Dutch Research Agenda
Research along routes by Consortia (NWA-ORC) 2022
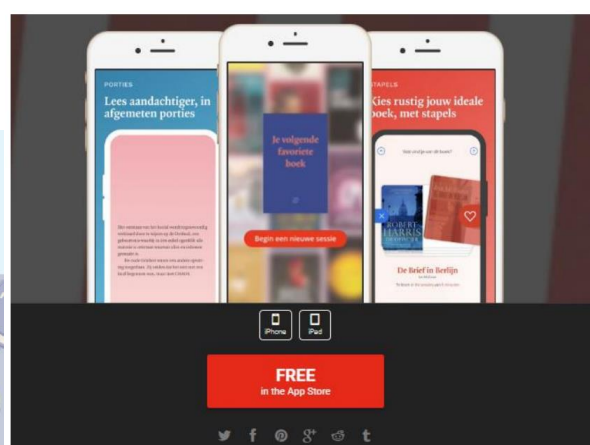**Full proposal form IMPACT PLAN APPROACH**
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Full Proposal form NWA-ORC 2022 - Form for Impact Plan Approach

Becoming literate in a digital age

Adapting reading education in the Netherlands

Illustration: Tim Hengeveld, Immer

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1   Overview

1.1   Title

Becoming literate in a digital age: Adapting reading education in the Netherlands

1.2   NWA route(s) & cluster question(s)

Primary NWA route applicable to the research proposal	*Child and adolescent development, upbringing and education*
Primary cluster question applicable to the research proposal**	065. What should education be like in the future?

1.3   Schematic overview of consortium

Main applicant			
First name, surname, title(s)	*Organisation*	*Position*	*Expertise (in key words)*
Prof dr. Els Stronks	Utrecht University (UU)	Professor, co-founder of LitLab.nl	digital educational platforms for the teaching of reading, history of reading

Co-applicants				
First name, surname, title(s)	*Organisation*	*Host country*	*Position*	*Expertise (in key words)*
Prof dr. Henk Aarts	Utrecht University (UU)	NL	Coordinator Alliantie Programma HUMANAI, UU, UMCU, TU/e en WUR	Human Motivation, Habit theories, Social norms, behavioural change, Autonomy and AI.
Dr. Agnes Andeweg	Utrecht University (UU)	NL	Assistant Professor	Shared reading
Dr. Kelly Beekman	Fontys Hogeschool (Fontys)	NL	Public Knowledge Institute	Technology-enhanced assessment
Dr. Judith Bekebrede	Universitaire pabo van Amsterdam	NL	Director	Educating teachers for primary education
Dr. Nynke Bos	Hogeschool InHollland (InHolland)	NL	Public Knowledge Institute	Technology-enhanced education
Prof dr. Paul van den Broek	Leiden University (UnivLeiden)	NL	Professor	(Neuro)cognitive models of reading comprehension, reading development, reading tests and interventions
Prof dr. Mehdi Dastani	Universiteit Utrecht (UU)	NL	Professor	Social robots, AI and human interaction, learning analytics

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Prof dr. Yra van Dijk	Lucas, Leiden University (UnivLeiden)	NL	Professor	Modern Dutch literature in a global perspective, interpretation, literature and new media, educational technologies
Dr. Hanneke van Eijken	Utrecht University (UU), member of the Commissie Europese Integratie (CEI) van de Adviesraad Internationale Vraagstukken (AIV)	NL	Assistant Professor	Digital literacy and (European) law
Prof dr. Christine Espin	Leiden University (UnivLeiden)	NL	Professor	Reading disabilities, reading and reading comprehension interventions, reading assessment, adolescents
Dr. Marije Groos	Hogeschool Leiden: Academische pabo	NL	Associate Professor	Educating teachers for primary education
Dr. Hans Hummel	Open Universiteit (OU)	NL	Associate Professor	Serious gaming in education, instructional design for technology-enhanced learning
Prof dr. Peter de Jong	University of Amsterdam (UvA)	NL	Professor	Reading development, reading comprehension, Specific Learning Disorders, interventions, longitudinal research
Dr. Wenckje Jongstra	Hogeschool KPZ	NL	Associate Lector	Education of teachers
Dr. Carlijn Kamphuis	Utrecht University (UU)	NL	Associate Professor of Public Health	The role of low literacy for socioeconomic inequalities in health; how low literacy impact on societal participation
Dr. Koen Leurs	Utrecht University (UU)	NL	Associate Professor	Media literacy, marginalized youth
Dr. E. Mantingh	Graduate School of Teaching, Utrecht University (UU)	NL	Assistant Professor	Reading education (didactic and pedagogical aspects)
Prof. dr Ron Oostdam	Kenniscentrum Onderwijs en Opvoeding, Hogeschool van Amsterdam (HvA)	NL	Professor	educational technologies
Prof dr. Ted Sanders	Utrecht University (UU)	NL	Professor	Discourse processing, discourse structure, discourse representation, comprehensible language
Prof dr. Elwin Savelsbergh	Hogeschool Utrecht (HvU)	NL	Lector	Curriculum development in primary and secondary education

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Prof dr. Eliane Segers	Radboud University (RU)	NL	Professor		Learning to read, reading comprehension, digital media
Dr. Esther van der Stappen	Avans University of Applied Sciences (Avans)	NL	Lector		Digital didactics, instructional design, technology-enhanced learning, software development
Prof dr. Roel van Steensel	Free University Amsterdam (VU)	NL	Endowed professor		Emergent literacy, home literacy, reading comprehension, reading motivation
Prof dr. Judith Rispens	University of Amsterdam	NL	Professor		Language and literacy acquisition, developmental language disorders, language processing

Co-funder(s)					
First name, surname, title(s)	*Organisation*	*Host country*	*Type*	*Sector*	*Expertise (in key words)*
Robert Chamalaun, chair; prof. dr. Gert Rijlaarsdam, workgroup WODN within Levende Talen	Levende Talen Nederlands, Professional organisation of the teachers of Dutch	NL	Governmental organisation	Education	Reading education
Gerlien van Dalen, director	Stichting Lezen	NL	Governmental organisation	Culture	Promoting reading in children
Tony van Dalen	Expertis	NL	Business Medium		Reading education
Ella Duijnker	School board Stichting Samen tussen Amstel en IJ (Staij)	NL	Governmental organisation	Education	Reading education
Jon Geerars, owner	Scholieren.com		Business medium	Education	Digital media & youth
Johannes de Geus	CED groep (CED)	NL	Business medium	Education	Development and implementation of educational materials
Desiree Heilegers	Ministerie van Onderwijs, Cultuur en Wetenschap (OCW)	NL	Governmental organisation	Government	Policy making; data analysis
Anne Heinsbroek	Stichting VoorleesExpress	NL	Foundation	Education	Reading education
Rosalin van der Hoeven, educational publisher	Lexima		Business medium	Education	Digital media & reading education

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Niels 't Hooft, educational publisher	Immer	NL	Business Medium	Education	Reading education
Jos Keuning	Stichting Cito (Cito)	NL	Public Knowledge Institute	Education	Research and development
Koosje Kuypers, teacher of Dutch at Schravenlant Lyceum, coordinator of reading program	Woordenaars.nl	NL	Governmental organisation	Education	Reading education
Prof dr. Kris van de Poel	Taalunie (TU)	NL	Governmental organisation	Culture	Promoting policy Dutch language
Prof dr. Nicoline van der Sijs	Instituut voor de Nederlandse Taal (INT)	NL	Governmental organisation	Culture and Education	Promoting linguistic and cultural research
Dr. Rosie van Veen, educational publisjer	Uitgeverij Noordhoff	NL	Business medium	Education	Development and implementation of educational materials
Rosemarie Van der Veen-Oei, head research	KB Nationale Bibliotheek, Digitale Bibliotheek Nederlandse Letteren	NL	Governmental organisation	Culture and Education	Digital reading research, digital reading, promoting reading and reading education
Conrad Verhoef, Teacher of Dutch, training of teacher,	ROC College Friese Poort, MBO	NL	Governmental organisation	Education	Reading education
Akke Visser	Stichting Culturele Apotheek	NL	Business Medium	Education	shared reading, teaching of reading experts
Krista van Vreeswijk, Jeroen Ulijn, school board members	BasisBuren	NL	Governmental organisation	Education	Reading education
Cristel Wieman	Stichting Klasse	NL	Governmental organisation	Education	Reading education
Famke Wink, Teacher of Dutch and coordinator of reading program, Practical education	Pro Drachten	NL	Governmental organisation	Education	Reading education

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(practical education (praktijkschool)					

Cooperation partners					
First name, surname, title(s)	*Organisation*	*Host country*	*Type*	*Sector*	*Expertise (in key words)*
Prof Dr. Sander Bax	Tilburg Center of the Learning Sciences, Tilburg University (Tilburg)	NL	Governmental organisation	Education	Education of teachers, digital media & textual culture
Dr. Martine Braaksma, advisor	Onderwijsraad	NL	Semi-governmental	Government	Advice on long-term educational policies
Dr. Inouk Boerma	IPabo	NL	Public Knowledge Institute	Education	Education of teachers
Michelle van Dijk, team leader, founder of Woordenaars.nl	Wolfert Tweetalig (Wolfert)	NL	Governmental organisation	Education	Education of reading & digital media
Dr. Joyce Gubbels, Dr. Nicole Swart	Expertisecentrum Nederlands	NL	Private Knowledge institute	Education	Research and development
Marie-José Klaver, MA	OSG Singelland (VO)	NL	Governmental organisation	Education	Reading education
Dr. A. Klein, Eef Jacobs	Oberon	NL	Private Knowledge Institute	Education	Research and development
Carolien Nagtegaal-Jansen, Teamleader and Teacher of Dutch	Het Zuiderpark College	NL	Governmental organisation	Education	Dutch as second language
Dr. Sybren Spit	Werkverband Amsterdamse Psycho-linguisten (WAP)	NL	Foundation	Education and Healthcare	Science communication (bridge between research and practice)
Dr. Marloes Schrijvers	Hogeschool van Rotterdam	NL	Public Knowledge Institute	Education	Educating teachers for secondary education
Erika Welgraven, educational publisher	Educatieve uitgeverij Blink	NL	Business medium	Education	Development and implementation of digital educational materials

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2 Problem analysis & Impact

2.1 Fit to NWA route(s) & cluster question(s)

With our societal and commercial partners, we respond to the challenge 'How can reading education help Dutch students (age 4-18) to become literate in a digital age?'. This challenge is part of the Route Youth: '**What should education be like in the future?**' (question 65). Current reading education fails Dutch students: for instance, nearly 25% of 15-year-olds in the Netherlands do not reach minimum standards of reading comprehension and struggle significantly in their ability to evaluate and reflect on written texts (Gubbels et al., 2019; Staat van het Onderwijs 2022). It also fails to provide equal opportunities to acquire essential reading skills. The gap in literacy skills between privileged and less-privileged students (divided by socio-economic, ethnic and multilingual backgrounds) is widening (Keizer et al., 2022). Recent data show that young children who start off as poorly performing readers in early years of primary school do not catch up with peers (CPB, 2020). For example, whether or not Dutch is spoken at home proves to be a reliable predictor for success (Swart et al., 2022; Agirdag, 2020).

Our project provides an essential component for the ambition of the NWA-ORC Route Youth to provide equal opportunities for all students to contribute to society and live a happy, healthy (adult) life. Knowledge and appreciation of textual culture contribute to a sense of belonging and to the cognitive and mental development of children (Van der Velden 2012; Taalunie 2017; Wennekers et al., 2017). In democratic societies, deficits in literacy among adults are associated with diminished socio-economic status, less social participation, increased health problems, and feelings of exclusion (Bavishi, et al., 2016; Leurs et al., 2018; Stringhini et al., 2017; Castles, et al., 2018). Moreover, in a civilised and democratic society all citizens are expected to be able to reflect upon written information and understand the world around them through reading. This is even more true in the digital age, given phenomena such as fake news, AI driven chatbots, and social bubbles. If the educational system does not ensure that students reach the necessary level of reading proficiency by the time they graduate, not only the students' personal well-being, but also the ideal of an open and inclusive society is at risk.

Our project also contributes to the ambition of the NWA Route Youth to deliver "future-proof" education. The transformation of Dutch reading education is necessary not only because of the (persistently) alarming results from current reading assessments, but also because reading education still needs to be adapted to an age where digital media has become the norm. The processing of written texts changes drastically as a result of the use of the attention-dragging and omnipresent online ICT applications, such as smartphones, apps, games etc., and the traditional pedagogy and didactics may not be sufficient to attain the known benefits of reading - such as the ability to process written information critically. Changing these online digital attention-diverting habits into reading comprehension activities is a key target that requires new perspectives and methodologies in the Dutch reading system. Accordingly, to give direction to the transformation, we need to fill a knowledge gap: **we need fundamental research into what constitutes the processing of written texts in the digital age, and into the teaching methods and teaching materials that effectively support this processing**.

Gaining insight into the dynamics of reading and reading education in a digital age, and thus filling this knowledge gap, is not just a national, but an international desideratum. All over the world countries are struggling to respond to the challenge digital media pose to reading education. Online reading behaviour is known to lead to difficulties with (especially deep) reading comprehension (Singer et al., 2016; Segers et al., 2021) and possibly affects the attention span of students (Wolf, 2018; Støle et al., 2020). Because what students read is much less controlled by adults such as parents, teachers, and publishers (for instance schools, libraries and bookstores have lost their gatekeeping function), extra efforts by adults may be needed to safeguard the reading youth (e.g. Vuorikari et al., 2022). Not being able to process written texts, either in digital or non-digital form, also affects the broader skill of digital literacy, defined by the American Library Association as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." Moreover, now that AI systems are capable of generating new texts through, for example, Chatbots, it is paramount that children be able to process such texts to assess the correctness of information in the texts and to critically reflect upon the texts in relation to their own knowledge and opinions. Although it is tempting to confine the impact of digital media on reading to unwanted behaviour (e.g. 'distraction' and 'a diminishing concentration span'), the problem we have at hand is more profound than this. In a modern society with "a mania for an informed existence", as the historian Anthony Grafton put it, processing information has become crucial to our everyday lives (Grafton et al. 2021). This was, for example, evident during the Covid-19 health pandemic, which the World Health Organization director-general Tedros Adhanom Ghebreyesus described as an "infodemic," short for information pandemic (2020).

Our proposed project is designed to fill the (international) knowledge gap that exists on how to adapt reading education to the impact of digital media, taking the Dutch educational system as a case study. It is

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imperative that we align with the results of current Dutch reading education. In this project, we assure that the new knowledge we aim to acquire about teaching reading comprehension and reading behaviour in the digital age aligns with what we already know about deficits of Dutch reading education. In preparation for this NWA project, two consortium members have written reports for the Dutch parliament and policy makers on the current state of Dutch reading education (Van den Broek et al., 2021; Van Steensel et al. 2021). Also, six members of the consortium have initiated the publication of the edited volume *Omdat lezen loont. Op naar effectief leesonderwijs* in Nederland (Pica, 2022) with contributions from experts across the entire knowledge chain (students, teachers, teachers of teachers, policy makers, publishers and scientists). We also reviewed the existing studies and reports and looked at the way Dutch reading education currently responds to the impact of digital media.

From those findings, we know that problems are not confined to poorly performing Dutch students: Both good and poor young Dutch readers perform less well than their European counterparts, and their decline has been consistent in the past decades. The Dutch Inspectorate of Education recently reported that at the end of primary education, only 50% of students reach level 2F of the Referentiekader Taal (the Dutch standard for reading and writing skills). This percentage compares to the goal set ten years ago of having 65% of students reach level 2F at the end of primary school, and is less than the percentage of students who actually reached that level ten years ago (Onderwijsinspectie, 2022). Reading for a prolonged period of time (processing longer texts) has also become increasingly problematic (Raad voor Cultuur/Onderwijsraad, 2019). Literary scholars and journalists have noticed how detached from Dutch culture students have become as a result of their inability to process long-reads such as novels, biographies and so on (Van Dijk & Klaver, 2021; Vrieling, 2022). From the age of 10 years onwards, young Dutch readers lose the ability and motivation to read for extended periods of time. According to the most recent PIRLS results, Dutch youth are among the least motivated readers worldwide (Gubbels et al., 2017). This is worrisome because we know that the relation between motivation and learning in general, and between motivation and reading comprehension in particular, is reciprocal: Students' lack of motivation can lead to less reading and lower school performance (Orhan-Özen, 2017) and less reading and lower school performance contribute to a lack of (reading) motivation (Wigfield and Cambria, 2010).

There is a general consensus that **a lack of emphasis on the processing of the content of what is read is an important cause of the dismal results of Dutch reading education**. The natural flow of applying what you read to yourself, and to the world that surrounds you is interrupted as a result of this lack of emphasis. In the reading of nonfiction texts, this is due to an unproductive emphasis by teachers and reading education books on the analysis of the structure of texts (e.g. Rooijackers et al., 2021). The instructions for the reading of fiction and nonfiction are strictly separated, and this also affects the students' ability to process content. The ability to process content is important for the development of the self - a known effect of reading fiction, which is not reached by reading non-fiction (e.g. Van Dijk & Stronks 2022). The rapidly changing habits of youth that include watching online videos, playing online games, and reading short digital texts on their smart phones rather than long-reads such as novels and non-fiction, contribute to the problems of processing the content of written texts. Yet, these changes in habits are not reflected in current Dutch reading education, even though the majority of schools works with or provide digital devices for their students (Swart et al., 2022). Dutch experts on curriculum development have pointed to the necessity of including digital media developments in the new curricula for primary and secondary reading education (Bron et al., 2020). The Dutch Referentiekader Taal, however, does not yet set specific goals for reading education in digital contexts (although the need for such goals is emphasised in the most recent evaluation of this Referentiekader (Van den Broek et al., 2022). Also, the recent Masterplan Basisvaardigheden lists the development of educational goals and tools for the teaching of reading in the digital age as a must (OCW 2022).

The goal of this project is to conduct research on methods and techniques that facilitate the adaptation of Dutch reading education to the digital age. 'Becoming literate in the digital age' to us means to acquire the reading comprehension and reading behaviour necessary to be successful as a citizen in a world that is becoming more digital and global (as the internet and media like TikTok and Instagram inevitably are). It also means that we explore the opportunities of digital media for future reading education. Digital media outlets can be a distraction for young readers but can also be an aid if used wisely in reading education (e.g. van Uittert et al., 2022; Segers et al. 2020; Ter Beek et al., 2019). For example, BookTok (offspring of TikTok) and Instagram can help young readers to build communities of kindred spirits (Overpelt, 2022).

