Higher education currently faces many changes, some externally driven by government policies and changing patterns of social and economic demand and some internally driven by changes in the way knowledge is produced and organised. Universities are now tending to provide a broader range of instructional methods and, at the same time, students are also expected to undertake more independent learning. Web applications and open educational resources offer unique opportunities for autonomous and collaborative learning, and to customize the learning environment for individual needs. But the processes of online learning and online knowledge management involve issues of complexity and sustainability that students – even at university level – are not always able to cope with. This work presents three research case studies aimed at analysing different ways of dealing effectively with the dynamics of the web. The goal was to determine whether specific activities, tools and environments can enhance the development of skills for lifelong learning, such as the ability to effectively search the Internet, using online resources for continuous education and to manage one’s online presence. Quantitative and qualitative data were gathered within a framework of Personal Knowledge Management and the results are potentially useful both for teachers and learners.

**KEYWORDS:** Higher Education, Personal Knowledge Management, Digital Competence, Lifelong Learning, Research and Information Management.
Introduction

Over the last decades there have been many changes within the Higher Education System, that have involved the transition from a traditional university system, focused on controlled and teacher-directed instruction, to a new framework in which the student is at the centre of the educational system and attaches great importance on autonomous learning. In order to adapt to this new scenario, students need to develop different types of competencies. In this context, the use of applications such as social networks, wikis or blogs are initiatives to improve learning, motivate students and improve their performance. Consequently, considerable efforts have being made to promote the incorporation of ICT in Higher Education.

The impact of new technological practices in universities can be seen right across a spectrum of different activities, from the digitizing of management information, to the use of virtual learning environments (VLEs) and social media in teaching and learning, to the development of digital scholarship in academic research. The nature and scale of this impact varies from institutions to institutions. It is this broad context of technological and structural changes that some scholars (for example, Goodfellow & Lea, 2013) are looking to encapsulate in the concept of ‘digital university’, an emerging context in which “fundamentally different forms of social practice around learning and technologies jostle together and strain the boundaries of institutions and the professional communities who inhabit them” (Goodfellow & Lea, 2013, p. 2).

But the particular challenges that technologies present to learners and teachers pursuing specific goals in particular subjects and discipline can’t be underestimated. The introduction of technologies in the learning process involves issues of complexity and sustainability that students – even at university level – are not always able to recognize and cope with.

In this work, after exploring the research context (the use of ICT at University and the digital competences of university students), we will focus on the notion of PKM (Personal Knowledge Management), i.e. the collection of processes that individuals need to carry out in their daily activities in order to manage their own knowledge management work including gather, classify, store, search and retrieve knowledge (Tsui, 2002). This process is not limited to work-related activities but also the social activities and the necessary skills are to be taught in order to support learners who, as ‘institutional citizens’, need to exploit services and make use of socialization, collaboration and operation areas. We present three research case studies:

– one indirect, based on the ethnographic digital observation and on the administration of a survey to a group of Engineering students at the University of Pisa;
– two direct case studies, concerning activities carried out for three years within two University courses in Udine (Education Sciences) and Pordenone (Multi-media Communication).

We gathered both quantitative and qualitative data about student digital practices. We mapped student ICT uses and analysed quantitative data using factor analysis to reduce the variables. We furthermore analysed student digital tasks.
1. Theoretical Background

1.1 Digital natives and digital competence

Many authors observe that social media are increasingly present in Higher Education in order to allow Universities to (re)connect to a new kind of students (Selwyn, 2012).

As a part of the larger educational environment, technology provides a context that is shaped in part by the ways teachers enable their students to make use of the technological tools. Technological contexts include the actual devices students use and the systems that support these devices. Margaryan, Littlejohn and Vojt (2011) did not find evidence to support popular claims that young people, the so called ‘digital natives’, adopt radically different learning styles. Their attitudes to learning appear to be influenced by lecturers’ teaching approaches.

