lines, that is teacher professional development and STEM education, is increasingly visible. The increased coherence of the research programme makes a number of developments possible and desirable. The programme can be positioned better internationally by means of key publications about important underlying mechanisms with the staff members as first authors. This might improve the possiblilities to get funding for fundamental educational research like PROO. Application for future funding for professionalization of higher education teachers might also become a possibility.

Relevance to society:
The research programme strengthens ESoE's growing teacher education programme directly. This is important because of the societal need for more and well-qualified STEM teachers. The cooperation with schools has been broadened from involvement in teacher education to doing research together. Schools appreciate this (in their words) culture change very much. They recognize and appreciate the relevance of ESoE's research. Cooperation with TU/e departments now takes place in several research projects. Departments appreciate the broad expertise of ESoE, related to STEM didactics, pedagogy and their knowledge about and experience in secondary education. Particularly the combination of expertise regarding STEM and teacher professional development is appreciated. The sustainability and upscaling of pilots in practice can be further strengthened.

Viability
The ESoE is in a transitional situation. Last summer one of the professors left, while another will leave in the near future. A profile has been drawn up with the academic staff for a new professor. The choice for a new professor will determine the direction and viability of the research program. Based on the international appreciation for publications from the research program and the discussions we had with schools and departments, we suggest to strive for clear additional expertise, the two lines of the research program being strong: STEM and teacher professional development. For the development of the research program it is also important to ensure that both forms of expertise are also present at associate and assistant professor level.

Quality and organization of PhD programmes

The PhD students greatly appreciate the guidance provided by the ESoE staff, which is not only focused on successfully completing the thesis but also on growing as a scientist. The academic staff is easily accessible, provides excellent feedback, and conducts career counseling where the interests of PhD students are put first. The recruitment and supervision policy of external PhD students has been strengthened. Supervision plans are available, but can be monitored better. PhD students also make as much use as possible of the good training offer of the national Research School ICO. When drawing up a supervision plan, it is important to make a distinction between dual PhD students who have their own network (such as DUDOC) and dual PhD students who do not have this. Learning from each other by the PhD students can be further expanded.

Research integrity
The ESoE follows three codes of conduct for scientific research. However, an ethical committee and good procedures and facilities for data management are still missing.

Diversity
The ESoE has a diverse research group. However, even more productive use can be made of the diverse backgrounds of the PhD students: this is already happening incidentally and informally, but this potential can be used even more structurally.

Recommendations
In a short time, a more coherent program was set up with relatively few people, with more impact inwards and outwards. The research group is characterized by a pleasant atmosphere.

More specific recommendations:
- Profile of new professor: importance of adding expertise in the field of teacher professional development.
- Recruitment policy for academic staff: ensure a good balance between expertise in the field of teacher professional development and STEM.
- Attention to key publications on the underlying mechanisms of the research program by academic staff. This can also strengthen options for obtaining financing for fundamental educational research.
- Dialogue around research program can be further enhanced with PhD students, schools, and faculties.
- More attention to scaling up and making pilots more sustainable in practice.
- Support and stimulate learning from each other in the PhD students group.
- Develop and implement a strategy for promoting scientific integrity and productive use of diversity.

DATA MANAGEMENT AND STORAGE: PROCEDURES AND GUIDELINES OF THE EINDHOVEN SCHOOL OF EDUCATION

December 2019

CONTENT OF THIS DOCUMENT

This document is about research data management at ESoE. It is composed to share procedures that need to be used by ESoE researchers to safely file their documents and protect them against loss. Also guidelines are provided to share data with other researchers within and outside of ESoE.

The content of this document is meant for new and existing ESoE employees with research tasks. This includes external PhD students (buitenpromovendi) that have a "0-contract" at ESoE. Particular attention goes out to what to do when an employee leaves ESoE to work elsewhere.

The following information will be provided:

1. Scientific integrity and ethical review of research projects
2. Procedures regarding the storage and sharing of research data and other files;
3. Options for storing large amounts of data;
4. Options for sharing data;
5. Procedures regarding the transfer of research data of employees leaving ESoE;
6. Questions and background information.