Our goal to understand which types of reading education aids individual students, especially those who are at risk of a delay in their development as readers, to acquire the ability to process written

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information in the digital age, is the core of our proposed project. We focus on reading comprehension and reading behaviour because they are most affected by digital media. We tie reading comprehension to citizenship because we consider the ability to connect and engage intellectually and socially with what is read (the purposes of 'processing what is read'), is most at stake in future reading education. We define reading behaviour as the act of actual processing of written information that relies on reading comprehension, which can vary in frequency (e.g., reading once a week) and intensity (e.g., reading for a duration of one hour). We target students enrolled in Dutch education, who are growing up in the Netherlands, and speak Dutch as their first or second language.

In absence of goals set by the Dutch Referentiekader Taal, we take two EU legislation initiatives as our point of departure for 'becoming literate in the digital age': the Digital Services Act (EU, 2020) that aims to create a safer digital space where the fundamental rights of users are protected and the European Framework for Life Long Learning (EU, 2006) that defines reading comprehension as an asset for life, and is based upon the comprehension of written information, in relation to one self and the embedding of oneself in the surrounding culture:

> "the ability to [...] interpret concepts, thoughts, feelings, facts and opinions in [...] written form [...] to interact linguistically in an appropriate and creative way in a full range of societal and cultural contexts; in education and training, work, home and leisure."

Rather than singling out reading in digital contexts as a new form of reading that requires education separated from reading education in traditional media (Schnabel et al., 2016), we strive for integration, as recently advocated by the organisation Kennisnet (Zegveld, 2022). Integration requires us to align our work with the committee that is currently redesigning the Dutch language and culture curriculum (Vakvernieuwingscommissie Nederlands, VCN). The professional organisation for teachers of the Dutch language (Levende Talen Nederlands) and the overarching organisation for primary and secondary education (PO-Raad and VO-Raad) that advise the VCN are part of our consortium; some members of our consortium are also advisors to the VCN committee on personal title.

The NWA-ORC Route Youth offers the opportunity to propose research - based on the Dutch case study - that fills the existing knowledge gap on how to adapt reading education to the impact of digital media, and work together with our societal and commercial partners to deliver practice centred answers and solutions. This is executed in three research lines. Research line 1 (WP1) produces a conceptual model and educational framework that can be used - by us during the project, and by others after the project - to determine the effectiveness of reading education in a digital age. The model addresses new viewpoints of behavioural change to study how individuals can be motivated to, and acquire the proper cognitive processing skills to process written texts in the online-digital habit context. Research line 2 (WP2) develops and executes longitudinal design-implement-test cycles of educational interventions to test the model and framework. Research line 3 (WP3) monitors the effects of the educational interventions with advanced learning analytics and AI methods, exploring their opportunities to give real time feedback during reading education.

In phase 1, research line 1 of the project, we build a conceptual model of reading comprehension and reading behaviour in the digital age with cognitive linguists, literary scholars, behavioural psychologists, educational developers and AI experts, teachers and students (WP1A). We gather currently scattered theoretical insights on the interplay between reading comprehension and reading behaviour. To obtain a good fit between theory and practice, research line 1 also develops an educational framework (WP1B). The framework consists of a (new) didactic and pedagogical approach to reading education. Central in the didactic approach are the dynamics between regular and digital contexts. The pedagogical approach concerns how relationships or relatedness (teacher-student or among students) contribute to reading motivation, feelings of belongingness and competence, and the construction of reading identities. The framework furthermore consists of educational designs for the interventions that have either a large presence of educational technology ('EdTech'), a deliberately chosen absence of educational technology ('techfree'), or combinations of both (blended). We adopt this framework to evaluate to what extent the application of tech-features (like apps, games, and social media) make reading education more attractive and effective. In the case of EdTech interventions, the framework provides two options: digital learning platforms (DLP) and learning management and support systems (LMS). DLPs are in form and content aimed at instructing or testing knowledge, skills and developing attitudes in schools. LMSs are key sources of data production: student-generated data and metadata provide valuable information

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about learners and learning, which can subsequently be mined to monitor student progress and optimise educational efforts (Van Dijck, 2021). In phase 2, research line 2, four types of educational interventions (WP2A-WP2D) put the model and framework to the test. Research line 3 (WP3) provides input for WP1B in phase 1, but mainly harvests the data from all interventions (especially the interventions supported by LMS) in phase 2 of the project, and analyzes the data in phase 3 to deliver feedback on the learning process as much as possible in real time. In phase 3, we use the insights from other WP's for the optimisation of the theoretical model produced by WP1A.

During all phases of the project, WP4 (dissemination) provides preliminary results to students and teachers and organises communication and implementation of the project's results. The objective of WP4 is to engage stakeholders outside the consortium - as many as possible, including students, teachers, school boards and policy makers - with the testing of teaching materials and teaching methods, to realise and test teaching materials and methods as soon as possible in a community formed during the early stage of the project.
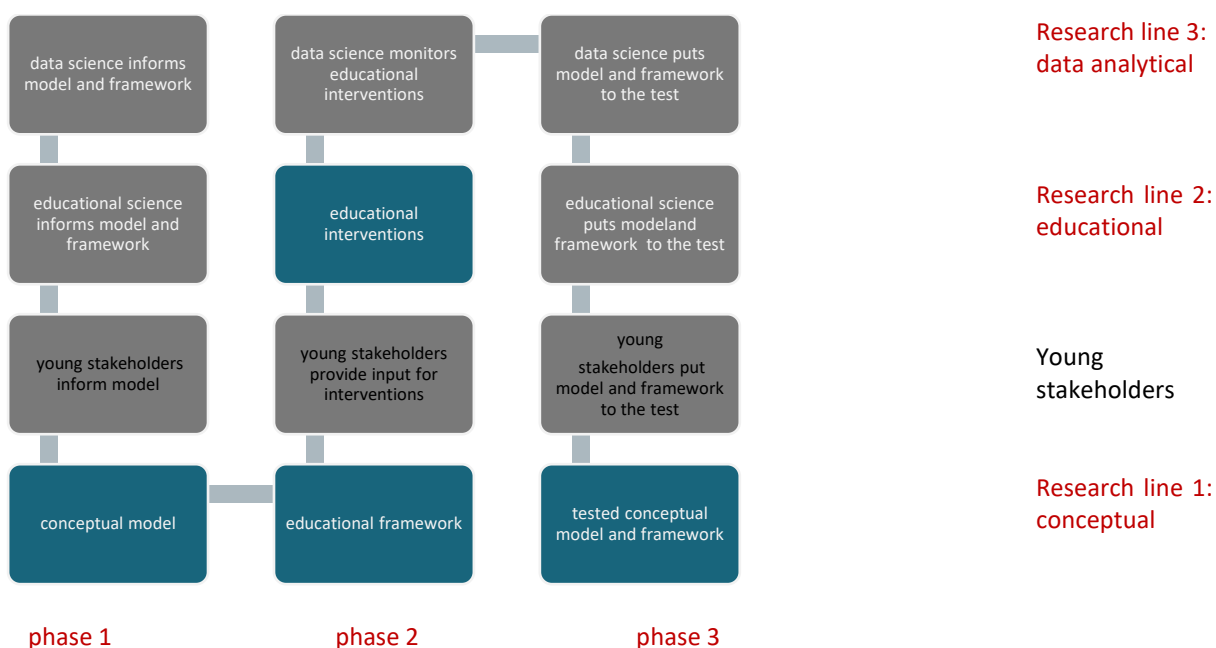

Fig. 1: Project research design

All results will be obtained via a coherent set of interrelated complementary work packages, and with representatives of all stakeholders involved in each phase. The model and new pedagogy, for instance, are designed in cooperation with representatives of teachers and students in our consortium to ensure they meet their requirements and psychological needs. Likewise, the educational interventions we develop and test consist of frames of actions (e.g. teachers' training, help desks for teachers, masterclasses etc.) that tie them not only to the students but also the (future) teachers (e.g. Wise, 2014).

Our project is connected to all three themes of the research agenda of the NWA Route Youth. Regarding the theme Learning and Developing in Different Contexts, we explore the positive and negative effects of digital media on future education via the testing of the opportunities and limitations of EdTech in reading education. We acknowledge that future reading education must safeguard young readers from the pitfalls of digital media by providing these readers with the ability to process written texts. Further, we use EdTech to design reading education aligned with the personal and individual needs of young readers.

Regarding the theme Diversity and Equality, via our design-implement-test cycles, we take into account what has previously been observed about the gap in reading performance between privileged and socio-economically deprived students (Bron et al., 2020), and about how schools have failed to exploit the potential of the digital literacy of their students. We strive for reading education that will support students at risk in particular, and prevent these students from social isolation (Buiskamp and Houtkoop, 2014). Prior research has shown that low literacy runs in families. Children growing up in low literate (often low income) families have less access to (digital) materials and devices, and are at a higher risk of developing suboptimal levels of literacy (Hart & Risley, 2003; Storch & Whitehurst, 2001; Van Steensel, 2006). For these groups, the school is particularly

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important for providing digital literacy education. Because most Dutch schools are well-equipped when it comes to digital infrastructures (networks, devices, support etc.), schools are in the position to make a difference. We aim to empower teachers to be experts in providing reading education designed to meet the individual needs of students at risk. We aim to support schools where teaching digital literacy is falling behind via teacher training and access to affordable teaching materials.

Finally, regarding the theme <u>Normativity in Education,</u> we set out to design reading education that teaches students to look upon themselves as readers in a digital world. We therefore embed our teaching materials and teaching methods in a newly developed pedagogic and didactic approach that bolsters the social identity of future generations. Although we restrict ourselves to education at schools, we will, where possible, also point teachers to digital applications that parents can use and that align with our project goals, such as http://letterprins.nl, developed by the Donders Institute and Radboud University, a playful game that helps parents and children to find a book to read (in line with our WP2C). Some co-funding partners in our consortium, such as the VoorleesExpress (see WP2A), already cross the border between home and school. In the case of the VoorleesExpress, this is done with the freely available, popular, low-tech website https://prentenboekeninalletalen.nl/, with picture books that can be read aloud upon the reader's demand in many languages, including Dutch dialects, Arabic, Farsi, German etc.

2.2   Suitability of Impact Plan approach

For a lasting and widespread impact on the educational system as a whole, we want to create reading education that is designed and developed with all relevant stakeholders, and that is sustained for future use by well-educated teachers, affordable and accessible teaching materials and well-informed members of school boards and policy makers. The Impact Plan approach is most suited, for it enables all of our consortium partners (scientists, societal and commercial partners) to cooperate in the pathway from project output to project outcomes to societal impact. In section 4 all stakeholders, as well as their roles and responsibilities are described in detail. The work packages in section 7 describe how we collaborate.

2.3   Societal & scientific impact

2.3.1 Desired societal change and impact

Impact 1:
A Dutch citizenry in which the ability to process written information in the digital age is of high-quality for all groups.
Impact 2
Teachers in primary education and teachers of Dutch in secondary education who have adequate methods and materials to teach reading comprehension and reading behaviour in the digital world.
Impact 3
Dutch test developers, educational publishers, members of school boards and policy makers who are able to act upon a solid body of knowledge on the teaching of reading comprehension and reading behaviour apt to process written information in the digital world.

Assumptions	Substantiated	Tested
reading comprehension and reading behaviour can be improved by making reading education apt to the digital age	WP1-4	WP1-4
the relation between reading behaviour and reading comprehension is reciprocal, and improvements can only be achieved addressing both	WP1A+WP1B	WP2A-2D
improved reading comprehension and reading behaviour contribute to successful participation of all young citizens in society	WP1A+WP1B, WP2A-2D	Outcome

2.3.2. Scientific questions and problem
The underlying scientific issue addressed in our project is the impact of digital media on education. Digital media affects both the learning process itself (what is learned, and how and why this is learned) and the actors in

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learning processes (how teachers, students, publishers, the teachers of teachers, members of school boards to policy makers are confronted with digital media).

In this project, scientists will examine the impact of digital media on reading education, focusing on both processes and actors across divergent disciplines. Relevant to this project is the international research done by literary, media and communication scholars, cognitive psychologists and social scientists on how reading online and living in a digital world affect the concept of literacy, and how time spent reading online, with much exposure to how so-called 'surface reading' (skipping through texts rather than processing them), affects reading comprehension (Mol, 2022); how reading education controls the access to these new forms of literacy (e.g. Frechette & Williams 2016), for instance when EdTech is being governed by commercial rather than public organisations, the 'googlization' of education (e.g. Kerstens & Van Dijck 2021). Also relevant is the work done by educational scientists and AI experts on how education can be improved by effective use of Edtech (e.g. Bergdahl, et al., 2020), how interoperability of technology can be achieved across all levels of the EdTech-ecosystem (e.g. Bapna et al, 2021), and how EdTech can lead to social exclusion but also entails the promise of social mobility (e.g. Gaidelys et al. 2022). Our project works on the intersection of changes to processes and actors, and is based on a main question that addresses conceptual, educational and technological issues:

> **Main question:** How should reading education be transformed, and to what extent should technology be applied, in order to improve both reading comprehension and reading behaviour of all students in the Netherlands (age 4-18) in a digital age?

We will align our research with the results of all mentioned disciplines. However, the focus we bring to the field is new: **the exploration and manipulation (through reading education) of the dynamics between the processing of written information and (actual) reading behaviour in offline and online settings**. As the online reading habits of youth continue to change (for instance due to the rise of new digital media, or better accessibility to existing digital media), we assert that reading education should be much more about actual reading behaviour than has traditionally been the case.

This claim opens up a new field of research that we explore in this project. Specifically, we assume that current reading education does not educate readers about their self-agency to engage in reading behaviour and, in doing so, to improve their ability to process written information. Based on this assumption, a major questions arises: What progress can be made if we do connect reading behaviour and reading comprehension in the transition that reading education has to undergo to withstand the impact of digital media? What is the connection between various forms of processing? Generally, processing entails making meaningful connections at various layers of understanding and levels of complexity, including connections within and between texts connections, connections between the text and the reader's background knowledge, and connections between the reader's inner world and the world outside. Processing is connected to a wide span of readers' goals: from sourcing (a more cognitive goal: Einav et al., 2020; Mascaro & Sperber, 2009), to the goal of using texts to connect and position oneself within the surrounding world (engaging, a more affective goal with a cultural dimension: Adler, 2020; Arredondo, 2018). These goals are often, if not always, under scrutiny of separate scientific disciplines. Current theoretical models are scattered across disciplines, and users of the models are either unaware of other models, or struggle to find common ground, hindered by the variety in disciplinary terminology. For example, cognitive science focuses on identifying the properties of the mental representations resulting from reading comprehension (Snow, 2020; Perfetti & Stafura, 2014; Van den Broek, 2010). Linguistics and communication science focus on text properties and markers of perspective-taking that play a crucial role in comprehension (Kleijn, Pander Maat & Sanders, 2019; Mouw et al, 2020). Social and behavioural sciences address the psychological processes underlying habit formation of reading behaviour in offline and online settings (Huang et al., 2014; Mokhtari et al., 2009). Literary studies focus on the collective experience of readers and how readers are affected by and interpret texts (e.g. Van Dijk and Stronks 2022). Answers to our main question can therefore be obtained through interdisciplinary cooperation between relevant disciplines, and ongoing exchange between theory and practice. We address Conceptual, Educational and Data-analytical subquestions, and distinguish between three phases (see also Fig. 1).

Subquestions and research lines
1) *Conceptual*: To analyse and conceptually model (the teaching of) reading comprehension processes and reading behaviour necessary for processing written information in a digital age.

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Phase 1: What is an adequate definition of reading comprehension and reading behaviour based on accumulated descriptions from various disciplines? And what is the contribution of EdTech and teaching methods to the modelling of the teaching of reading comprehension and reading behaviour?

Phase 2 and 3: How can analysis of the effects of educational interventions improve the model of (the teaching of) this reading comprehension and reading behaviour?

2) *Educational*: To determine how, and to what extent reading comprehension and reading behaviour can be taught using EdTech.

Phase 2: How can effective educational interventions and teaching methods targeted at reading comprehension and reading behaviour with or without EdTech be designed around so-called pressure points and effective building blocks?

3) *Data analytical*: To enhance the impact of the educational interventions through learning analytics and artificial intelligence methods.

Phase 1: What is the possible contribution of learning analytics and AI to the modelling of the teaching of reading comprehension and reading behaviour?

Phase 2: How can the educational interventions be analysed to inform students and teachers during the educational interventions?

Phase 3: How can we test and improve the model of (the teaching of) adequate reading comprehension and reading behaviour in the digital agent based on the interventions and collected data?

State of the fields: conceptual model and educational framework (WP1A + WP1B), research line 1

We identified three axes in the existing research into reading comprehension, reading behaviour and reading education during our preparatory meetings for this application that will allow us to construct an adequate definition across disciplines: (1) the **influence of specific text characteristics** on reading comprehension and reading behaviour (e.g. Van den Broek 2021); (2) the **social-cognitive potential of reading** that contributes to the development of the civic identity of the reader (e.g. Eekhof, Van Krieken & Willems (2022)); (3) the **individual differences** between readers with respect to their sensitivity to this potential (e.g, Van den Bosch et al., 2018). This application is written with a provisional model based on these axes in mind.

The postdoc and PhD student will extend and test the provisional model by integrating (at least) the following insights we found scattered across disciplines: insights from **cognitive sciences** (in which the acquisition of reading comprehension is often seen as 'sourcing to get informed', for instance Bråten et al. 2016) with insights deriving from **literary studies** (that look upon reading as 'a means to get connected to the culture around you', for instance Paris & Hamilton, 2009). And insights from **behavioural studies**. We will build on for instance Hagoort 2019 on 'language comprehension' not as single-word-processing; and Trasumdi et al. 2022 on 'embodied cognition', the intertwinement of human cognition, emotion and motivation; Vuong 2019 on 'language aptitude' as a combination of cognitive and behavioural factors; and on the importance of the need for autonomy in education according to the Self-Determination Theory (SDT) (Ryan & Deci, 2006), as students grow up as readers in a society that requires them to rely on personal autonomy (Botte et al., 2022). The autonomy of the young reader is now restricted to the choice of reading materials (Dera 2022).