Furthermore, Gurung & Rutledge (2014) research on the overlapping of student personal and educational digital engagement shows that this overlap is not necessarily positive as portrayed by the prevalent discourses of technology enthusiasts. It has mixed roles – facilitative as well as obstructive. The so called ‘digital natives’ are not necessarily digitally competent (Benett, Maton and Kervin, 2008).

Digital competence is recognised as one of the eight key competences for lifelong learning by the European Union, summarised as ‘involving the confident and critical use of Information Society Technology (IST) for work, leisure and communication’ (EU, 2006). As Ala-Mutka (2011) points out, there are many definitions of Digital Competence and there are many overlapping concepts, such as digital literacy, ICT literacy, media literacy etc. ICT literacy is typically the narrowest digital concept, and mainly concentrated on technical knowledge and usage of computers and software applications. Internet literacy adds to the tool-related knowledge and skills the considerations and ability to successfully function in networked media environments. Information literacy and media literacy concepts largely overlap. However, some different foci can be detected in that information literacy is more about finding, organising and processing information, whereas media literacy is more about having the skills to interpret, use and create media for one’s own benefit and participation. A critical attitude is important in both of them, since they cover both digital and non-digital domains. In the digital domain, digital literacy is the broadest concept and includes the main aspects of the other concepts, and further aspects for using digital tools responsibly and effectively for personal tasks and development, benefiting from people networks.

In the European framework of key competences for lifelong learning (2006)¹, digital competence is a transversal key competence that enhances other key competences (e.g., linguistics, mathematical, learning to learn, cultural awareness). It is related to many of the so-called 21st century skills, which should be acquired by all citizens, in order to ensure their active participation in society and the economy.

There are many different versions of the 21st century skills framework. One is elaborated by OECD (Ananiadou & Claro, 2009) that focuses on three dimensions: information, communication, ethics and social impact. We used this framework to analyse the digital tasks produced by students during our case studies.

1.2 Personal Knowledge Management

This work refers also to a wider area of study, that of PKM (Personal Knowledge Management), i.e. the capability to retrieve information and to use them for learning.

PKM is a concept that has grown out of a combination of different fields as diverse as Knowledge Management (KM), personal information management, cognitive psychology, philosophy, management science, education, communications and many other disciplines.

In the past decade, several scholars – e.g. Frand & Hixon (1999), Avery et al. (2001), Berman & Annexstein (2003), Wright (2005), Zuber-Skerritt (2005), Agnihotri & Troutt (2009), and Jarche (2010) – have developed their model to describe PKM. Their model shared the same assumption that PKM is playing an important role in knowledge management and has benefits to individuals, organisations and social communities.

In the original model of PKM elaborated by Frand and Hixon (1999) PKM competences include: searching/finding; categorising/classifying; naming things/making distinctions; evaluating/assessing; integrating/relating. Later models drew on different tools and identified a complex process that included the ability to manage information derived from the web and its resources.

The notion of PKM is a response to the idea that knowledge workers increasingly need to be responsible for their own growth and learning (Smedley, 2009). According to Pauleen and Gorman (2013), there are five essential and practical areas that an individual must ‘master’ in order to engage in effective PKM: management, learning, communication, interpersonal skills and use of technology. According to Clemente & Pollara (2005), the core focus of PKM is ‘personal enquiry’, i.e. the quest to find, connect, learn and explore. Analogously, Jarche (2010) affirms that PKM allows individuals to take control of their personal and professional development through a continuous process of seeking, sensing-making, and sharing. We based our project activities on this process and on the activities involved in research and information management.

We chose a framework in which competences are divided into two main groups: Basic and Higher Order PKM skills (Cigognini, 2008; Pettenati et al., 2009). The former encompass abilities and skills that can be deliberately learnt and include three macro-competence categories: create, organise and share. The Higher Order skills and competences are grouped into four main categories: connectedness, ability to balance formal and informal contexts, critical ability and creativity.
2. The research

2.1 Goals and Methodology

This work presents three research case studies aimed at analysing different ways of dealing effectively with the dynamics of the web.