On 9 December 2019 this document has been established by the management team of ESoE. This implies that all employees are obliged to follow the procedures described.

WHY IS DATA MANAGEMENT AND STORAGE IMPORTANT?

Data management and storage is important for several reasons:

1. **Data safety**

Data safety concerns protecting data against loss by ensuring safe storage and making regular back-ups of your data. This includes data organization (in order to find the right data quickly) and data security (in order to protect data from unwanted (or "accidental") changes.

2. **Data sharing**

Another purpose of research data management is to make data available to others in order to collaborate or exchange information. Sharing data may have several reasons, such as:

- Cooperation with other researchers (inside ESoE or elsewhere);
- Making research data available for reuse by other researchers;
- Scientific integrity (for example, making data available for quality checks, audits);
- Obligation to share data by research funding bodies[35]

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[35] Since 2016 in NWO projects, researchers are obliged to store data for reproducibility reasons. NWO encourages sharing data that are relevant for reuse (for example final data files). See this link.

As can be concluded from the above, there is a link between research data management and scientific integrity.

SCIENTIFIC INTEGRITY AND ETHICAL REVIEW

Scientific integrity is demanded from all TU/e employees:

> *"Everyone involved in education and research at TU/e bears personal responsibility for observing and maintaining scientific integrity. At TU/e we require strict compliance with the overall principles of professional scientific conduct in all cases."*
>
> *"The Netherlands Code of Conduct for Research Integrity endorsed by 6 umbrella organizations, including the VSNU, which entered into force with effect from 1 October 2018, provides details of these principles. This Code replaces The Netherlands Code of Conduct for Academic Practice from the VSNU. Next to that TU/e has its own Code of Scientific Conduct. This TU/e Code of Conduct offers a more concise version, which also takes into account the specific characteristics of scientific activities at a university of technology."*

Sources: click here and here

ESoE researchers are obliged to adhere to, amongst other codes[36], the code of conduct of the VSNU, [37]. This code states that raw research data need to be stored for at least 10 years[38].

From January 1st 2020, all research projects conducted at TU/e including human participants need to be reviewed by the **ethical review board**. See the website of the board for more information on their procedure. Permission of the ethical review board is necessary before the data collection starts. To apply for permission by the ethical review board, first this form needs to be filled out. For obtaining permission, researchers need to show how they obtain **informed consent** of their participants. Informed consent templates and instructions can be found via the ESoE sharepoint.

OPTIONS FOR STORING LARGE AMOUNTS OF DATA

ESoE employees (including buitenpromovendi) are urged to use their S-drive and Surfdrive for data storage. The S-drive should be used for video and audio data (as these are biometrical data). Surfdrive can be used for other files. Data on your personal Surfdrive are stored on servers in the Netherlands, under European legislation, and are never forwarded to third parties. Capacity is 250 GB. Install the desktop client to automatically synchronize files and folders. Access to your files anytime, anywhere and with any device using your TU/e account.

If the capacity of Surfdrive is insufficient[39], TU/e provides additional options for data storage. Contact m.koopman@tue.nl or c.m.m.cantrijn@tue.nl for information about possibilities. If you are applying for new funding at NWO, please take into account costs for data storage beyond Surfdrive's capacity in the project budget.

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[36] The Code of Scientific Conduct of TU/e (effective on January 31, 2019), and the code of conduct of the Dutch Educational Research Association (VOR) for doing scientific research.
[37] See
https://www.nwo.nl/en/policies/scientific+integrity+policy/netherlands+code+of+conduct+for+research+integrity
[38] See the DANS website
[39] When gathering video data please select the resolution you need on the camera beforehand. Otherwise files may be unnecessarily large. If you need high resolution files, consider compressing files *after* the analyses.