Behavioural studies could add the dimension of habits: current models are restricted to skills (such as finding information, evaluating information and integrating information (e.g. Salmerón 2018)). As habits determine the frequency and regularity of reading, the combination of habits and skills is essential to foster reading comprehension. Recent analyses of the 2018-Pisa results for instance show that reading to learn is done best with books (Ikeda & Rech 2022). Surface reading (concentranting on 'what is evident, perceptible, apprehensible in texts' (Best & Marcus 2009) is much less affected by reading with the help of digital devices. We will build on existing studies on habit formation (Aarts, Verplanken & Van Knippenberg, 1998; Marien, Custers, & Aarts, 2019) and the recent insights in the realities of reading in a digital age (most specifically youth's preference for digital media (such as Goatley et. al., 2016, Xiu et qal., 2019; Clemens 2022)).

WP1B: educational framework

Educational sciences focuses on the development of effective interventions for promoting reading comprehension (e.g. Heyne et al., 2023; Scammacca et al., 2015) and on improving teachers' ability to implement such interventions (e.g. Darling-Hammond et al., 2017; Maandag et al, 2017; De Naeghel & Van Keer, 2014). Previous research and meta-analyses (e.g. Williams et al., 2022; Dietrichson et al., 2021; Kumar Basak, 2018) have shown that designing and implementing effective technology-enhanced learning requires actions that

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concern: (1) **technological skills and resources,** from user-friendliness to appropriate support for the teachers to adequate technical infrastructures at school; (2) **knowledge of (decision-driven) data collection and (data-driven) assessment** to enhance learning successfully; (3) **a coherent educational approach** based on teacher-guided learning. To this we add: (4) **an eye for changing student's habits**. In order for educational technologies to be effective, they must be embedded in a supportive frame of actions. For instance, whether a text will be studied deeply by the pupils depends not only on features of the text, but also the relevance of the text for the student and whether the teacher expresses a genuine interest in pupils' answers (e.g. Houtveen & Van Steensel 2019). Our WP1B defines the frames of actions for our educational interventions (WP2A-WP2D).

With regard to the choice of technology: The scattered results of EdTech developed for reading education do not add up to a solid recipe for technological decisions (Coiro, 2021). In general, playful learning (through apps, games, interactions with robots, ebooks with virtual & augmented reality) is recognized as an activity that can enhance students' motivation and lead to better learning results when compared with more traditional learning (e.g., Hummel et al., 2020). There are various games for reading comprehension with empirical proof that these games actually increase reading comprehension, like the 'Maya game' (Kieran & Anderson, 2016). However, caution implementing these general results is required, as signalled by the prize-winning 'Readification-project of the Dutch Reading Coalition and Ubisoft'. In the existing app, narratives around games written by some famous Dutch Young Adult-authors were presented to young players. The data show that only 10% of the users actually finished reading the stories. And only a meagre 0.3% were interested in hearing more reading suggestions afterwards (CPNB, 2021). The reading game proved ineffective in motivating low literate readers to read for a longer period of time, with more comprehension. This may have been caused by too little attention for the surrounding frame of actions needed to make a game like this successful. This is one of the dynamics we set out to explore.

A postdoc will work on didactic-pedagogical principles of the framework, based on **constructive alignment and cognitive apprenticeship**. In education designed on the basis of constructive alignment, teachers communicate the learning outcomes to students at the start, and teachers and students share the responsibility of achieving the intended learning (verifiable by the assessment tasks). EdTech is especially effective in this approach because it allows for personalisation: developing different types of teaching materials and assessment for different types of students with a range of abilities (e.g. Ali 2018). Cognitive apprenticeship (e.g. Dennen & Burner 2007) defines the relationship between adults and students in terms of cooperation, and in learning processes built on 'scaffolding' and 'modelling': teachers demonstrate how to solve a problem for their students. They then let the students try to solve the problem themselves by taking a step back and only giving support when needed. Recent research in historical forms of apprenticeship (e.g. Prak & Wallis 2018) reveal inspirational, role reversing learning processes. The habits of youth are sometimes better or more intensively geared towards digital media, which might require such reversion of roles. For this reason, we ivite young students to co-create part of the research with us.

The redefinition of these roles is a pedagogical question. We perceive reading education as emancipation towards grown-up ways of being in the world (e.g. Biesta 2017). In current reading education, adults determine how children and adolescents see themselves as readers. The so-called **reading identities** of the young are constructed top-down by adults and almost always negative in nature, labelling students most at risk as 'struggling readers'; a label that proves to be as persistent as demotivational. However, positive labels, grounded bottom-up from the habits of young people and geared towards the development of a student's own reading identity prove to have a lasting emancipatory effect (e.g. Glenn at al 2016; McGill-Franzen 2013; Alvermann 2001). Other cases also suggest that the extent to which awareness of a certain lifestyle is an important part of the self, positively impacts behaviour (Walton et al. 2018).

State of the fields: **Educational interventions (WP2A-WP2D), research line 2**
In preparatory meetings, we identified crucial moments in students' development of reading comprehension and reading behaviour (so-called pressure points: leaps in the development of reading comprehension and reading behaviour that - if they are not made - hampering further development (Van den Broek et al 2021; Compton & Pearson 2016)), where most impact of successful combinations of EdTech, techfree and blended learning environments can be expected: (1) **age 4**: the point at which the foundational skills of reading are practised and the ability to comprehend is first trained (e.g. Metsalal et al, 2021), and children from homes where Dutch is not

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the first language are impeded in their progress; (2) **age 10**: the point at which reading comprehension is first used to learn, and the increasing demands cause motivational problems (e.g. Aarnoutse & Smits 2020); (3) **age 12**: the point at which reading education for students in the Dutch school system is adapted to the four forms of secondary education (practical education (praktijkschool), vocational education (vmbo kader/vmbo tl), havo and vwo) and especially students in vbmo schools are vulnerable to developing unproductive reading habits. (4) **age 15**: the point at which the number of hours dedicated to reading education is substantially lowered for most students in this system (percentage wise, at MBO schools).

To arrive at a list of types of educational interventions that are most likely to be effective, we reviewed the existing literature (e.g. Geudens et al. 2022; Van Steensel et al. 2022; Gobyn et al., 2019; Houtveen et al., 2019; Hougen, 2014) and identified four different types of interventions that will serve as the building blocks.

Intervention WP2A: improving listening comprehension, inference making, and vocabulary (e.g. McMaster & Espin, 2017; Wagner et al. 2007) Two PhD students in this WP will work on the question of how reading education can improve the interaction around texts (universally touted as an important route towards improving reading comprehension skills) via improvements in listening comprehension, inference-making, and vocabulary. We know that listening comprehension (as a foundational skill), inference making and extending one's vocabulary are crucial to early decoding and later reading achievement (Rohde, 2015; Sénéchal, 2006; de Jong & van der Leij, 2002). **How can they be developed and how can their positive effects be sustained over time (Lindenburg et al. 2022; McMaster & Espin, 2017)**? EdTech could be helpful. For example, an embedded dictionary (Furenes et al., 2021) and enrichment of vocabulary through lexical simplification (Furenes et al., 2021) have been found to positively affect children's vocabulary learning. Similarly, technology has been used to improve vocabulary and inference making for young children via listening to narrative stories (McMaster et al., 2019).

Intervention WP2B: sourcing and engaging with information (e.g. Arredondo, 2018)
Two PhD students in this WP will work on the question how developing readers at different ages can be encouraged to apply critical comprehension processes when reading in digital contexts. Online reading implies that readers can navigate, select, integrate, and evaluate information from different sources (Salméron et al., 2018). To be able to do this effectively, readers need to take in account source information (e.g., Clark, 1996), to identify the intentions of the author or sender of the information, in order to decide on its validity, reliability and relevance. In principle, even 4-year children are able to infer the intentions of communication partners ('learn to source') (Einav et al., 2020; Mascaro & Sperber, 2009).

However, the transference of these skills into the domain of reading seems limited. Recently, Braasch and Kessler (2021) have presented an updated theoretical model of sourcing during reading that represents reading as an automatic, rather passive activity: new input of a written text may cue activation of information from long-term memory (including background knowledge from other texts, beliefs, and attitudes). Rather alarmingly, even if ample sourcing information is available, most readers fail to source. Unless readers are primed to pay attention to sourcing, even skilled readers (students at universities) forget to do so (Bråten et al., 2016; Stadtler, Scharrer, Macedo-Rouet, Rouet, Bromme, 2016). As a result, the content of written texts is stored into memory without a proper check of its validity (a key factor in processing written information).
To promote sourcing, we assume that manipulations need to be made at the text level and the task level.

We hypothesize that readers are more inclined to engage in sourcing if the task they have to perform is meaningful or purposeful to them (Guthrie, Wigfield, & You, 2012; Priniski, Hecht, & Harackiewicz, 2018; Herrington, Reeves & Oliver, 2014) and if they can exercise a certain amount of control (t.i. have autonomy) over the task (Ryan & Deci, 2000; Oudeyer, Gottlieb & Lopes, 2016). We assume that digital media may play a particularly powerful role in designing such interventions: in a serious game-based environment students might, for instance, be given the opportunity to take in a certain role or perspective (e.g., by choosing an avatar in a role-play set-up), and can be stimulated to have an active responsibility for more to weigh information from different sources or to understand written documents or hints in order to solve problems (Oudeyer, Gottlieb & Lopes (2016). This learning approach has been proven both effective and satisfying with scenario-based games for HE (e.g. Hummel et al., 2020) and MBO (e.g.. Hummel et al, 2021). **We further hypothesize that readers are more inclined to engage in sourcing once they detect discrepancies.** Discrepancies must be resolved in order to build a coherent mental model, otherwise, standards of coherence are not met (Van den Broek et al., 2011). We believe it matters to them whether

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information is presented as objective or subjective (Rouet, 2016; Canestrelli, Mak & Sanders, 2013; Kleijn, Mak & Sanders, 2021; Traxler et al., 1997).

Intervention WP2C: development of digital reading preferences (e.g. Dera et al, 2022). The PhD student in this WP will work on the question: Which EdTech, digital free or blended reading education helps students to define and enhance their reading comprehension and reading behaviour by preferences for digital texts? Digital texts have features that distinguish them from paper texts (scrolling, multimedia, hyperlinks, line length, number of columns, distracting elements such as (moving) images) that may affect reading time and comprehension (Dyson, 2004; Sanchez & Wiley, 2009). Comprehension of texts with hyperlinks, for example, requires the reader to make inferences between parts of the text and apply more background knowledge (Segers, 2017, Blom et al., 2018). These distinguishing features complicate a comparison between reading from paper and screen. This is solved by looking at digital texts that are quite similar to paper texts, resulting in the conclusion that there are no differences between reading narrative texts from paper and screen (e.g. Delgado et al. (2018) and Clinton (2019)). Informative texts read from the screen prove more problematic, but only when reading under time pressure (Delgado et al., 2018). **The next step in this research is to make a better comparison, between texts on paper and digital texts that include the distinguishing features to see if and how digital texts foster self-efficacy (Bandura, 1997) and reading comprehension (Coiro, 2021).**

Digital environments allow for easy social interactions between readers that may positively affect reading behaviour (see Ryan & Deci, 2000), and, as a result, to an increased vocabulary and comprehension (see Petscher, 2010). Digital texts also allow designers to introduce new features: for instance, our co-funding partner Immer introduced a tracking component in which the reader can set reading goals daily (e.g., read 2K words daily) and plan, for example, 10-minute reading sessions for which the reading material is then divided in parts that can be read in that time frame. Finally, artificial intelligence is used to give the reader a summary after reading, or a quiz. This may help to reflect on the text, consolidating what is read.

Intervention WP2D: sharing of reading experiences (e.g. Davis 2016) The PhD student in this WP will work on the question: To what extent does shared reading - on location or online, supported by reading technology or not - have a stimulating effect on reading comprehension and reading behaviour of young adults? Shared reading is a specific method of reading literary texts (poems, short stories, novel fragments) developed by the British organisation The Reader. It does not require participants to read a text in advance, and it focuses on the personal and social experience of literature rather than on formal literary analysis. A reader-facilitator (a trained volunteer, student or teacher) reads a text aloud on the spot to spark a conversation. Reading the literature aloud in real-time means that everyone can be involved in a shared, live experience. Shared reading was introduced in the Netherlands by our co-funder Culturele Apotheek.

While digital platforms like BookTok, BookTube and BookStagram allow for exchanging reading experiences and thus provide readers with a sense of agency and community (Reddan, 2022; Jerasa & Boffone, 2021,219) these platforms facilitate asynchronous sharing, and appeal mostly to teens who are already motivated readers. **The synchronous character of shared reading potentially has stronger effects on feelings of belonging (relatedness), and thus could stimulate reading motivation and positive reading habits.** So far no research has been done on the effects of shared reading in secondary educational settings (only healthcare, community and prison contexts involving adults, and young children in primary schools were examined (Liebling et.al. 2022; Billington et.al. 2019; Canning 2017; Davis et al., 2016). However, the behaviours related to positive language outcomes which are stimulated by shared reading are likely to be as important for teens as they are for younger children. These behaviours include exposure to high levels of syntactic and lexical diversity, ample opportunities to use techniques such as expanding, recasting and asking open-ended questions, and high levels of joint attention, contingent talk and responsiveness (Noble et al., 2019, 8).

State of the fields: data analysis (research line 3) (phase 1, 2 and 3)
From an information and data perspective, we need to develop a shared vision and alignment on data-driven learning, decision-driven data collection, and learning analytics. These are necessary for: (1) the personalization of the learning process and for providing targeted supplementary instruction (Bok et al., 2021); (2) the evaluation of the results produced by the educational interventions, and thus the testing of our conceptual model. The

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challenge is to align our conceptual model and educational interventions with the new opportunities and make timely decisions about their usefulness, in combination also with more traditional means to measure the effects of educational interventions (test, interviews) when educational interventions are completed.

The PhD student in this WP3 will work on the question: How to employ techniques from Artificial Intelligence and Data Science, including machine learning, data mining, and statistical analysis to search for deeper, longitudinal patterns in data sets of user interaction to yield new insights in the way the young acquire adequate reading comprehension and reading behaviour over time? We depart from recent developments in multi-modal learning analytics (Schneider et al., 2015; Ochoa et al., 2017, Sharma et al., 2020, Giannakos et al., 2022) that will allow for a standardised and experimentally valid data collection of teachers' and students' behaviour and students' learning outcomes. There is a growing amount of hardware (cameras, microphones, haptic devices, eye trackers), and software technologies for data collection (e.g., data loggers, compression software) that can support researchers to collect multimodal data (Ahn et al. 2020, Andrade 2017, Giannakos et al. 2019, Yang et al. 2022). Also, various tools and techniques are available to analyse collected data, e.g. to detect gestures and facial expressions in video, to track emotions, to recognize patterns in log files, and to triangulate various data sources sets (Molenaar et al., 2023, Cukurova et al., 2019, Blikstein et al. 2016, Schneider et al. 2021, Sung et al. 2022). These tools and technologies can be used to support students and teachers in their educational tasks, perhaps even in real-time to improve learning at the time it's taking place (Radu et al. 2022, Schwendimann et al. 2017).

The trustworthy handling of data, including the ethical, legal, and social implications of data use, resulting from our educational interventions are also of utmost importance. **The work package leader and the main applicant are members of the ELSA Lab Low Literacy (with NL AIC label) that is setting standards for this handling.**

2.4   Problem analysis: societal problem and causes

The societal problem this project addresses is the challenge posed by the teaching of reading comprehension and reading behaviour to Dutch youth in the digital age. The ability to process written information and to acquire world knowledge is key to participation at all levels of the 'knowledge economy' of the Netherlands, and key to providing equal opportunities for social participation. Precisely because of the rise of visual and digital media, being able to process written information is key in understanding and reflecting upon information, upon the self and upon the culture in which one grows up. Reading comprehension has been a crucial asset in the Western world since the invention of the printing press at the end of the fifteenth century, as more and more readers became involved in the sharing of knowledge, and democratic processes required all citizens to be knowledgeable (Hisgen and Van der Weel, 2022). Against this backdrop, we contend that we need to combat inequality by improving the chance for all children to become literate adults. In addition to what was said about the problem in Section 2.1: The fact that the problem is both severe and persistent contributes to the urgency. In 2016, nearly 2 million Dutch citizens above the age of 16 were low literate (Algemene Rekenkamer, 2016; Gubbels et al, 2019). Unsatisfying results of reading education have been repeatedly reported by the Dutch Inspectorate of Education (e.g., Onderwijsinspectie 2016, 2017, 2018, 2019). Over the past decade, average reading performance scores for most European countries have improved on international tests such as the Program for International Student Assessment (PISA) and Progress in International Reading Literacy Study (PIRLS) (Batalha and Duarte, 2022). Worldwide, only four countries have experienced a level of decline similar to the Netherlands (PISA 2018). The international benchmark urges us to see the Dutch social problem - **young citizens unable to participate in a democratic society, and a growing gap between poorly performing and more proficient readers** - as an avoidable risk.

Assumptions	Substantiated	Tested
the decline in reading comprehension in the Netherlands is exceptional and avoidable, given the international benchmark	WP1-4	Outcome

Who is affected?
In the end, everyone in Dutch society is affected by the problem we address, given the risk that young poorly performing readers present to a democratic society. Arguably, the youth themselves are most affected. Every

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year, national newspapers give young people the opportunity to explain how the inadequacy of the current education in reading comprehension sets them back (see for instance Verstappen in *Trouw*, 2021). Youth organisations such as Scholieren.com and CNV Jongeren have alarmed the government, pointing in particular to the inequality resulting from current reading education. To respond to the needs of Dutch youth, a coalition of educational institutions and institutions for the promotion of reading was formed (Leescoalitie, 2020). Also, the Dutch minister of education, Wiersma, launched a Masterplan Basisvaardigheden to help struggling readers in primary and secondary education. The Dutch parliament is considering more long term improvements through the professionalisation of teachers (Van den Broek et al, 2021) to ensure fewer students will be affected in the future. The teachers themselves are also affected: Current political and public debates are dominated by concerns about teachers' ability to provide adequate reading education, impacted by teachers' lack of skills and a shortage of language teachers at both the primary and secondary level (Centerdata 2021-2022). For this reason, the education of (future) teachers is also a concern.

Assumptions	Substantiated	Tested
all children with a reading delay should have the opportunity to catch up	WP2A-WP2D	WP2A-WP2D
all teachers should be better equipped to improve of reading comprehension and reading behaviour	WP2A-WP2D, WP4	Outcome

Context and causes

From the perspective of the history of reading, the introduction of new mass media has repeatedly compelled teachers of reading to reconsider teaching methods. In *Too Much to Know. Managing Scholarly Information before the Modern Age* (Yale University Press, 2011), historian Blair assessed how after the invention of the printing press in the late fifteenth century, innovative forms of reference books were composed and distributed to help young readers to organise what they read in an era of new technology and exploding information. And after the introduction of the compelling moving image in the twentieth century, teachers hastily developed analytic tools to teach students how to 'read the visual' (Serafine 2014), stimulated for instance by popular screen based adaptations of a complex novel such as Jane Austen's *Pride and Prejudice* (1813) (Cartmell, 2011).