The main purposes of the research were the following:

1. to analyse and map which ICT tools students use for learning;
2. to analyse how students’ digital competences can be supported and developed by a range of types of activities;
3. to consider a systematic and integrated use of information and communication technologies to accomplish learning tasks;
4. to provide adequate environments to optimize the processes of personal knowledge management;
5. to choose and test tools in order to design and implement some pilot projects.

In order to answer these research questions we used three research case studies.

In the first indirect case study we investigated on ICT as ‘environment’ for learning, focusing on the notion of PLE (Personal Learning Environment) and reporting the case of a Management course at the University of Pisa, where the institutional VLE – based on Moodle – has been integrated with a student support group hosted on a social network, Ning. A survey was administered (2010, 2011 and 2012) to a sample of 400 first year Engineering students, in order to investigate on their ability to make an ‘effective’ use of ICT for learning. Available data refer to 220 students.

The same questionnaire was also administered during two direct case studies (in 2011, 2012 and 2013). Totally 180 students were involved both in answering the questionnaire and in specific digital tasks. These activities, aimed at the development of basic and advanced PKM skills in students, were carried out within brief courses on Research and Information Management, designed for two different groups of students: a group of first year students of Education Sciences at the University of Udine followed a basic course and was assigned activities aimed at developing PKM basic skills; a group of first year students of Multimedia Communication at the University of Udine (Pordenone campus) was trained for advanced skills. The courses shared contents, learning outcomes (even if at a different level: basic and advanced) and were taught by the same teacher. Actually both courses consisted in a series of brief seminars and various kinds of online synchronous and asynchronous activities in order to test different modalities of learning: blended, purely online, synchronous and asynchronous interactions.

The three case studies are connected: the first one was aimed at the accomplishment of first three research goals; the second and third case studies made it possible to further investigate these areas and, at the same time, to achieve the fourth and fifth research goals.
2.2 Questionnaire on ICT Uses for Learning

To investigate on the use of ICT tools (both hardware and software) for learning we used a translation of the ELRC (E-learning Research Centre) questionnaire approved by JISC (Joint Information Systems Committee), a British institution that monitor the use of digital technology in the UK. The questionnaire includes 20 questions. Some of them required students to map their learning activities (12 typologies) with 36 tools. Specifically students were asked to link specific tasks (i.e. communicating with students; communicating with tutors/teachers; doing a learning task collaboratively; doing a learning task individually; gathering information; viewing course material; writing an assignment etc.) with the tools they used: **hardware** (for example: laptop, iPad or Tablet pc, digital audio etc.); **online communication tools** (chat rooms, emails, blogs, wikis etc.); **online learning facilities** (search engines, videoconferencing tools, virtual learning environments, etc.); **specialized software** (spreadsheets, word processor, power point, simulation software etc.).

2.3 Face-to-face and Online Synchronous/Asynchronous Activities

In the two direct case studies students, besides answering to the questionnaire, were asked to follow brief courses on specific subjects, in different modalities. The students in Udine, which participated in 2011 in a special laboratory for Online Research, were divided into three groups: one group attended in classroom, one group followed online and the third group followed in a blended way (both in presence and online). Online asynchronous activities were proposed for the three groups, with a different rhythm for each group.

In Pordenone the seminars were carried out in 2012 and in 2013 within the course of *Englihes and Media Communication in a World Context*. The course was blended: students were present at the University with the English course teacher; brief synchronous seminars were carried out online and students were asked to perform assigned tasks both at University (using the wifi network) and at home.

The courses lasted each 20 hours, including brief seminars and activities. At the end of the course, students were expected to be able to: 1. search Google effectively and precisely, by customizing it; 2. know when to use other search engines and web directories; 3. evaluate what they find on the web; 4. create their own PLE; 5. make an effective use of resources found on the web.

2.4 Digital Tools and Digital Tasks

We tested different tools and different kind of activities. The main idea was to provide an overview of useful web tools for learning, a series of practical references and a ‘toolbox’ to be used in different contexts (at university, but also self-learning and professional training).

Two wikis were used as ‘hubs’ for all the activities and the content: 1) [http://dottoratoudinesperimentale.pbworks.com](http://dottoratoudinesperimentale.pbworks.com); 2) [http://pordenonestm.pbworks.com](http://pordenonestm.pbworks.com).