If your research project is finished, data and other files should be stored in ESoE's digital archive instead of on your laptop. Contact m.koopman@tue.nl or e.neleman@tue.nl. They can create a folder and upload your files. Data will be stored for 10 years after the end date of the project and is removed afterwards[40]. Nobody else is allowed to (re)use your data without your explicit permission.

Storing data only on stand-alone devices such as computers, laptops, USB drives or external hard drives is strongly discouraged. Computers and laptops need to be encrypted by ICT services by means of Bitlocker.

OPTIONS FOR SHARING DATA

Surfdrive allows for sharing files and folders with colleagues. As everybody at ESoE is able to work with Surfdrive, this is the preferred option for sharing data. We advise *not* to use external platforms such as GoogleDrive, WeTransfer, iCloud, or Dropbox, because data is not stored in the Netherlands and because of regularly changing privacy policies of such platforms.

There are some options to share data with non-TU/e employees. We recommend the following options:

- SURFfilesender: for sharing files up to 500 GB (encrypted up to 250 MB);
  https://filesender.surf.nl/ (can be used by non-TU/e employees if you send them a voucher; a safe alternative to WeTransfer)
- DataverseNL: for sharing data of active research projects; https://dataverse.nl/
- The 4TU.ResearchData (http://researchdata.4tu.nl/home/) as a repository for sharing finished research projects (first 100 GB for free; storage for 15 years; a restricted access version will be available soon)

Please contact rdmsupport@tue.nl for more information.

DATA SHARING AND STORAGE WHEN AN EMPLOYEE LEAVES ESOE

Since data need to be stored safely after the project end date, ESoE feels responsible for storing data that was collected by former ESoE employees after their work at ESoE has finished. This implies that the following steps need to be taken before the end date of an employee's contract[41]:

- Managers will have an exit conversation with employees that leave in which data storage at ESoE is discussed;
- Final versions of data files that are suitable for sharing with other researchers (inside and outside TU/e) will be made available for use by others via the 4TU.ResearchData centre by the employee;
- *All* data need to be stored at the ESoE digital archive; employer will transfer the data to the research coordinator or secretariat who will take care of storage;

The employee is free to make and use a copy of his or her research data. ESoE will not use research data without permission of the employee that collected the data and only if participants gave permission for re-use too.

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[40] In case of NWO or EU funding this period is obligatory; if you have other funding and want to store data for a shorter period, please contact m.koopman@tue.nl *before* asking your participants for their consent.

[41] Please note: Folders that are shared on Surfdrive will disappear 30 days after the end date of the contract of an employee.

- **!!!! Use your S-drive (video and audio files) and Surfdrive to store and backup your research data and other files.** See intranet for practical information.
- **!!!! Have ICT services encrypt your computer or laptop with Bitlocker.**
- **Write a data management plan (particularly if you are a PhD student or if you are doing a NWO funded project; see the NWO website)** Ask yourself:
    o Are the research data stored safely (S-drive/SURFdrive)?
    o Meta data and documentation: can data be retrieved easily and is meta data included so that data remains comprehensible?
    o Access and reuse: can your colleagues (and – if necessary – other researchers) access and use your data?
- **Store raw data at least for 10 years after the project end date.** For information on which data (files) should be selected for storage, click here.
- **Name files and arrange folders in a systematic and consistent manner.** See intranet for examples.
- **Keep your original raw data in a separate folder and use a copy for the analyses.**
- **Do <u>not</u> use USB sticks and/or external hard drives for backups.**
- **For PhD students: participate in PROOF courses on scientific integrity and open science.**

MORE INFORMATION

If you have any questions, please feel free to contact:

- Maaike Koopman (research coordinator ESoE; experience with several TU/e data management options)
- Leon Osinski (TU/e Information Expertise Centre; expert on data management; click here for support options)

Or check the following websites

- Data coach: all information of the TU/e IEC on data management and storage
- PROOF course on open science and information literacy for PhD students (obligatory for all ESoE PhD students)
- PROOF course on scientific integrity for PhD students (obligatory for all TU/e PhD students)
- Data coach training for other employees