In previous media revolutions, educational practices sometimes took decades to adjust to new media and the effects on young readers. About twenty years into the media revolution caused by the digital media, Digital Humanities expert Davidson predicted the cognitive effects of digital media on reading processes in *Now You See It: How the Brain Science of Attention Will Transform the Way We Live, Work, and Learn* (Viking Press, 2011). In the same year, social psychologist Turkle described in *Alone Together* (Basic Books, 2011) how digital texting and digital reading cultures change how people relate to the world outside them.

What is new and urgent in the Dutch case, however, is that adaptations to digital developments are required in the midst of what was already a reading educational crisis: The first alarming reports of the Onderwijsinspectie date from exactly the same year Davidson and Turkle made their predictions (Onderwijsinspectie, *Staat van het onderwijs*, 2011). Despite widespread recognition across multiple stakeholders of the severity of the reading problems of Dutch youth, the Dutch educational system has struggled to adequately respond to the declines in reading performance in the past decade. All efforts have not resulted in the desired outcomes.

Assumption	Substantiated	Tested
an important, and thus far not sufficiently addressed cause for the persistent decline in reading comprehension is that the Dutch educational system has yet to respond to the introduction of a new mass media	WP1-4	WP2A-WP2D

The role of the lack of knowledge in the cause of the problem

We currently lack the knowledge to adequately support teachers as they adjust to the teaching of reading in an age of digital media. Not only scientists, but also teachers and policy makers have reported on this knowledge gap. In the Netherlands, the most recent conference of Levende Talen (the professional organisation of language teachers) on December 2, 2022 was partly devoted to *Onlinelezen,* and resulted in the general conclusion that a solid body of knowledge that helps to decide what to do in the classroom, is currently missing. The same conclusion has been reached worldwide, see for instance the OECD-report *21st-Century Readers. Developing*

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Literacy Skills in a Digital World (2021, p. 14): "The relationship between reading performance and time spent using digital devices for schoolwork was negative in 36 countries and economies after accounting for students' and schools' socio-economic status. However, this relationship was positive in Australia, Denmark, Korea, New Zealand, and the United States." The difference in outcomes are still inexplicable, due to a lack of knowledge of the dynamics between reading education, reading comprehension and digital media/devices, with reading in the digital constantly evolving into new behaviour and reading comprehension that are in the process of being acquired, internalised and culturalized (see for instance Kiili et al., 2018; Salmerón et al. 2018; Clemens 2022).

Assumption	Substantiated	Tested
filling the knowledge gap with regard to the teaching of reading comprehension and reading behaviour in the digital age is both necessary and timely	WP1-4	WP1-4

3   Impact Pathway

See Annex 1A and 1B for the connections between Impact, Outcomes and Output.

3.1   Outcomes

We have identified the following actions, activities and changes in behaviour and/or partnerships of the consortium partners and societal stakeholders to achieve the desired societal impact defined in Section 2.3.1:

1. what: **all students have a more proficient ability to process written information in the digital age**
    who: all young stakeholders in the consortium;
    when: starting during the course of this project, with a lasting effect after the project ends if our approach of developing resilient reading identities proves to be adequate;
    where: first among the young stakeholders in our consortium, at a later stage nationwide;
    why: to give all students more agency;
    how: redefining the role of students in reading education and involving them in the project.

2. what: **teachers improve reading education**, using teaching materials and methods fitted to the teaching of reading comprehension and reading behaviour and processing of written information in the digital age, and geared toward creating equal opportunities for all young citizens;
    who: scientists in the consortium, working together with teachers, students, educational publishers and organisations responsible for the professionalisation and education of teachers in the consortium;
    when: starting during the course of this project, with a lasting effect after the project ends if our materials and methods prove to be adequate;
    where: first at the schools in our consortium, at a later stage nationwide, if proven to be adequate;
    why: to materialise insights gained in this project with regard to teaching materials and methods apt to teach reading comprehension and reading behaviour in the digital age;
    how: insights in how to adapt teaching materials are acquired, tested and implemented during this project by scientists, teachers, students and educational publishers, and then implemented on a larger scale through dissemination by organisations responsible for the professionalisation and education of teachers in the consortium, if proven to be adequate.

3. what: **teacher training programmes offer improved curricula and in service training** for future and active teachers in primary and secondary education; curricula and in service training that enable them to teach reading comprehension and reading behaviour of all students, and especially those who need it most, in the digital age;
    who: consortium members working at Pabo's, universities of applied science and universities and in organisations responsible for the professionalisation of teachers;
    when: starting during the last year of our project, with lasting and intensifying effects afterwards;
    where: nationwide;
    why: to ensure the results of the educational interventions carry beyond the project;
    how: insights in how to adapt teaching methods and materials (if proven to be adequate) are implemented in curricula of organisations responsible for the professionalisation and education of teachers in the consortium, and beyond.

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4. what: **publishers and test developers create testing and teaching materials** that align with the new curricula and new teaching materials and methods and are apt for the teaching of reading comprehension and reading behaviour of all students in the digital age.
   who: scientists in the consortium, working together with teachers, students, educational publishers and test developers in the consortium;
   when: starting in the second year of our project, with lasting and intensifying effects after the project;
   where: first locally at the schools in our consortium, at a later stage nationwide;
   why: to materialise insights gained in this project by producing exemplary materials, methods and formative and summative tests;
   how: the teaching materials and methods we design are accompanied by formative and summative tests and tested in the educational interventions.

5. what: **members of school board make informed decisions** about the professionalisation of teachers and reading education to support teachers where and when possible;
   who: scientists, organisations responsible for the professionalisation and education of teachers and policy makers in the consortium and advisory board;
   when: during the project, with a lasting effect after the project;
   where: nationwide;
   why: to make sure what we deliver can be implemented by teachers on a large scale;
   how: scientists interact with policy makers, educational organisations and school board members present in the consortium to discuss what is possible in the context of the shortage of teachers, the pressing workload of teachers etc.

6. what: **policy makers make informed decisions** about reading education to support teachers where and when possible;
   who: scientists, policy makers, members of school board in the consortium;
   when: during the project, with a lasting effect after the project;
   where: nationwide;
   why: to make sure what we deliver can be implemented on a large scale;
   how: scientists interact with policy makers, educational organisations and school board members present in the consortium to discuss what is possible in the context of the shortage of teachers, the pressing work load of teachers etc.

Assumption from Outcomes to Impact	Substantiated	Tested
outcomes of the project will have more impact if we co-create the planned output	WP1-4	Outcome

3.2 Output

The consortium partners and societal stakeholders need the following insights resulting from project activities to enable them to change their behaviour, collaboration and activities:

1. a multidisciplinary conceptual model of reading comprehension and reading behaviour apt to process written information in the digital age;
2. a tested and effective pedagogic/didactic framework fitted to this model;
3. tested teaching materials, tests and teaching methods based on this conceptual model and educational framework, with or without (much) EdTech and geared towards the individual needs of young students that need effective reading education the most;
4. teacher training programmes based on these tested materials and methods that support future teachers to teaching reading comprehension and reading behaviour in the digital age;
5. in service training that supports active teachers in the transition to teaching reading comprehension and reading behaviour in the digital age;
6. contribution to the body of knowledge necessary for member of school boards;

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7. contribution to the body of knowledge necessary for policy makers (for instance for legislation in line with the Digital Services Act (EU, 2020) and the European Framework for Life Long Learning (EU, 2006)) and members of school boards.

Assumption from Outcomes to Output	Substantiated	Tested
the foreseen output is created to have effects after the project has ended	WP1-4	Outcome

4   Consortium

The current consortium grew out of a number of pioneering workshops, organised by the applicants from the moment PISA results were published in 2018. It became very clear that in order to achieve the impact we envision, the consortium needed to include stakeholders at any stage of the project, from the complete knowledge chain. We made an analysis to identify all stakeholders: **(1)** multidisciplinary scientists willing to make progress by developing an integrative conceptual model of (the teaching of) reading in the digital age; **(2)** multidisciplinary scientists and developers with experience in evidence based educational interventions, digital learning platforms (DLP) and learning management and support systems (LMS); **(3)** AI-experts that can analyse the data produced in these educational interventions with techniques that surpass standard statistical analyses; **(4)** organisations and individuals responsible for reading education (the teachers themselves, but also their teacher's organisation and school boards, and the teachers of the teachers at Pabo, universities of applied sciences and universities, as well as educational publishers); **(5)** organisations representing Dutch young readers; **(6)** societal foundations contributing to the dissemination of information about reading comprehension and reading behaviour; **(7)** policy makers in charge of curricula changes.

Suitability of the applicants

Together, the applicants cover all relevant scientific expertise, and possess the intellectual, organisational and interdisciplinary skills needed to make this project a success. They are researchers from various research traditions (both theoretical and practical) who are willing to look beyond their own theories, methods, knowledge and experiences. They all have experience in doing interdisciplinary research and know how to contribute their disciplinary expertise in an interdisciplinary research project. The applicants involved in this project have national and international reputations for innovative research in the areas of reading education, reading comprehension, literacy, behaviour, educational technology and AI. They have successful research lines and have been awarded with national (e.g. Veni/ Vidi/ Vici/ NRO-Pro) and international grants (e.g. US Institute of Education Sciences). The applicants have published and presented on prestigious research outlets and bring in the diverse range of methodological expertise (corpus analysis, eye tracking, on-line language processing, text comprehension measures, qualitative analysis, quantitative statistical analysis, design of controlled educational intervention studies, longitudinal data analysis, cross-sectional analysis) needed in the project. All applicants are experienced supervisors of PhD students and postdocs. Moreover, they are dedicated to devote their existing research time to the project, setting up additional research that will serve as proof of principle of the model and framework designed in WP1A+B, conducted in collaboration with MA students at their home institutions and/or with colleagues with relevant expertise outside the current consortium.

The applicants are active in the scientific community: e.g. they organise workshops and are members of editorial boards of international journals. Applicants, partners and stakeholders have also been successful in valorisation (e.g. creating LitLab.nl - a platform that facilitates (the teaching of) reading in a digital age). They also fulfil management positions in the local universities (department chair, vice-dean, program director of BA/MA) showing a diverse set of management and organisational skills.

Suitability of the partners

The co-funding and cooperating partners cover the whole range of the knowledge chain: from **trainers of teachers** (HU, Graduate School of Teaching in Utrecht and Tilburg, HvA, IPabo, Academic PABO Leiden and Amsterdam, Hogeschool KPZ, Hogeschool Rotterdam) to **educational publishers and platforms** (Blink, Noordhoff, Lexima, Expertis, CED, Immer, Woordenaars.nl, LitLab.nl) to **organisations responsible for the professionalisation of teachers** (Levende Talen, Oberon) and reading assessment (Cito), to members of school boards (BasisBuren. Stichting Klasse, Stichting Amstel and the IJ) and policy makers (Onderwijsraad, OCW, WAP, Taalunie) to **organisations that promote and foster literacy** (Stichting Lezen, VoorleesExpress, Culturele

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Apotheek, Royal Library (KB)). **Schools and school boards** are selected across the country and across school levels: Stichting Amstel and het IJ (Staij), BasisBuren and Stichting Klasse represent primary education, PRO Drachten Practical Education, Het Zuiderpark College represents vocational education (VMBO), Wolfert Tweetalig and Schravenlant Lyceum HAVO and VWO, Slingeland, ROC Friese Poort represents MBO. To achieve our intended societal breakthrough we invested in the inclusion of **partners that represent the young readers themselves** (Scholieren.com, JOB MBO, Jongenklankbord Taalunie), and applicants and co-funding partners eager to co-create research together with students (see Section 4.1 for more details on our cooperation).

4.1   Stakeholders, co-design & co-creation and consortium

Co-design of the proposal

The proposal in its current form is a co-creation of all consortium members. It is compiled in a series of brainstorming and writing sessions, its actual shape was drafted by many and overseen by the main applicant. In this manner, we ensured all perspectives, knowledge and expertise were included as the application took shape, and responsibilities and ownership of the proposal were equally shared. The consortium is composed to facilitate long-lasting, enduring changes via close collaboration. Long-lasting effects are secured through the management of the project: the consortium is large and diverse in nature, but built upon existing cooperations between applicants and partners. Also, the main applicant (who knows all of the consortium members personally) role will be to unite and align the contributions of all consortium members, as was done in the co-creation of this proposal.

The involvement of stakeholders

Similarly, the researchers and societal partners in the consortium are willing and able to learn during the project, creating essential preconditions for theoretical work to be informed by practice and for interventions to be implemented in educational practices and policy. In view of the project's credibility, and to legitimise our results, we will also set up interactions with stakeholders outside the consortium. By proactively involving all relevant stakeholders in WP1-4 (see the table below) we ensure all stakeholders have an equal say in the results. **Special attention is paid to the young stakeholders, the students themselves,** for their voices are often underrepresented in educational reforms (see Van den Broek & Dönmez, 2022 for an exception to this rule). We get them involved in three ways. Firstly, partners representing the youth in our consortium are involved in all WP's, from the start of the project to the finish. Secondly, individual students are consulted in the educational interventions and through nationwide polls, and co-create elements of WP2A-2D. We organise feedback sessions to hear from students outside our project to add to the credibility of our results (see WP4 for details). Finally, we included representatives of young stakeholders in our Project Advisory Board.

The role, tasks, profile and position of the consortium partners (see Section 7 for more details)

Task: develop an integrated conceptual model and framework, based on insights provided by educational (technology) experts and data analysts

Role: co-design
Profile, Position and *Strengths/Complementarities*: scientists at universities UU (also Graduate School of Teaching in Utrecht), VU, OU, RU, UvA, UnivLeiden, Expertisecentrum Nederlands, OCW, scientists at universities of applied sciences Academic PABO Leiden; IPABO, KPZ, Rotterdam, HvU, HvA (***in-depth knowledge of various disciplinary conceptual models and access to data of current reading education***); Avans, Levende Talen (***in-depth knowledge of educational technologies and their surrounding frames of actions***); teachers and students at ProDrachten, Friese Poort MBO, BasisBuren, Stichting Klasse, Staij, Singelland, Het Zuiderpark College, Wolfert Tweetalig, Schravenlant Lyceum, educational publishers and platforms (Noordhoff, Blink, Immer, Lexima, Expertis, CED, LitLab.nl, Woordenaars.nl) and representatives of students (at all involved schools and at Scholieren.com, Jongerenklankboard Taalunie, Levende Talen) (***hands-on knowledge of current reading practices***).

Task: educational interventions based on this model and framework

Role: co-design, co-create and test
Profile, Position and *Strengths/Complementarities*: scientists at universities UU, VU, OU, RU, UvA, UnivLeiden (***in-depth knowledge of educational interventions and reading education***); scientists at universities of applied sciences Academic PABO Leiden; IPABO, KPZ, Rotterdam, HvU, Avans, InHolland, Fontys, Levende Talen (***in-depth knowledge of educational technologies and their surrounding frames of actions***); teachers and students at

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ProDrachten, Friese Poort MBO, BasisBuren, Stichting Klasse, Staij, Singelland, Het Zuiderpark College, Wolfert Tweetalig, Schravenlant Lyceum); educational publishers and platforms organisations that foster literacy (Noordhoff, Blink, Immer, Lexima, VoorleesExpress, Expertis, CED, LitLab.nl, Woordenaars.nl, INT, KB, Stichting Lezen, Culturele Apotheek) and representatives of students (at all involved schools and Scholieren.com, Jongerenklankboard Taalunie) (***hands-on knowledge of current educational practices and access to (production of) online and offline reading materials***); Cito, Levende Talen (***in depth knowledge of (online) reading assessment***).

Task: analyses of the data produced in these interventions
Role: co-design and co-create
Profile, Position and *Strengths/Complementarities*: scientists at UU, University of Applied Sciences Avans (***in-depth knowledge of relevant data analytic approaches and in-depth knowledge of the inner working of educational technologies***); teachers and students at ProDrachten, Friese Poort MBO, BasisBuren, Stichting Klasse, Staij, Singelland, Het Zuiderpark College, Wolfert, Schravenlant Lyceum), and representatives of students (at involved schools and Scholieren.com, Jongerenklankboard Taalunie, Levende Talen) (***experience in evaluating learning outcomes***).

Task: dissemination of results in curricula of future teachers, professionalisation of active teachers, educational materials, in reading policy, among scientists
Role: co-design and co-create
Profile, Position and *Strengths/Complementarities*: scientists at universities UU, VU, OU, RU, UvA, UnivLeiden and universities of applied sciences Academic PABO Leiden, IPabo, KPZ, Rotterdam, HU, Avans, HvA, InHolland, Fontys (***in-depth knowledge of reading comprehension and reading behaviour and educational interventions***); Noordhoff, Blink, Immer, Lexima, VoorleesExpress, Expertis, CED, INT, LitLab.nl, Woordenaars.nl ((***inter)national networks and ability to publish on results, and to implement results in the education of teachers***); teachers and students at ProDrachten, Friese Poort MBO, BasisBuren, Stichting Klasse, Staij, Singelland, Het Zuiderpark College, Wolfert Tweetalig, Schravenlant Lyceum), representatives of students (at all involved schools and Scholieren.com, Jongerenklankboard Taalunie) (***spokespersons for the results***); Cito (***network of specialists in reading assessment***)*;* organisations that foster literacy, enhance the professionalisation of teachers and inform policy makers and school boards VoorleesExpress, KB, Stichting Lezen, Culturele Apotheek, Oberon, WAP, Onderwijsraad, Taalunie, Levende Talen (***networks of policy makers, school boards***).

4.2   Involvement and development of young and mid-level researchers within the project

Focus at a young, next generation of researchers
We strive for a diverse consortium: there is no gender or age bias in the group of applicants. This project offers 8 PhD positions and 2 postdoc positions in order to train a next generation of young researchers in the intersection of science and educational practices, in all facets of the knowledge chain, providing them interdisciplinary and intersectoral experience. They will all enrol in the graduate school programmes at their universities for additional training in scientific and more general professionalisation skills and meetings with junior, mid-career and senior researchers that provide mentor opportunities. We will ensure our young scientists participate in a national or international conference each year. The PhDs and postdocs actively interact with the teachers, students, publishers and interventions specialists during their research projects. As a bonus this will also give them insight in working in such institutions which is beneficial to their professional development. The scientific teams will be supported by student assistants who will gain experience with carrying out scientific research under the supervision of senior staff. The PIs are committed to support the junior researchers in their further career, and make themselves available for advice on applications and the development of a career path.