During the course different tasks were assigned to be performed either during the lessons (using the wifi area of the University in Pordenone) or at home (in-
intermediate project works for students both in Udine and in Pordenone). Among the first ones: brainstorming to choose good search terms; categorizing the search terms and create a Mind map of the search; search quizzes; analysis of web results and evaluation of credibility of websites; creating a personalized search engine using Google CSE. The intermediate project works included searches on YouTube, on iTunes, on Twitter; creating a Facebook page or a Facebook Group on a positive social or cultural initiative; using delicious to collect bookmarks on a specific topic etc.

For the final assessment students were asked to prepare – in group of 2-3 people – a multimedia piece of work (a presentation, a short video, a website, a wiki, a poster, etc.) choosing among one of these three tasks: My digital identity, i.e. a presentation on their data on the web and on the way to manage their online reputation; PLE description and design, a description of the web technologies used for personal and academic purposes; Spreading good news. Internet branding for no profit initiatives, i.e. the application of corporate branding techniques that could help make a small no-profit initiative more popular on the web.

2.5 Data Analysis

In the three research case studies we gathered both qualitative and quantitative data. The data refer to 400 students, in different cities and studying different disciplines. Quantitative data were gathered through a questionnaire in all the three case studies; for the direct case studies there were also intermediate and final tests on acquired knowledge and project works produced by the students. We also gathered secondary data, such as feedback on the course, through interviews with the students and their teachers.

In Cinque (2013) the detailed description of data gathering and analysis is presented and discussed; here we summarise some of the main findings, such as:

- a map of students ICT uses for different clusters of learning activities;
- a Factor analysis which was carried out to reduce the variables and identify the main areas of ICT uses for learning;
- the analysis of digital tasks, i.e. of the project works produced by the students participating in the second and third case studies.

3. Some results

3.1 Mapping ICT Uses

As mentioned before, for the ICT use, students had to map their learning activities (12 typologies) with 36 tools.

In the analysis of these data, we created dichotomies for each category of tools. Hardware was divided into three sub-groups: 1.1 audio (Au) / video (Vi); 1.2 mobile (Mo) / desktop (Fi); 1.3 input (In) / output (Ou). Online communication tools included two sub-groups: 2.1 synchronous (Sy) / asynchronous (As); 2.2 sharing (Cn) / social network (SN). Online learning facilities are represented by one group: 3.1 closed systems (Cl) / open source (Op); specialized software is
Activities were grouped in the following tasks: assimilative task (reading from a text book, listening to course material, revising for an exam etc.); information handling task (gathering information, managing information, oral presentation, self-assessment etc.); organizational task (planning a group activity, planning an individual learning task etc.); communicative task (communicating with students, communicating with tutors/teachers etc.); productive/experiential task (writing an assignment, doing a learning task collaboratively or doing a project work).

A further step consisted in mapping activities and tools on the Cartesian plane consisting of two perpendicular axes representing: productivity (concern for results); relationality (concern for people). On the diagonal the learning axe is represented (see figure 1).

As far as hardware is concerned (blue group), we can say that while for productive tasks ‘traditional’ tools (audio, desktop, input devices) are prevailing, relationality allows for a more variegate usage. We put together two groups (online communication tools and online learning facilities: red group) and we observed that among ‘relational oriented’ usages there is a prevalence of synchronous tools, of social networking sites and, partially, of open resources. As far as specialized software is concerned (green group), no differences are evident between the two areas (relationality and productivity) and in both cases ‘passive’ functions (retrieve) and usage of well-known software (Office) prevail.

3.2 Factor Analysis

Following a recent study approach (Valentín et al., 2013), in order to identify the different ICT uses and to reduce the number of variables, we performed a factor analysis of principal components with Varimax rotation on the use of ICTs. This
allowed us to establish four factors (Table 1): factor 1 is related to communication among students (forums and chats), surfing the Internet and the consultation of newspapers and magazines (Social Use); factor 2 comprises four elements related to the use of professional tools such as databases, web page design, etc. (Technical Use); factor 3 is composed of indicators related to office software use such text processors, slide presentations, etc. (Academic Use); factor 4 comprises e-learning Software Platforms and e-mail (Platform Use).