4.3   Project management

main applicant and PAC meet every six months	main applicant, program manager and steering board meet every three months to coordinate WP's
	WP leaders and partners supervise the postdocs and PhD students on a daily/weekly/monthly basis

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to oversee progress	all consortium members meet a yearly basis and in the meantime contribute the project as planned

The project is structured so that 'research-to-practice lines' are short and direct. The project involves ongoing interactions and collaborations between the researchers and the consortium partners who represent important stakeholders to achieve true knowledge co-creation: active participation of the complete knowledge chain of the teaching of reading (researchers, teachers, school boards, policy makers, educational publishers and businesses, libraries).

To execute and coordinate these 'research-to-practice lines', each work package (WP) is assigned a WP leader who is responsible for the execution of the tasks identified in his or her WP, relying on the project's principle that all responsibilities are allocated to specific members of the consortium in these WPs. All WPs will include PhD students and/or postdocs and/or research assistants that will be supervised by at least two experienced academics at a daily basis. The WP leaders are assisted by other professionals from the consortium. They will meet every three months with the project manager and main applicant as a steering group. This steering group is responsible for hiring the PhD students, postdocs, and other staff, for coordination across WPs, perform yearly project evaluations and risk assessments to keep track of progress. The project manager assists in the administration duties of the WP leaders. The main applicant will oversee the progress of all WPs with the help of the Project Advisory Committee at six monthly intervals.

Project Advisory Committee (PAC) consists of representatives of key players in the consortium:
Co-funding partners: Gerlien van Dalen, director Stichting Lezen.
Cooperation partners: **Marie-José Klaver**, teacher at Singellant and publicist.
Young stakeholders: **Dilara Bilgic**, born in Turkey in 2002, authored two influential books (*De Black Box Democratie* (2020) and *De gelabelde* (2022)) that explore the relation between democracy, literacy and personal development. **Ilse Bruls**, policy maker at MBO JOB.
Independent scientists: **Prof Dr. Catherine Snow** (Harvard Graduate School, USA), international leading scientist in the field of language, literacy and reading instruction research and has ample experience with experimental research that makes a societal impact; **Prof Dr. Kate Cain** (Lancaster University, UK), internationally renowned expert in the scientific field of reading comprehension and brings in ample experience with regards to theory, methodology, and interventions in deep reading comprehension and as leader of several long-lasting projects on reading development; **Prof Dr. Susan te Pas** (Utrecht University and member of the Onderwijsraad), internationally renowned expert in cognitive psychology and education; **Prof Dr. Orhan Agirdag** (KU Leuven and member of the Onderwijsraad), internationally renowned expert on education in a multicultural society, author of Onderwijs in een gekleurde samenleving (EPO, 2020).; **Prof Dr. José van Dijck,** Utrecht University, internationally renowned expert in Media technologies, digital education and digital societies; **Prof Dr. Maarten van Steenkiste** (Ghent University), internationally renowned expert in Self-Efficacy Theory.

5   Productive interactions

Type of activity and time in the project: Consortium workshops, 8 years annually
Purpose: Engage consortium stakeholders: Build structured consortium network to ensure fast and effective communication between partners and to monitor and evaluate plans/results of the project.
Connects to Output #: 1-7
Stakeholders: all consortium members.

Type of activity: Meetings between main applicant, program manager and the steering group (4 x yearly); Meeting between PAC and main applicant (2 x yearly)
Purpose: project management
Connects to Output #: 1-7
Stakeholders: main applicant, PAC, project manager, WP leaders.

Type of activity: Meetings between main applicant, WP leaders. supervisors, postdocs and PhD students (2 x yearly); Participation in scientific conferences (years 2-5)

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Purpose: Create multi-disciplinary scientific community; Communicate with academics from all locations: create feedback opportunities; inform about project's progress; monitor and evaluate plans/results/analyses based on the feedback; Capacity strengthening of junior academics under the supervision of senior researchers.
Connects to Output #: 1-7
Stakeholders: main applicant, PAC, project manager, WP leaders.

Type of activity: Focus groups with the teachers, students, publishers where educational interventions and course materials, instructions, instruction sheets and infographics are developed (years 2-5)
Purpose: co-create and co-design educational interventions
Connects to Output #: 1-3
Stakeholders: members of WP1A, 1B and WP2A-Di

Type of activity: Conferences for all stakeholders (years 3 & 7); Open access non-scientific publications for the interested audience (year 3, 5, 8); Websites (years 1-8).
Purpose: Engage all external and internal stakeholders: Create community for all stakeholders; Communicate with all stakeholders: create feedback opportunities; Inform about project's progress; monitor and evaluate plans/results based on the feedback.
Connects to Output #: 1-7
Stakeholders: all stakeholders (both from the consortium as well as external stakeholders).

Type of activity: masterclasses and workshops about the project's results on educational interventions (years 3-8)
Purpose: Communicate: inform and retrieve input from stakeholders on implementation of interventions; monitor and evaluate the implementation of interventions; Capacity strengthening: create course materials and instructions for teachers in training; Communicate: inform and retrieve input from stakeholders on implementation of interventions in school curricula.
Connects to Output #: 1-7
Stakeholders: all consortium members.

5.1   Stakeholder engagement

Our main objective of the strategy we planned for engaging stakeholders is to let the consortium itself function as a community in which members know each other and know and use the expertise available in the consortium. Only in such a community can individuals communicate easily with each other, learn from each other and co-design and co-create the part-projects in the work packages. In productive interactions stretching the entire duration of the project between applicants, newly hired research staff and staff at our co-funding partners, a mutual sharing of knowledge will take place. We also look at engaging stakeholders beyond the consortium to reach a wide and broad audience. Such stakeholders are ultimately the children who need to receive instruction, materials and training to develop their reading in a digital age; teachers who work in schools who are not part of our consortium; educational professionals and language specialists who need to deliver such materials to the children; publishers and intervention specialists who develop materials and methods for teaching reading comprehension at school and facilitating reading development in the home environment; researchers who develop methods to assess the development of reading comprehension; parents and caretakers who need to be informed about the importance of environmental factors; and organisations that provide information to a broader public about the role of reading in digital society.

We have planned activities to make an outreach to the stakeholders outside of our consortium organised by our partner Stichting Lezen who reaches a wide audience of educational professionals and language specialists; popularising articles are written by Stichting Lezen and WAP about the project's results; focus groups are held where external stakeholders will also be invited to give input and feedback on the project's plans and progress; and the consortium will create a range of materials that is freely accessible to all stakeholders outside the project. The scientific stakeholders will collaborate with educational stakeholders by organising workshops and masterclasses on conceptual insights into (the teaching of) reading comprehension and reading behaviour. The educational stakeholders concerned with professionalisation of reading education at universities of applied sciences will organise similar workshops to involve stakeholders (students and teachers) in primary and secondary schools. The commercial stakeholders will co-design and co-create adaptations to existing materials, methods and measures together with the scientific and educational stakeholders who will investigate the

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effectiveness of those adapted materials. The societal foundations in our consortium will set up activities together with all other stakeholders to disseminate the project's results to a wider audience and policymakers.

5.2   Communication

We will set up a website to communicate the project's results with stakeholders and any one in the wider audience interested in our project, and interested in getting in contact with us. We will send newsletters to communicate between the consortium partners and representatives of external stakeholders that we will engage with during the course of the project: other schools, publishers, policymakers outside the consortium who need to be reached to make a long term societal impact, and any individual interested in the wider audience. Our objective for all these activities is to make sure that information is optimally exchanged so that the consortium profits from the expertise of the consortium partners, the stakeholders outside the consortium and the other way around.

To disseminate the results of the project we established cooperation with NRO (Netherlands Initiative for Education Research). NRO facilitates knowledge utilisation by bridging the gap between research and practice. Since 2021, NRO has launched a new website, Onderwijskennis.nl, designed especially with this goal in mind. Based on consultation of NRO we see two promising possibilities for dissemination results of WP4: **1)** Contributing to a theme page about reading education in the digital age. A theme page consists of an overview of recent research and practical research-based tools and examples of successful implementation of insights from research. Although NRO has published several pages (see for instance https://www.onderwijskennis.nl/themas/lezen-schrijven-en-taal), about reading education, such a page does not yet exist. **2)** Contributing to a guidance report (Leidraad) about reading education in the digital age. The guidance reports are more extensive than the theme pages. They are based upon the guidance reports of the British Education Endowment Foundation (EEF). A guidance reports offers a set of recommendations for teachers, each of which is based on scientific research. NRO has started to develop the guidance reports in 2021 and will continue to develop new guidance reports the following years. The NRO-website and report will be produced in WP4 in cooperation with co-funders Levende Talen Nederlands (LTN), Stichting Lezen, and cooperating partners Onderwijsraad, and Oberon. LTN is a professional association of teachers of Dutch Language and Literature, and professionals involved in teaching Dutch. They represent a large number of teachers of Dutch. Stichting Lezen has a vast network of key societal partners in the field of stimulating reading in children. Oberon is a consultancy firm promoting improvements in reading education. The Education Council (Onderwijsraad) is an independent organisation that advises Parliament and Ministers on Education policies and laws.

In addition to the website, we will organise two conferences together with co-funder Stichting Lezen and co-operating partner Onderwijsraad, to share and discuss preliminary results of the project and to translate them into policy advice to the government. Through their partnerships, de Onderwijsraad and Stichting Lezen can use the insights as a basis for further explorations, seminars and discussions.

5.3   Monitoring & Evaluation

We have strategically planned activities during which the project's results are monitored and evaluated by stakeholders in- and outside the consortium. These activities involve meet-ups where expertise from different levels (academia; educational professionals; professionals stimulating literacy; policy makers, publishers inside and outside the consortium) come together where part output of the project is presented and discussed so that changes needed can be implemented on time (see Section 7.3 for our risk management). More important even is the (daily) monitoring of checks and balances we perform as a result of **1)** co-designing and co-creating activities in the project. Stakeholders are included and consulted on a regular basis in each WP (see Section 7.1 for details). And as a result of the general principle we work by: **2)** our interventions will be as embedded in the standard curriculum as possible. The 'general learning objectives' for VMBO and MBO, for instance, such as 'learning to communicate' and 'listening skills' are directly served by and aligned with the interventions in WP2A and WP2D.

5.4   Capacity strengthening

This project delivers materials and courses that will strengthen the capacity of stakeholders in and outside of our consortium. Our objective of the strategically planned activities is to equip our consortium partners with the information and skills needed to achieve the project's output (train the PhD students, postdocs, teachers and teachers that train teachers), but also to equip stakeholders outside the consortium (future teachers, academics

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outside the consortium, teachers outside the consortium) to make a sustainable change in levels of (the teaching of) reading in a digital age.

6 Scientific objectives & research questions

6.1 Scientific objectives

The overarching objective is to use the Dutch case to push scientific boundaries in the field of reading education to ensure that reading education is up to the challenge of teaching reading comprehension and reading behaviour in a digital age. The three phases of the project have corresponding scientific objectives.

1. **Conceptual objective**: To develop interdisciplinary insights into (the teaching of) reading in a digital age through the development of a model and framework;
2. **Educational objective**: To design, develop and test educational interventions that foster reading acquisition in a digital age;
3. **Data analytical objective**: To develop and apply learning analytics in combination with more traditional methods to evaluate the effects and the effectiveness of these educational interventions.

6.2 Scientific relevance

The original, innovative and challenging nature of this proposal
This project is original in its anticipation of the ongoing effects of the development of online reading, and in the use of the preference of reading digitally among the youth to their benefit by investigating how and to what extent incorporating digital educational technologies is possible and effective in the teaching of reading in a digital age. The digital age affects the teaching of reading, but provides opportunities to design educational tools and to monitor the student's and teacher's progress more closely. By using learning analytics that help us gain insight in how (individual) reading practices develop and can be fostered, in combination with more traditional means of effect evaluation, we will generate a unique data set that spans age and developmental levels and that will lead to fine-grained developmental insights. This data analysis approach will prevent us from relying on results from the past, and will challenge us to devise solutions that will work, despite rapidly changing reading practices.

Our project is innovative for a number of reasons. First, we work cross-sectionally, drawing a direct line from primary to secondary education. We thus take into account all leaps in the transformation of young readers: such a wide scope is exceptionally. Second, we take into account actual reading behaviour to transform pedagogic and didactic approaches. This offers us the unique opportunity to work on a new national narrative around the acquisition of reading comprehension and reading behaviour that includes the young student's own perspective. Third, the Dutch case - the enormity of the educational crisis as a driving force, the relatively small-scale of the country as a favourable circumstance - offers the opportunity to combine theory and practice in every aspect of the transformation we envision.

Our project is challenging in nature because we address an internationally recognized problem that is yet without a scientific solution. The project's interdisciplinary and transdisciplinary setup allows us to address cutting edge research questions. Scientific breakthroughs have been stalled by the fact that scientific knowledge of reading education is scattered across a large number of relevant disciplines (language and literary studies, pedagogics, psychology, educational science, artificial intelligence). To not only understand, but also adequately respond to the gravity of the changes, unprecedented cooperation between scientists is required. Such cooperation can lead to new perspectives on the dynamics between reading comprehension and reading behaviour, and will help to address the challenges posed by digital media to reading education.

Position of the project in the national and international research landscape
The project is firmly positioned within national and international research on the teaching of reading in a digital age. Worldwide, many students struggle to become literate. As a result, many countries and continents have launched research projects, to improve the scientific understanding of the implications of digitization on the history of reading. Most relevant to us, especially given the fact that we take EU legislation initiatives as our reference (see Section 2.1), is the project "European E-Read (Evolution of reading in the age of digitisation". This COST Action had the goal to help individuals, disciplines, societies and sectors across Europe to cope optimally with the effects of digitisation (https://ereadcost.eu/). To this project, we bring a new focus on reading education across age groups and across primary and secondary education, and on a nationwide transformation of reading education with all of the relevant partners of the knowledge chain involved in nationwide education. In this

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respect, its curriculum approach, the proposed project is an addition to many if not all of the existing European projects devoted to reading education supported by EdTech (such as A is voor App, https://www.aisforapp.eu/, Reading Fluency Apps for Struggling Readers in Primary School), because existing projects target and single out specific age groups, without having the opportunity to develop an overarching pedagogic and didactic framework as well as a program for the professionalisation of teachers.

Our consortium also builds on contributions to NWA Startimpuls project "Jongeren in een veerkrachtige samenleving" (Join), which sought to acknowledge the resilience of youth to foster inclusivity and participation. For example, language and reading skills acquisition of young refugees to the Netherlands was promoted through digital literacy training and digital storytelling (Leurs et al., 2018).

With our approach, we also go beyond current efforts of the Dutch Nationaal Onderwijslab AI (https://www.ru.nl/nolai) that focuses on the dynamics between digitisation and education only, but measures the effects of single tests and educational interventions limited to one or two hours of teaching. The curriculum approach we take, and the development of an integrative model will allow researchers around the world to broaden their perspective on the teaching of reading comprehension and reading behaviour, and to set more ambitious and meaningful scientific targets for their research.

In our advisory board we have included distinguished experts of the international research scene José van Dijck in digital media and education, Catherine Snow and Kate Cain in reading comprehension, Prof Maarten van Steenkiste in behavioural science, to ensure the project is constantly informed with the latest insights and knowledge.

6.3 Scientific impact

A new, integrated and developmental model of reading comprehension and reading behaviour in a digital age

We expect this model to have lasting impact in literary studies, linguistics, pedagogics, (developmental) psychology, cognitive science, and education science by offering a common conceptual ground to work on. What will add to this impact is the fact that our model will be developmental. Current models of the teaching of online reading are not. Our model will be the first to capture the development between the years 4-18. Furthermore, our model has value for theories of habit formation and behaviour change in digital reading settings that, so far, mainly addressed questions in the area of health and consumer behaviour (Marien et al., 2019).

We also expect impact on conceptual insights in specific disciplines, such as psychology. Currently, the Self-Determination-Theory encompasses three innate psychological needs that drive an individual's motivation: autonomy (the need to have authorship of one's behaviour and resulting outcomes in the world), competence (the need to produce desired outcomes and to master tasks), and relatedness (the need to feel connected to others) (e.g. Ryan 2020). It is an open question as to whether or not these needs will change or are changing as a result of frequent use of digital media. The need to feel connected to others, for instance, could become more dominant than the need for autonomy, given the autonomy inherent to digital media.

Insights in effective educational methods of teaching reading comprehension and reading behaviour in a digital age

We expect impact on especially the field of educational science when it comes to finding answers to the question how and to what extent digital or blended educational environments can stimulate reading in a digital age. Through educational design research, we will design, develop and evaluate educational interventions that advance the general knowledge among educational scientists about the characteristics of effective interventions (Plomp, 2008). The fact that our learning analytics will result in instruments that measure (progress in) reading comprehension as well as (changes in) reading behaviour in a great number of data sets, adds significant importance to our undertaking. All researchers currently lack data about the actual reading practices of the developing youth that help them to test their models of reading proficiency. Our data will thus feed into their studies.

New data analytic methods in educational science

During our educational interventions, data analysis will feed into the process of evaluating and adjusting the educational interventions on our much larger scale than educational scientists are used to, and - more importantly - in almost real-time. Large scale data analysis in educational science almost always result in long intervals between the actual intervention and the analysis of the effects of the interventions (because of the time consuming and not fully datafied procedures). We expect scientific interest for the AI-pipeline we will set up to limit the time between the actual interventions and the measuring of its effect.

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Existing contacts used to achieve the intended scientific impact

All applicants have established and extensive networks in their fields of expertise. These contacts include scientific organisations such as the KNAW, ECREA, AoIR; professional organisations such as Lowan Ondersteuning Onderwijs Nieuwkomers; and contacts with international and international experts in their fields.

7   Project overview

7.1   Project structure and coherence (see also Annex 2)

Added value of coherence and synergies between the work packages

Together, the work packages form a coherent group of interrelated complementary work packages that connect academic and commercial partners, the expert user and the non-expert end user, and various theoretical and practical approaches. PhD students, postdocs and WP leaders and members will work together based on an agenda that aims to crack open DL-based systems towards interpretable systems that can be used in real-life practical situations relevant for the commercial and educational partners, and at the same time mutually fertilising academic research. We will strengthen this research ecosystem through focussed outreach and communication, empowering consumers, policy makers and entrepreneurs.

Coherence and synergy is expected because the output of WP1A and WP1B (integrated model and framework of the teaching of reading in a digital age) is constructed with the direct input of WP2A-WP2D (the designing, implementing and testing of educational interventions) and WP3 (the design of a pipeline that will allow us to chart the reader's progress and well as the teacher's activities digitally). The output of WP3 is made by studying the output of WP2A-WP2D, and feeds into the creation of an improved integrated model and framework (WP1A and WP1B). Nevertheless, the work packages all address specific objectives, execute particular activities, and target different age groups and groups at risk. The work packages can thus function in relative isolation, thereby minimising the chance that an unforeseen result in one work package affects the activities of the other work packages.

There is an internal check built in the design of our WPs. WP1A+B produces a conceptual model and educational framework that are designed and tested by WP2A-WP2D, but also the PhD-student and a postdoc in WP1A, as proof of principle. With this internal check, we expect the improved model and framework resulting from phase 3 of the project to be even more robust.

The project's timeline

The project spans a timeline of eight years and consists of three phases that are all connected to each other. The research, outreach and implementation activities are divided over eight work packages.

7.2   Description of the work packages

Work package number	WP1A
Work package title	**Conceptual model of reading comprehension and reading behaviour in a digital age**
Work package leader	Van den Broek (UnivLeiden)
Involved partners	Kamphuis and Van Eijken (UU); data analist OCW; Levende Talen; Scholieren.com; Expertis, Taalunie, Stichting Lezen, Expertisecentrum Nederlands, all co-funding and co-operating schools
Start date	Stage 1: 01-01-2024 till 01-09-2027 (designing and testing the model in cross-sectional /longitudinal designs); Stage 2: 01-09-2026 till 01-09-2029 (testing key hypotheses derived from the model and framework in experimental designs); Stage 3: 01-09-2029 till 01-01-2032 (improvement of model based on results and output of Stages 1 and 2).
End date	01-01-2032
Objectives	
The overall aim of WP1A is to develop and test an integrated theoretical model that serves as a shared foundation to the other interventional and monitoring WPs, thereby ensuring coherence across the project's	

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components. The integrated model - once tested and improved with the contribution of WP1B and WP2A-WP2D - would be an addition to international theories of reading comprehension processes and actual reading behaviour in a digital age. The specific objectives of the WP are:

(1) to construct a comprehensive model of reading in the digital age that integrates evidence-based, multidisciplinary insights on central factors that shape the motivation to read and the ability to cognitively process reading materials in offline and online settings to read across development;

(2) to provide the foundation for a systematic empirical study of the effects of educational interventions of reading in the digital age.

Methodology

We employ a multipronged, multidisciplinary approach, consisting of **(1)** review of existing research literature to integrate current theoretical models of (the teaching of) reading comprehension processes and behaviour reading habits in a digital age, e.g., meta-analyses, other integrative reviews, and original research articles by using AI-driven search machinery (e.g., www.asreview.nl); **(2)** consultation with partnering educational organizations, reading specialists, and other stakeholders (focus groups); **(3)** analysis of existing reading methods and interventions and of educational practices in countries where students appear to be successful in attaining the necessary reading comprehension skills; **(4)** empirical test of the novel developed integrated model of (the teaching of) reading comprehension processes and behaviour reading habits in a digital age including a combination of longitudinal and experimental designs to establish correlational and causal evidence of hypotheses derived from the model.

Description of research activities

The postdoc and PhD student in this WP are supervised by Van den Broek (Leiden) and Aarts and Kamphuis (UU). The postdoc is supported by a data analyst of OCW. All of them are embedded in teams with stakeholders and consortium partners.

Subtask 1 Identification of factors influencing (the teaching of) reading comprehension processes and reading behaviour in a digital age in relevant research literature;

Subtask 2 Obtain feedback from students and teachers;

Subtask 3 Consult with educational- technology and data- analysis specialists of WP1B and 3;

Subtask 4 Design and test the integrative conceptual model.

Subtask 5 Outline principles and designs for educational interventions based on this model.

Productive interactions (co-design and co-creation)

A staged approach to the development of the model is chosen to allow new project outputs to be included in the model at pre-specified time points. The consortium partners and young stakeholders help identify the crucial elements of our model, drawing on their first-hand experience with instruction across cohorts and with designing and teaching the existing methods. Likewise, they share valuable insights in the development –and lack of development- of (the teaching of) reading comprehension in a digital age. Stichting Lezen, Taalunie and Expertis bring knowledge on existing reading habits in the homes and schools, as well as on best practices inside, but also outside the Netherlands. OCW brings in knowledge of big data analysis and will collaborate in exploring connection of data bases of to track development of reading comprehension. Scholieren.com and all co-funding/operating schools provide input of young stakeholders and teachers.

Contribution to project (impact)

This WP benefits from the insights provided by WP1B and will provide WP3 with data. This WP contributes to the following output of the project:

- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model
- Insight in how to measure the effects of the (teaching of) reading in a digital age at different developmental stages.

Work package number	WP1B
Work package title	**Didactic and pedagogic framework for educational interventions**
Work package leader	Van der Stappen (Avans)
Involved partners	IPABO, Hogeschool KPZ, HvU, Rotterdam, Expertisecentrum Nederlands, Levende Talen, all co-funding and co-operating schools
Start date	Stage 1: 01-01-2024 till 01-09-2027 (designing and testing the framework in cross-sectional /longitudinal designs);

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	Stage 2: 01-09-2026 till 01-09-2029 (testing key hypotheses derived from the model and framework in experimental designs); Stage 3: 01-09-2029 till 01-01-2032 (improvement of framework based on results and output of Stages 1 and 2).
End date	01-01-2032

Objectives

The overall aim of WP1B is to develop and test an educational framework fitted to the integrated model of WP1A. Once tested and improved with the contribution of WP1A and WP2A-WP2D it is an addition to international theories of the teaching of reading comprehension processes and actual reading behaviour in a digital age. The specific objectives of WP1B are:

(1) to inform the conceptual model made in WP1A, in service of the educational extension of the model;
(2) to design a pedagogic-didactic approach that is foundational to future reading education;
(3) to construct a framework for the educational interventions that will allow us to compare results and outcomes of the interventions WP2A-WP2D in WP3.

Methodology

We employ a multipronged, multidisciplinary approach, **(1)**: review of the existing literature (objective 1 &2); **(2)** design-test cycles in cooperation with teachers and test developers objective 2); **(3)** co-creative approach with our (young) stakeholders, specifically the researchers from WP1, WP2A-D and WP3, we develop a conceptual framework for all (digital) interventions developed in this project. In addition, we will analyse best practices, and have meetings with stakeholders (teachers, teachers of teachers, students) to include the perspectives from educational practice in the conceptual framework. This framework will be based on the co-creative propagation approach (Froyd et al., 2017), to ensure we deliver high quality interventions, i.e., educational technology and the surrounding frame of action that meets the following criteria (Nieveen, 1999): relevance (content validity), consistency (construct validity), practicality (usability) and effectiveness.

Description of research activities

The postdoc, under the supervision of co-applicant Leurs (UU) and Mantingh (Graduate School of Teaching Utrecht, UU) will work on objective 2. Co-applicants De Jong and Van der Stappen work on objectives 1 and 3.

Subtask 1, objective 1 Informing WP1 based on the review of literature;

Subtask 2, objective 2 Contributing to the framework based on reviews of the existing literature, field observations and design-test cycles in educational practice. This will include activities aimed at participation of children and adolescents (workshops and an education program based on students' guided self-reflection on their reading experiences, modelled after (Bupa 2022)).

Subtask 3, objective 3 Co-creating the conceptual framework with our stakeholders.

Productive interactions (co-design and co-creation)

Subtask 1 is executed in cooperation with WP1A. Subtask 2 is executed in cooperation with teachers from our co-funding schools (Staij, BasisBuren, Stichting Klasse, Slingeland). Subtask 3 is executed in cooperation with WP1A, WP2A-D, WP3, and stakeholders from co-funding schools. The Academische PABO Leiden, IPABO, HU, Rotterdam, Hogeschool KPZ, Levende Talen, and Graduate School of teaching in Utrecht and Tilburg bring knowledge on the current training teachers receive in reading acquisition, as well as on the training teachers receive in other countries. The KB brings a number of digital educational platforms for reading acquisition that are used nationwide and that allow for an analysis of the educational opportunities that digital media offer with regard to reading acquisition.

Contribution to project (impact)

The conceptual framework of WP1B will serve the project itself in two ways: **(1)** guide the development of the interventions to improve the teaching of reading in a digital age (WP2A-D) and ensure involvement of all relevant stakeholders in these development processes; **(2)** allow for comparison of the results and outcomes of the interventions in WP3 by providing guidelines on the measurement and metrics for the evaluation of the interventions. Furthermore, this WP1B contributes to the following output of the project:

- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model
- Insight in general design principles for the improvement of the (teaching of) reading in a digital age that can be applied across different contexts
- Insight in how to measure the effects of the (teaching of) reading in a digital age at different developmental stages.

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Work package number	WP2A
Work package title	**Educational interventions: contextualised vocabulary and listening comprehension**
Work package leader	Espin (UnivLeiden)
Involved partners	INT, Lexima, CED, Woordenaars.nl, Wolfert, Lyceum Schravenlant, KB, VoorleesExpress, ProDrachten, Staij, BasisBuren, Stichting Klasse, Pabo Leiden and Amsterdam, IPabo, Cito, Levende Talen, Scholieren.com
Start date	01-09-2024
End date	01-09-2029

Objectives

The overall aim of WP2A is to develop a series of educational interventions and their surrounding frame of actions (from the training of teachers to the training of school boards) that answers the question: Which EdTech, digital free or blended reading education help students to improve their reading comprehension and reading behaviour via improvements in vocabulary, inference making, and listening comprehension (See Section 2.3.2 for the rationale behind this question). The objectives of this WP are:

(1) to design, test and implement educational interventions aimed at improving vocabulary, inference-making, and listening comprehension

(2) *with a special focus on students in primary school (ages 4-12), and on students with and without reading disabilities and young adults (12-14) in practical education)* ;

(3) to thus provide input for systematic empirical study of the teaching of reading in a digital age in WP3.

Methodology

We design, implement and evaluate both interventions through a so-called co-creative propagation approach (Froyd et al., 2017) or Educational Design Research approach (McKenney & Reeves, 2018) in which we design, develop and implement the educational technology interventions in various iterative cycles together with our stakeholders and developing partners through four phases (Bannan, 2008; McKenney & Reeves, 2018): informed exploration, deliberation with young stakeholders, enactment, evaluation. Ethical consent and data management plan will be developed at the start with the help of WP3.

Description of research activities

The two PhD students work in this WP under the supervision of co-applicants Espin (UnivLeiden) and Bos InHolland); and co-applicants Rispens (UvA) and Bos (InHolland). The PhD students collaborate with members of our co-funding partners INT, Immer, CED, Lexima, VoorleesExpress, Woordenaars.nl. Over the course of the proposed project, the development of the educational technologies will pass through four phases (Bannan, 2008; McKenney & Reeves, 2018) (informed exploration, deliberation with young stakeholders, enactment, evaluation).

Subtask 1 Examine the relative effects of interventions aimed at improving vocabulary, inference-making, and listening comprehension for students across age- and ability levels (e.g., with and without disabilities). We draw upon existing interventions in vocabulary, inference-making, and listening comprehension, and compare the relative effects of the interventions for students across age- and ability levels. Both proximal and distal effects are considered. Interventions are implemented by the research team under controlled conditions. The role of technology in enhancing the effectiveness of the interventions is considered.

We then build interventions designed to meet the specific needs of students of different age- and ability levels, emphasizing vocabulary, inference-making, and listening comprehension to different extents. Co-funding partner Cito will co-design fitted reading assessments.

Subtask 2 Testing effects of the combined interventions when implemented by teachers in school settings. Examine the effects of interventions aimed at improving vocabulary, inference making and listening comprehension on students' reading comprehension and reading behaviour. Determine what supports are needed to ensure that teachers implement the interventions with fidelity. And explore the role of technology for enhancing the effectiveness of the intervention implementation.

Subtask 3 Determine evidence-based features and components in digital reading environments that foster reading processes and outcomes (comprehension, behaviour such as self-efficacy).

Productive interactions (co-design and co-creation)

Tasks are executed with co-funding partners at schools, Scholieren.com, Levende Talen, Cito, CED, Woordenaars.nl, LitLab.nl, Lexima, Immer. The PhD student and supervisors meet regularly with the consortium to monitor and evaluate progress.

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Contribution to project (impact)

This WP benefits from the insights provided by WP 1 and will provide WP3 with data. This WP contributes to the following output of the project:

- Tested educational materials.
- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model and framework.
- Insight in general design principles for the improvement of the (teaching of) reading in a digital age that can be applied across different contexts at different developmental stages.

Work package number	WP2B
Work package title	**Educational intervention: sourcing and engaging**
Work package leader	Hummel (OU)
Involved partners	ROC Friese Poort MBO; Het Zuiderpark College (VMBO); Expertis; CED; Lexima; Woordenaars.nl; LitLab.nl; KB; Pabo Leiden and Amsterdam, IPabo, Cito; Graduate School of Teaching Tilburg and Utrecht, Universities of Applied Science Rotterdam and KPZ, Levende Talen, Scholieren.com
Start date	01-09-2024
End date	01-09-2029

Objectives

The overall aim of WP2B is to develop a series of educational interventions and surrounding frame of actions that answers the question: Which EdTech (digital free, blended or fully digital) reading education helps students to have meaningful interactions with reading information, and to develop the ability to deal with discrepancies in information, in light of the development of their reading comprehension, reading behaviour and citizenship? (See Section 2.3.2 for the rationale behind this question). Objectives of this WP:

(1) to design, implement and test two more meaningful educational technology interventions aimed at the acquisition of searching, evaluating and (meaningful) integrating of information skills;

(2) *with a special focus on MBO students, and on students in group 7 and 8 (10-11 years);*

(3) to thus provide input for systematic empirical study of the teaching of reading in a digital age in WP3.

MBO students are an under-examined group, and there are concerns about their low level of reading proficiency (De Greef, 2020). Students in group 7 are increasingly using longer and more complex texts as a means for learning (Chall & Jacobs, 1983): promoting sourcing in this phase could prevent reading problems later in students' school careers.

Methodology

We design, implement and evaluate both interventions through a so-called co-creative propagation approach (Froyd et al., 2017) or Educational Design Research approach (McKenney & Reeves, 2018) in which we design, develop and implement the educational technology interventions in various iterative cycles together with our stakeholders and developing partners through four phases (Bannan, 2008; McKenney & Reeves, 2018): informed exploration, deliberation with young stakeholders, enactment, evaluation. Ethical consent and data management plan will be developed at the start with the help of WP3.

Description of research activities

The 2 PhD students work in this WP under the supervision of co-applicants Van Steensel (VU) and Hummel (OU); and co-applicants Sanders (UU) and Van der Stappen (Avans). Curricular principles and teaching strategies to enhance meaning include activating students' prior knowledge (Ausubel, 1968) connecting to students' personal worlds, showing the value of what is learned beyond school and working with "real" problems (Loyens & Gijbels, 2008) aiming at "authentic learning" (Herrington, Reeves & Oliver, 2014. We will built on these insights for the development of both interventions.

Subtask 1 Design two types of interventions aimed at establishing a connection between finding and evaluating information in more meaningful reading contexts, thus: the development of the awareness of critical sourcing of information (for instance reading of texts while gaming and thus experience virtual consequences of choices; training to become resistant to digital nudges); the development of awareness of engagement with information (for instance reading of texts while gaming and becoming aware of the importance of specific texts). Co-funding partner Cito will co-design fitted reading assessments,

Subtask 2 Implement, test and evaluate these interventions in a comparative study, comparing similar reading tasks with or without using the authentic digital environments.

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Subtask 3 Determine evidence-based features and components in digital reading environments that foster reading processes and outcomes (comprehension, behaviour such as self-efficacy).	
Productive interactions (co-design and co-creation)	
Tasks are executed with co-funding partners at schools, Scholieren.com., Levende Talen, Cito, CED, Woordenaars.nl, LitLab.nl, Expertis, Lexima, Immer. The PhD student and supervisors meet regularly with the consortium to monitor and evaluate progress. Co-funding partner Scholieren.com will ensure student's input.	
Contribution to project (impact)	

This WP benefits from the insights provided by WP 1 and will provide WP3 with data. This WP contributes to the following output of the project:
- Tested educational materials.
- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model and framework.
- Insight in general design principles for the improvement of the (teaching of) reading in a digital age that can be applied across different contexts at different developmental stages.

Work package number	WP2C
Work package title	**Educational interventions: online and offline reading preferences**
Work package leader	Segers (RU)
Involved partners	Immer, ProDrachten, Het Zuiderpark College (VMBO), Cito, Scholieren.com; Graduate School of Teaching Tilburg and Utrecht, Universities of Applied Science Rotterdam and KPZ, Levende Talen
Start date	01-09-2024
End date	01-09-2029

Objectives

The overall aim of WP2C is to develop a series of educational interventions and surrounding frame of actions (from the training of teachers to the training of school boards) that answers the question: Which EdTech, digital free or blended reading education helps students to define and enhance their reading motivation, comprehension and reading behaviour by preferences for their digital reading environment regarding form and content? (See Section 2.3.2 for the rationale behind this question). The objectives are:
(1) to design, test and implement a minimum of 3 educational interventions aiming at the development of reading preferences;
(2) *with a special focus on (pre-)vbmo-students (12-15)*;
(3) to thus provide input for systematic empirical study of the teaching of reading in a digital age in WP3.

Methodology

We design, implement and evaluate both interventions through a so-called co-creative propagation approach (Froyd et al., 2017) or Educational Design Research approach (McKenney & Reeves, 2018) in which we design, develop and implement the educational technology interventions in various iterative cycles together with our stakeholders and developing partners. Ethical consent and data management plan will be developed at the start with the help of WP3.

Description of research activities

The student works in this WP under the supervision of Segers (RU) and Beekman (Fontys), together with a daily supervisor from Segers' group. We aim at a series of experiments focusing on (1) ergonomic design, (2) motivational nudges, (3) comprehension aids and (4) social interaction.
Subtask 1 Co-creating of a digital prototype in designing, refining, and testing sprints to determine the components in a digital reading environment (the Immer app) tailored to the preferences and abilities of the individual readers. Co-funding partner Cito will co-design fitted reading assessments, co-funding partner Scholieren.com will organise focus groups and nationwide polls to ensure student's input.
Subtask 2 Implement, test and evaluate these interventions in a comparative study. Versions with and without the designed features will be compared by dividing the participants in an experimental and a control group. Learning analytics will be collected during digital reading (reading fluency, comprehension of the texts being read, interactions with the device), as well as general behavioural measures (motivation, self-efficacy, general reading comprehension).

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Subtask 3 Running a large-scale longitudinal intervention study in which the designed intervention in a sample of 500 students in secondary vocational education. The students will be tested in three waves of data collection (see Scheltinga et al., 2000). The design allows for analysing reciprocal relations between the different factors under study and examining the effects of the intervention. In addition, the role of the teacher will be taken into account, as well as treatment fidelity. Teachers notoriously lack the time (see Scheltinga et al., 2000), and it is challenging to track of what is (not) being done. This is a huge benefit of the proposed intervention: the foreseen effect is primarily driven by the EdTech and can easily fit into the ongoing curricular activities.

Subtask 4 Determine evidence-based features and components in digital reading environments that foster reading processes and outcomes (comprehension, behaviour such as self-efficacy).

Productive interactions (co-design and co-creation)

Tasks are executed with co-funding partners at schools. Levende Talen, Scholieren.com and educational publisher Immer and Cito. The PhD student and supervisors meet regularly with the consortium to monitor and evaluate progress.

Contribution to project (impact)

This WP benefits from the insights provided by WP 1 and will provide WP3 with data. This WP contributes to the following output of the project:

- Tested educational materials.
- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model and framework.
- Insight in general design principles for the improvement of the (teaching of) reading in a digital age that can be applied across different contexts at different developmental stages.

Work package number	WP2D
Work package title	**Educational interventions: online and offline shared reading**
Work package leaders	Andeweg (UU)
Involved partners	Culturele Apotheek, Immer, Lexima, LitLab.nl, Noordhoff, MBO Friese Poort, ProDrachten, Het Zuiderpark College (VMBO), Cito, Scholieren.com, Graduate School of Teaching Tilburg and Utrecht, Universities of Applied Science Rotterdam and KPZ, Levende Talen
Start date	01-09-2024
End date	01-09-2029

Objectives

The overall aim of WP2D is to develop educational interventions and surrounding frame of actions (from the training of teachers and students to the training of school boards) that help to answer the question: How can shared reading (with or without (much) EdTech) contribute to developing reading preferences and reading behaviour, in light also of the development of the young reader's citizenship? (See Section 2.3.2 for the rationale behind this question). The objectives are:

1. to design, test and implement educational interventions aimed at the development of effective shared reading practices;
2. *with a special focus on students with fewer opportunities for social mobility (VMBO, practical education and MBO);*
3. to thus provide input for systematic empirical study of the teaching of reading in a digital age in WP3, allowing for the comparison of different variables in shared reading, by including: **(1)** off line and online shared reading groups; **(2)** groups with and without supporting applications (Immer, Lexima); **(3)** groups led by different types of reader-facilitators, all trained by the Culturele Apotheek (adult volunteers from the Culturele Apotheek, students from older age groups, and teachers); **(4)** different reading materials.

Methodology

In this WP the PhD student will design, implement and evaluate educational interventions based on shared reading using quantitative and qualitative methodologies which have been successfully used in shared reading research and VTS research (Cappello & Walker, 2016, Yenawine & Miller, 2014), and experiences in the pilot 'One Book, One Campus' at the UU. We design, implement and evaluate educational interventions through a so-called co-creative propagation approach (Froyd et al., 2017) in iterative cycles together with our stakeholders in four phases (Bannan, 2008; McKenney & Reeves, 2018): informed exploration,

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deliberation with young stakeholders, enactment, evaluation). For the evaluation of shared reading interventions we will use a tailored version of the methodologies developed by Billington a.o. (2019), which combines classic data immersion as practised in qualitative research with the expertise of literary-critical close reading, and the MERG-tool (Measuring the Experience of Reading Groups) by Liebling (Liebling et al., 2022). The MERG-tool gives priority to detailed qualitative data collection and shared reflection, and the use of Appreciative Inquiry, fusing qualitative with quantitative research methods. Ethical consent and data management plan will be developed at the start with the help of WP3.

Description of research activities

The PhD student works in this WP under the supervision of co-applicants Van Dijk (Leiden) and Andeweg (UU).

Subtask 1 Design educational interventions (selection of texts suitable to school level with (young) stakeholders; training of three groups of reader-facilitators by Culturele Apotheek). Co-funding partner Cito will co-design fitted reading assessments, co-funding partner Scholieren.com will organise focus groups and nationwide polls to ensure student's input.

Subtask 2 Implement, test and evaluate these interventions, setting up shared reading groups in VMBO, practical education and MBO schools which will run once a week for one year.

Subtask 3 Collecting data, analysing & evaluating data.

Subtask 4 Determine evidence-based features and components in digital reading environments that foster reading processes and outcomes (comprehension, behaviour such as self-efficacy). By involving not only trained volunteers but also trained (senior) pupils and teachers in our shared-reading experiments, professionalisation is improved and sustainable habits of class interaction are trained for greater impact.

Productive interactions (co-design and co-creation)

All tasks are executed with co-funding schools, Levende Talen, Scholieren.com and partners Culturele Apotheek, Immer, Lexima, LitLab.nl, Noordhoff. The PhD student and supervisors meet regularly with the consortium to monitor and evaluate progress.

Contribution to project (impact)

This WP benefits from the insights provided by WP 1 and will provide WP3 with data. This WP contributes to the following output of the project:

- Tested educational materials.
- Insight in the (teaching of) reading in a digital age through a tested innovative integrative model and framework.
- Insight in general design principles for the improvement of the (teaching of) reading in a digital age that can be applied across different contexts at different developmental stages.
- A database of suitable reading materials (stories/ novel fragments/poems/song lyrics) for the educational levels VMBO & MBO, and a training kit for reader-facilitators in schools.

Work package number	WP3
Work package title	**Data analyses of results of interventions and data management**
Work package leaders	Dastani (University Utrecht)
Involved partners	OCW, WAP, all co-funding and co-operating schools
Start date	01-01-2024
End date	01-01-2029

Objectives

The overall aims of WP3 are to develop 1) a toolkit for data collection and data analysis for researchers in WP1 and WP2, and 2) a data analytical framework that serves as the monitor of the interventions and their outcomes of WP2. The specific objectives of the WP are:

(1) to develop a toolkit for supporting researchers in data collection and data analysis according to the requirements demanded by law and ethical principles and in performing the necessary administrative tasks related to this. For this we will collaborate with ethical committees, using the appropriate documentation and tools such as templates for DPIA (Data Protection Impact Assessment), consent forms and agreements for data ownership and data security for participants in studies (or, if applicable, the student parents);

(2) to construct dashboards that support researchers to chart the effects of (the teaching of) reading comprehension and reading behaviour in the digital age based on the model produced in WP1A + WP1B and the interventions in WP2a-WP2D;

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(3) to support researchers to improve their insights in the (causal reasoning of) specific educational interventions in groups of readers with various socio-economic, ethnic and cultural backgrounds through data collection and analysis over time.

Methodology

We employ a multidisciplinary approach to develop data analytic toolkits and frameworks to support researchers in getting insight into (the teaching of) reading comprehension and reading behaviour. This approach consists of **(1)** reviewing the existing literature on data analytic toolkits and frameworks (e.g., digital learning analytics, digital learning metrics, digital learning dashboards, meta-analyses); **(2)** examination of current data analytical models of (the teaching of) reading comprehension in a digital age across disciplines, such as existing tools to operationalize the complexity of texts read by the students called the T-Scan; Pander Maat et al., 2014); **(3)** consultation with partnering educational organisations, reading specialists, and other stakeholders (focus groups) during the development and evaluation of the data analytic tools and frameworks. Four data sources can be used: **a)** registrations of students' actions in the learning environment as they can be seen in e.g., log files or eye-tracking data to uncover students' route through the material, their choice of answers to questions, the steps they take towards a solution to a task, and their interaction pattern with specific digital objects such as online laboratories or learning apps, **b)** student created digital products, such as for example concept maps, or hypotheses and observations as noted in dedicated apps, **c)** physiological data measuring students' emotions, focus etc., and **d)** in case of collaborative learning, students' collaboration activities such as digital chats or voice recordings. Tutorial actions may include changing the learning route of the students, hints on how to continue, a student assignment, feedback on a product or action, reflection questions etc. AI techniques such as machine learning, data mining and statistical methods will be used to analyse and optimise the diagnosis and tutoring component. We will produce both the analytic instrument as the psychometric tests in so-called sprints: short periods of time in which we develop, test and improve prototypes.

Description of research activities

A PhD will conduct the research in WP3, supervised by Dastani (UU), embedded in teams with co-applicant Van der Stappen (Avans) and stakeholders and consortium partners. This PhD student is supported by a data specialist appointed within the project to collect data from educational interventions.

Subtask 1 Identify learning metrics used in the disciplinary domains to monitor and assess reading comprehension and reading behaviour; Select/refine metrics that are suitable for each cohort and conduct using randomised controlled trials (RCTs).

Subtask 2 Consult with stakeholders on learning metrics used in the educational field and critical evaluation of identified metrics;

Subtask 3 Outline, develop, test and improve prototypes of tools and frameworks in sprints that support researchers in data collection and data analysis. These tools and frameworks will be based on the identified metrics and AI techniques (e.g., machine learning, data mining, statistical methods, search and federated query techniques of distributed data sets).

Subtask 4 Evaluate intervention outcomes using AI and Data Science techniques (e.g., causal learning and reasoning). Students from both experimental and control groups will be tested immediately after program participation and will be additionally followed to examine long-term intervention effects. Longitudinal data from the control group will be used to describe typical developmental trajectories. Treatment fidelity to the intervention is examined through observations of adherence and dosage, and ratings of child, parent, home visitor, and teacher satisfaction and motivation. Additionally, information on child, text, instruction, and environmental factors will be collected and used to consider differential developmental trajectories as well as differential intervention effects. Existing metrics with established validity and reliability will be used for assessment of these variables. Multi-level longitudinal analysis will be used to analyse quantitative data, thereby accounting for nesting (students in classes in schools in moments). The PhD student is responsible for test-assessment (reading motivation, self-efficacy and reading comprehension at waves 1, 2 and 3) and keeping track of treatment fidelity as well as collecting data from the digital reading activities during the intervention.

Subtask 5 Knowledge transfer of knowledge and materials.

Productive interactions (co-design and co-creation)

Identification metrics of the effectiveness of (the teaching of) reading comprehension in a digital age will be done through cooperation with WP1 and WP2, and consultation sessions with stakeholders among the co-funding and cooperation partners (Levende Talen, OCW, WAP, all co-funding schools, Scholieren.com).

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Contribution to project (impact)

This WP will provide the empirical analysis of the effectiveness of the educational interventions:
- insight in (the teaching of) reading in a digital age through a tested innovative integrative model;
- insight in the integrated effects of combined interventions; complex analysis over time;
- insight in how to measure the effects of (the teaching of) reading in a digital age at different developmental stages.

Work package number	WP 4
Work package title	**Implementation and dissemination**
Work package leader	Stronks (UU)
Involved partners	All applicants and co-funding and co-operating partners
Start date	01-09-2023
End date	01-01-2032

Objectives

This WP focuses on disseminating the project's output and securing the project's societal and scientific impact. Its core objectives are:
(1) establishing a network in which the consortium partners, external societal and commercial stakeholders, relevant academics, and the general public are connected and can meet;
(2) disseminating the project's results via this network to create knowledge and raise awareness;
(3) optimizing implementation of interventions through starting processes of change.

Methodology

All partners are involved in this WP and this WP is highly connected to the other WPs. We follow the Quality Implementation Framework (QIF, Meyers et al., 2012) to communicate the output of the other WPs to the stakeholders and to secure the implementation of the newly adapted and developed interventions as developed in WP2A-WP2D. In this WP we focus on the critical steps, as described in the QIF, of establishing the community, disseminate the project's output and optimise implementation of interventions.
the diagnosis and tutoring component.

Description of research activities

This WP is led by the main applicant together with the yet to be appointed program manager. Using the experiences of building two communities around digital educational platforms (LitLab.nl. ca 6000 student users per month, Schrijfakademie.nl, ca. 3000 student users per month) by the main applicant, this WP undertakes the following activities:

Subtask 1 Establish community: Organise conferences for all stakeholders; organise consortium meetings and workshops for (all) consortium partners; organise research teams meetings; organise two scientific international conferences and create a digital platform/space where stakeholders are united.

Subtask 2 Disseminate project's output to consortium partners, and external stakeholders (including parents and children): write open access publications for the general public; organise conferences for all stakeholders; create content (all partners involved) for digital platform (such as knowledge clips /videos; and make podcasts that o reach a wider audience; tipsheets and infographics for stakeholders to enforce a sustainable optimization of practice.

Subtask 3: Optimise implementation of interventions, by:
(1) Organising workshops where universities of applied sciences partners that train teachers at primary and secondary schools use materials that are tested in WPs 2A-2D, and develop their own course materials for their educational programs after this example.
(2) Co-creating (with co-funding and cooperating publishers and intervention specialists) materials for teachers who work with the adapted and new intervention materials: tipsheets; instruction leaflets; infographics; flyers etc.
(3) Organise workshops where policymakers interact with consortium partners and external stakeholders (teachers; publishers; educational professionals) to synchronise daily practice and recommendations for curricular activities.

Productive interactions (co-design and co-creation)

This WP involves all consortium partners. Throughout all phases of dissemination and implementation, the consortium partners will work together. Co-creation and co-design takes place during:

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(1) Dissemination via conferences: three conferences on (the teaching of) reading in a digital age in the Netherlands will be organised with co-funder Stichting Lezen (two conferences).
(2) Dissemination via newsletters and the project's website (with WAP), publications for a broader audience (with Stichting Lezen) and contributing to NRO-website Onderwijskennis.nl
(3) Creating materials to accelerate implementing the co-designed and co-created materials and interventions that can be used in the classroom and the home
(4) Creating and adapting course materials for students in teacher training programs or for practising teachers (professional development courses)

Contribution to project (impact)

This WP targets dissemination of the project's insights and implementation of the intervention created in the project (WP2A-WP2D). This WP is thus connected to all other work packages. The dissemination and implementation of the project's output is crucial for the following outcomes:

- Scientists translate the project's output into articles, dissertations, papers, presentation (INT, UU, UnivLeiden, UvA, RU, VU, OU).
- The coordinator of the policy makers in our consortium (OCW) translate the project's output to an improved curriculum of reading comprehension that is integrated throughout the curriculum.
- Stichting Lezen, WAP, Onderwijsraad, Oberon, Expertisecentrum Nederlands, Scholieren.com disseminate the project's output to external stakeholders.
- Coordinators of the teacher training programs of the universities of applied sciences and universities in the consortium (IPABO; Hogeschool KPZ, HvA, HvU, Hogeschool Rotterdam; Academic PABO, Graduate School of Teaching in Tilburg and Utrecht) implement professional development programs for teachers in their curricula.
- The coordinators within the school boards of the consortium (Staij, BasisBuren, Stichting Klasse, Singelland) facilitate and provide professional development of teachers in their schools.
- Teachers working in the schools (Staij; BasisBuren; Stichting Klasse; Singelland; Lyceum Schravenlant; MBO Friese Poort, ProDrachten, Het Zuiderpark College, Wolfert) and the professional organisation for teachers (Levende Talen) and educational publishers (Immer, Noordhoff, Expertis, Lexima, CED, LitLab.nl, Woordenaars.nl) improve the quality of instruction by engaging teachers outside the consortium.

7.3   Risk management and contingency plan

The project spans a timeline of eight years and during those years the project may encounter situations that put the project's output, outcomes and impact at risk. An inventory of the risks that may pose a threat to the project has been made, also based on the experience of the applicants in previous projects. Alternative plans that can be followed to minimize damage have also been laid out.

Risk: our focus at students most at risk might cause a high dropout rate of schools/students that threatens the (longitudinal) analysis in WP2A-WP2D
How mitigated: Close collaborations with coordinators of schoolboards during annual consortium meetings; feedback to teachers about development of classes which stimulates cooperation; communicate clearly to the students that their participation in project implies co-creation of the research, and that in general their opinion and experience matter to us: we rely in fact on their knowledge of their online reading behaviour, and need their input.
Alternative: find additional students that want to participate in longitudinal research through our co-funding partner Levende Talen, Scholieren.com and nationwide calls to action.

Risk: our focus at digital media and online reading behaviour implies a focus at (extremely) rapidly changing (educational) practices and infrastructures
How mitigated: our conceptual model and educational framework are more abstract than actual reading/media behaviour and infrastructures and are hopefully robust enough to withstand these changes. Also, the EdTech we built is based on the existing application and platforms of our co-funders and co-operating partners. These partners are constantly working on staying up-to-date. In that respect, they also provide some security in case of financial setbacks due to software programming of newly developed materials. We co-create with them, offering EdTech scientific expertise to them from within the project, so that we are able to succumb the challenges of rapid changes.

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Alternative: we take a certain point in time, and reading/media behaviour and infrastructure as the project's point of reference, to make sure that what is developed across WPs 2A-2D has a workable, internal logic.

Risk: our focus at digital media and online reading behaviour might not align with teacher's point of view on the causes of the current problems in reading education, or solutions for that problem
How mitigated: from the start of the project, WP4 has the goal to bring the message across that we need more knowledge of the impact of digital media on reading and reading education to find out if and how we should adjust reading education. Our project is not about advocating the introduction of digital media in reading education. Instead, we explore how digital media affect reading comprehension and reading behaviour, and aim to find out if and how, and to what extent digital media can help in solving the current general problem of Dutch reading education (its lack of focus on the content of what is read). Our interventions will be as low-key, and as embedded in the standard curriculum as possible to enhance acceptance.
Alternative: we accept that, especially within the project, we work with teachers, trainers of teachers and educational publishers that are willing to explore this issue with us. More sceptical teachers and trainers of teachers outside the project may take more time to engage in discussion on how the implementation of digital media in reading education is helpful in the current situation. Research results are leading, even if they are not always backed up by all teachers at this point in time.

Risk: research teams are located at various universities and institutes, possibly causing incoherence between the various WPs and their research teams
How mitigated: Regular meetings of work package leaders and regular joint work sessions on various locations: one team travels to the location of another team and they have a joint work session of several days in a row to share progress and tentative results.
Alternative: online developing sessions (sprints).

7.4 Justification of project budget

Budget range [A]	
Budget range requested budget	⊠ 2 – 5 M€

The project has budgeted under 'personnel costs' eight PhD students and two postdocs. The two postdocs are offered full time positions for two years. The PhD students and postdocs will be housed in the universities of the applicants who act as first supervisors. The PhD students and the postdocs will carry out experimental studies which will involve the participation of many children and young adults. The schools contribute in kind to part of this work, teaching reading comprehension with the newly developed/adapted materials, but additional tests need to be administered and more participants need to be recruited and tested at schools. As data collection and data analysis is time-consuming, money is requested for assistance at MBO level of the PhD students and postdocs, especially for the PhD of WP3 who depends on the harvesting of data (assistance at HBO level is requested in this case). To buy small gifts as a reward for participation in the experiments, 10.000 euro is requested. Eleven research leaves are requested so that the applicants can invest time in participating in the planned activities in the work packages and the supervision of the PhD students and the postdoc. The main applicant will invest research time in the overall management of the research.

Travel money has been requested (100.000 euro) so that the scientific teams (applicants, PhD students, postdocs) can participate in international conferences and international research visits. To increase international visibility two international scientific conferences are organised for which 50.000 euro is budgeted.

Material costs: In WP2A-WP2D intervention materials are adapted and developed. The co-funders will contribute in kind to these activities but the project will also develop new materials. 40.000 euro has been requested to buy devices on which digital intervention programs can be run in classrooms and to buy devices (laptops for eye tracking) and to cover the material costs. The digital intervention (educational game) will be programmed by developer appointed within the consortium (at 554.600, 2 x 277.300 euro) and an external company and based on quotes the project requests 60.000 euro for building the game and maintenance of the app. This game will be freely accessible for school and home environments and is therefore categorised as knowledge utilisation.

The project will only publish open access articles. Based on previous experience we have budgeted 50.000 euro under 'implementation costs' (each PhD student/postdoc can spend 5000 euro on OA articles).

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For knowledge utilisation 15.000 euro is requested to host and build a project website. This amount is based on previous experience. For creation of digital content for the website, an amount of 25.000 euro is requested, based on previous project experience.

The universities of applied sciences teaching colleges will contribute to the creation of teacher packages and course materials for students who follow teacher training programs, and 30.000 euro is requested for the planned activities in the work packages to facilitate designing, piloting and implementing of the teacher packages and universities of applied sciences course materials (organise workshops, and teach masterclasses). The publishers and intervention specialists will contribute in kind to the design and adaptation of reading instruction methods and 30.000 euro is requested to facilitate activities planned to optimise this. An additional 45.000 is requested to finance the implementation of the teacher packages and the developed materials.

A wide audience needs to be reached and the money is used to create promotion material such as instruction sheets, leaflets, knowledge clips, short instruction movies, infographics etc. Money (31.000 euro) is also requested to organise the consortium meetings and cover travel costs of PAC members (to cover: 8 annual consortium meeting for around 70 persons, three monthly WP meetings for all WP's, three monthly steering group meetings, six monthly meetings with the PAC). The PhD students and postdocs all work in different locations. Joint meetings are planned with an estimated cost 20.000 euro (travel and catering coffee/tea) to enhance cooperation. A consortium partners will organise via an in-kind contribution two conferences for a broad audience and publications for a wide audience. The project therefore did not budget these activities.

8   Data management & ethical aspects

8.1   Data management

1)   Will this project involve re-using existing research data?
☒ *Yes: Are there any constraints on its re-use?* No.
2)   Will data be collected or generated that are suitable for reuse?
☒ *Yes*
3)   After the project has been completed, how will the data be stored for the long-term and made available for the use by third parties? Are there possible restrictions to data sharing or embargo reasons?
We store our data sets (anonymized) and our data analyses on Open Science Framework so that the scientific community can access those data sets and data analyses. There are no embargo's or restrictions.
4)   Will any costs (financial and time) related to data management and sharing/preservation be incurred?
☒ Yes: please see our budget, justification of the budget (an data analyst in support of the PhD in WP3) and the descriptions of WP1B and WP3.

8.2   Ethical aspects

	Not applicable	Not yet applied for	Applied for	Received
Approval from a recognised (medical) ethics review committee	☐	☒	☐	☐
Approval from an animal experiments committee	☒	☐	☐	☐
Permission for research with the population screening Act	☒	☐	☐	☐

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9 Statements by the main applicant

9.1 Other grant applications

Title proposal	
Applicant(s)	
Funding agency and call	
Budget applied for	
Date of submission	
Estimated date of decision	
Difference with this proposal (percentage)	
Describe the difference	

9.2 By submitting this form I declare that:

☒ The main applicant is appointed at their host institute for the duration of the application process and for the project that is applied for.

☒ I, and all individuals and parties involved in this proposal, satisfy the nationally and internationally accepted standards for scientific conduct as stated in the *Netherlands Code of Conduct for Research Integrity 2018* (Universities of the Netherlands).

☒ I have discussed the final version of this proposal with all individuals mentioned in this proposal as (intended) consortium partners. All such individuals mentioned are aware of and agree with their role and intended contribution to the project, should this be awarded funding.

☒ All consortium partners mentioned in this proposal, especially the co-funders, have taken notice of the rules for this Call for proposals on Intellectual Property and publication (see section 5.1.6 of the call for proposals), including the conclusion of a project agreement between all consortium partners before the start of the project.

☒ I follow the NWO policy on data management.

☒ I have completed this application form truthfully.

Name main applicant: Els Stronks

Place: Utrecht

Date: January 23, 2023

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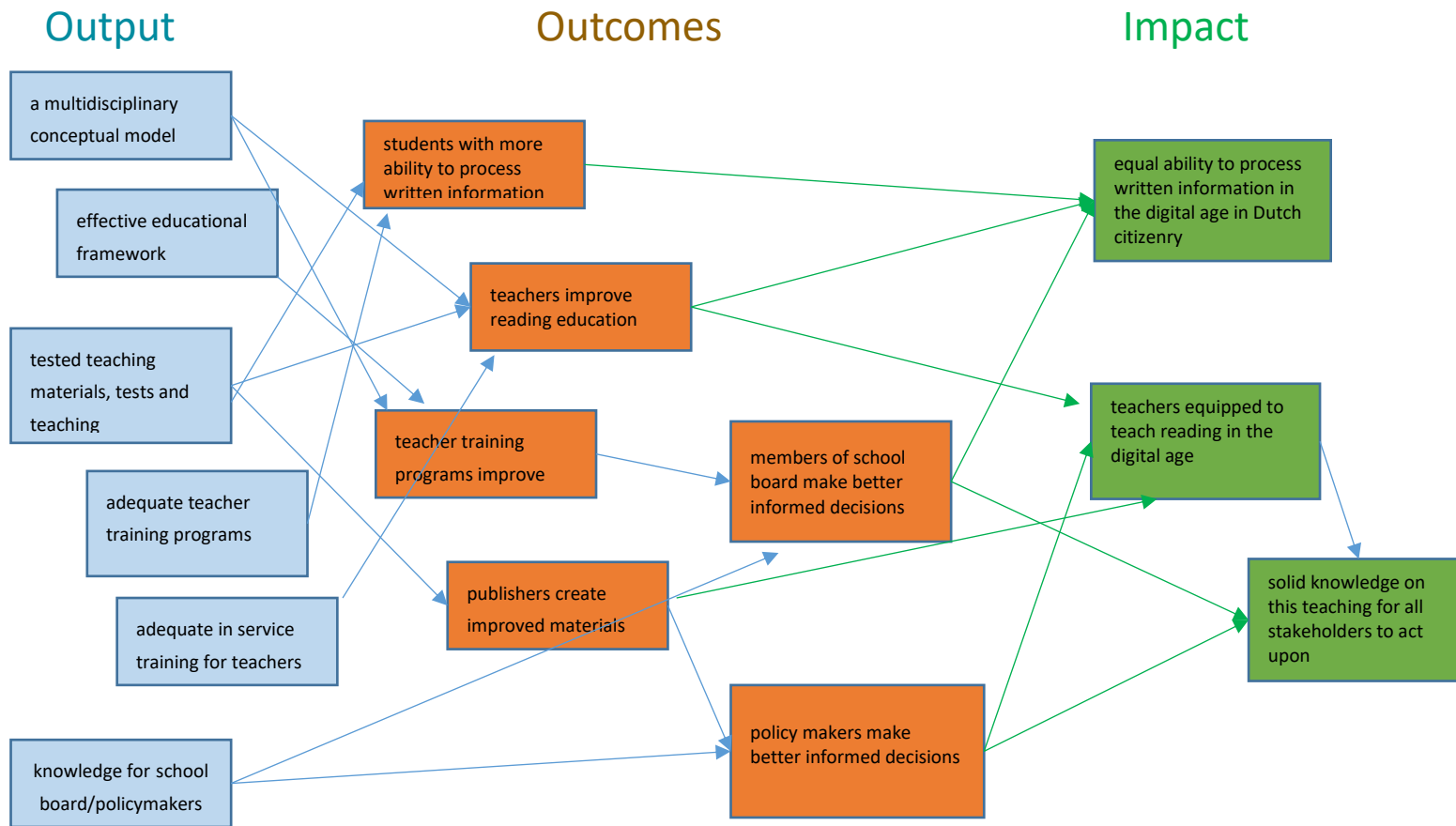
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11   Annex 1A: Pathway Diagram

Output

- a multidisciplinary conceptual model
- effective educational framework
- tested teaching materials, tests and teaching
- adequate teacher training programs
- adequate in service training for teachers
- knowledge for school board/policymakers

Outcomes

- students with more ability to process written information
- teachers improve reading education
- teacher training programs improve
- members of school board make better informed decisions
- publishers create improved materials
- policy makers make better informed decisions

Impact

- equal ability to process written information in the digital age in Dutch citizenry
- teachers equipped to teach reading in the digital age
- solid knowledge on this teaching for all stakeholders to act upon

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12 Annex 1B: Impact pathway indicators

Output	Indicators
Output 1 a multidisciplinary conceptual model of reading comprehension and reading behaviour apt to process written information in the digital age	- Model - Dissertation by PhD student on the designing, implementing and testing of this model as well as proof of principle of the model - Article(s) by postdoc on this model in scientific journals - Content for the project's website
Output 2 a tested and effective pedagogic/didactic framework fitted to this model	- Framework - Article(s) on this model in scientific journals by the postdoc - Content for the project's website
Output 3 tested teaching materials, tests and teaching methods based on this conceptual model and educational framework, with or without (much) EdTech and geared towards the individual needs of young students that need effective reading education the most	- Tested teaching materials - Six dissertations by PhD students on the designing, implementing and testing of these teaching materials, as proof of concept of the model and framework - One dissertation by PhD student on the data analytical aspects of the designing, implementing and testing of these teaching materials
Output 4 teacher training programmes based on these tested materials and methods that support future teachers to teaching reading comprehension and reading behaviour apt to process written information in the digital age	- Teacher training programmes for primary and secondary education at Universities of Applied Sciences and Universities
Output 5 in service training that supports active teachers in the transition to teaching reading comprehension and reading behaviour apt to process written information in the digital age	- Workshops and masterclasses for teachers in primary and secondary education
Output 6 contribution to the body of knowledge necessary for member of school boards	- Content for websites outside the project (such as the NRO Onderwijskennis.nl) on project's results
Output 7 contribution to the body of knowledge necessary for policy makers	- Policy briefs

Outcome	Indicator
Outcome 1 all students have a more proficient ability to process written information in the digital age	- Nationwide tests such as Cito Eindtoets Primary education (group 8), and Landelijk Eindexamen Nederlands Secondary education VMBO, HAVO and VWO - better results for MBO students in tests with reading components - Nationwide research Peil.nl (monitoring of reading profiency at the end of PO, at first years of Primary Education
Outcome 2 teachers improve reading education	- self-assessments of teachers (periodically harvested by their professional organisation for teachers of Dutch, Levende Talen Nederlands)

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	- better results for the students of these teachers at nationwide tests (see Outcome 1)
Outcome 3 teacher training programmes offer improved curricula and in service training	- nationwide assessments of these training programmes by external experts during so-called 'visitaties' by organisations assigned with this task, such as the VVAO - self-assessments of the teachers of these programmes that serve as input for this 'visitatie' - better equipped teachers of reading and better performing students of these teachers (see Outcome 1 and 2)
Outcome 4 publishers and test developers create testing and teaching materials	- teaching materials and tests are noticeable influenced by the project's results, as visible in the materials and tests themselves, but also by publisher's and test developer's editorial statement
Outcome 5 members of school boards make informed decisions	- decisions are in line with the project's results - decisions are noticeable influenced by the project's results, as visible in references made to published results of the project
Outcome 6 policy makers make informed decisions	- decisions are in line with the project's results - decisions are noticeable influenced by the project's results, as visible in references made to published results of the project

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13   Annex 2: Project overview

Project-level	Objectives	Applicants	Cooperation partners/co-funders
Becoming literate in a digital age: Adapting reading education in the Netherlands	Understand which types of reading education aids individual students, especially those who are at risk of a delay in their development as readers, to acquire the ability to process written information in the digital age Inform the complete knowledge chain (teachers, students, teacher's programs, organisations for the professionalisation of teachers, educational publishers and platforms, organisations supporting literacy, schools, school boards, policy makers) about insights gained in this project, and help implement them	UU, VU, RU, UvA, UnivLeiden, OU, Universities of Applied Sciences Avans, InHolland, Fontys, Amsterdam, Leiden, Utrecht, Rotterdam	IPabo, KPZ, Rotterdam; Graduate School of Teaching Tilburg; VoorleesExpress; Expertis; Noordhoff; CED; Blink; Cito; Staij; Stichting Klasse; BasisBuren; OSG Singelland; IPABO; Levende Talen; INT; Immer, Lexima; Culturele Apotheek; Scholieren.com; Schravenlant Lyceum; Het Zuiderpark College; ProDrachten; Wolfert; ROC Friese Poort MBO; Oberon; WAP; Stichting Lezen; Taalunie; KB; OCW; Expertisecentrum Nederlands
Work packages	**Objectives**	**Applicants**	**Cooperation partners/co-funders**
1A Conceptual model, phase 1 and 3, year 1-7	Study reading comprehensions and reading behaviour acquisition in the digital age, interpret results and design an integrated model. Evaluate use of model developed in phase 1 using the results of phase 2. Improve model in phase 3.	UnivLeiden, UU	Staij, BasisBuren, Stichting Klasse, BasisBuren; Slingeland; Schravenlant Lyceum, Het Zuiderpark College, ProDrachten, Wolfert, ROC Friese Poort MBO, Pabo Leiden, KB, IPABO, Hogeschool KPZ, HvU, Expertisecentrum Nederlands

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1B Educational framework, phase 2, year 1	Study the teaching of reading comprehensions and reading behaviour acquisition in the digital age, interpret results and design an educational framework	UvA, Avans, UU, HvU	IPABO, Hogeschool KPZ, Expertisecentrum Nederlands, all co-funding and co-operating schools
2A Educational intervention: contextualized vocabulary, phase 2, year 2-5	Design, and test educational technologies in relation to research line 1, the model and framework. Gain insight in the developmental nature of the teaching of) reading in a digital age Test key principles of effective interventions for improving (the teaching of) reading in a digital age for children and adolescents	UvA, UnivLeiden, InHolland	INT, Lexima, Woordenaars.nl, Wolfert Tweetalig, Lyceum Schravenlant, KB, VoorleesExpress, ProDrachten, Staij, BasisBuren, Stichting Klasse, Pabo Leiden and Amsterdam, IPabo, Cito
2B Educational intervention: sourcing and engaging, phase 2, year 2-5	Design, and test educational technologies in relation to research line 1, the model and framework. Gain insight in the developmental nature of the teaching of) reading in a digital age Test key principles of effective interventions for improving (the teaching of) reading in a digital age for children and adolescents	UU, VU, OU, Avans	ROC Friese Poort MBO; Het Zuiderpark College (VMBO); CED; Lexima; Woordenaars.nl; Expertis; LitLab.nl; KB; Pabo Leiden and Amsterdam; IPabo; Cito; Scholieren.com; Graduate School of Teaching Tilburg and Utrecht; Graduate School of Teaching Tilburg; Universities of Applied Science Rotterdam and KPZ
2C Educational intervention: reading preferences, phase 2, year 2-5	Design, and test educational technologies in relation to research line 1, the model and framework. Gain insight in the developmental nature of the teaching of) reading in a digital age	RU, Fontys	Immer, ProDrachten, Het Zuiderpark College (VMBO), Cito, Scholieren.com; Graduate School of Teaching Tilburg and Utrecht, Universities of Applied Science Rotterdam and KPZ

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	Test key principles of effective interventions for improving (the teaching of) reading in a digital age for children and adolescents		
2D Educational intervention: shared reading, phase 2, year 2-5	Design, and test educational technologies in relation to research line 1, the model and framework. Gain insight in the developmental nature of the teaching of) reading in a digital age Test key principles of effective interventions for improving (the teaching of) reading in a digital age for children and adolescents	UnivLeiden, UU	Culturele Apotheek, Immer, Lexima, LitLab.nl, Noordhoff, MBO Friese Poort, ProDrachten, Het Zuiderpark College (VMBO), Cito, Scholieren.com; Graduate School of Teaching Tilburg and Utrecht, Universities of Applied Science Rotterdam and KPZ
WP3 Data analysis, phase 1 and 3, year 1-6	Examine long-term effects across development using the learning analytics the educational technologies produce	UU, Avans	OCW, WAP, all co-funding and co-operating schools
WP4 Dissemination, phase 1, 2 and 3, year 1-8	Establish community Disseminate project's output Optimize implementation	Main applicant and all co-applicants	UU, VU, RU, UvA, Leiden, OU, UU; Universities of Applied Sciences KPZ, Rotterdam; Graduate School of Teaching Tilburg; VoorleesExpress; Expertis; Noordhoff; CED; Blink; Cito; Staij; Stichting Klasse; BasisBuren; OSG Singelland; IPABO; Academische PABO Leiden; Levende Talen, INT; Immer, Lexima; Culturele Apotheek, Scholieren.com; Schravenlant Lyceum; Het Zuiderpark College; ProDrachten; Wolfert tweetalig; ROC Friese Poort MBO; Oberon; WAP; Stichting Lezen; Taalunie; KB; OCW; Expertisecentrum Nederlands