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<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>1. Use of text processor</td>
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<td>2. Use of spreadsheets</td>
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<td>3. Use of e-mail</td>
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<td>4. Use of data bases</td>
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<td>5. Use of image editing</td>
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<td>6. Use of web page design</td>
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<td>7. Use of presentations</td>
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<td>8. Use of multimedia materials</td>
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<td>9. Use of browsers</td>
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<td>10. Use of chats</td>
<td>.837</td>
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<td>11. Use of forums</td>
<td>.833</td>
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<tr>
<td>12. Reading of online newspapers</td>
<td>.676</td>
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<tr>
<td>13. Use of Moodle</td>
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Table 1. Matrix of factor saturations of the variables related to the use of ICTs

3.3 Analysis of Digital Tasks

Some issues connected with the project works carried out during the course were discussed in classroom and received qualitative feedbacks. For the final project works we based on the OECD framework (Ananiadou & Claro, 2009) and created indicators basing on the three dimensions: information, communication, ethical and social impact.

Following an OECD study we identified three dimensions and six sub-dimensions.

The first dimension, information, concerns both information as a source (examples of skills and competencies belonging to this sub-dimension are information literacy, research and inquiry and media literacy) and information as a product (skills that belong mostly to this sub-dimension are creativity and innovation, problem solving). The second dimension, communication, includes the following sub-dimensions: effective communication (information and media literacy, critical thinking and communication are skills that belong to this sub-dimension) and collaboration and virtual interaction (collaboration/team working, flexibility and adaptability are examples of skills that belong to this sub-dimension). For the third dimension, ethics and social impact, the following dimensions are important: social responsibility (critical thinking, responsibility and decision
making are skills that are related to this sub-dimension) and social impact (these skills and competencies are often referred to as belonging to digital citizenship).

For every sub-dimension we identified actions. We finally exploded the different actions in ‘behaviours’. Large tables (Cinque, 2013) were used to represent the results related to this kind of evaluation, which highlighted different kind of ‘behaviours’.

For example, the indicators concerning the first sub-dimension (1.1 Information as a source) are the following:

- 1.1.1. the student understands and then clearly defines the information needs on the basis of a question, issue or task;
- 1.1.2. the student knows how to identify digitally pertinent information sources;
- 1.1.3. the student knows how to look up for and select the digital information required in an effective and efficient way considering the problem to be solved;
- 1.1.4. once the information has been found, the student is capable of evaluating how valuable and useful the source and its contents are for the task at hand;
- 1.1.5. the student is able to store and organize the data or digital information efficiently so that it can be used again.

Examples of skills and competencies belonging to this sub-dimension are information literacy, research and inquiry and media literacy.

Different indicators were used for the evaluation of group tasks. Some groups limited to search the web in order to find useful and relevant information from authoritative sources. Other groups were able to edit and share the information found in original ways, using ICT tools. Although we could not monitor the process of group work, from the results we could find evidence of the type of communication and interaction that the members of each group had implemented.

Finally, considering both the contents and the presentations of some works, it became evident if the students had set themselves or not the problem of a responsible use of the network – at a personal and social level – recognizing the potential risks, and the need for rules that could promote appropriate social interaction on the web. In particular, those groups that had created branding initiatives for non-profit organizations demonstrated the ability to consider the social, economic and cultural rights for the individual and the society of the network and took in considerations the challenges and opportunities of the new digital era.

Conclusions

Stop and Rewind

For the final project work a group of students chose to create a website, a presentation and a video Against musical piracy. In the video there is a young boy that tries to obtain ‘easily’ whatever he wants, including the most recent video and audio files, downloading them from illegal websites. But suddenly the video ‘rewinds’ and a voice comments on the risks and problems of musical piracy. This
work represents very clearly the general sense of the project: that is to convince students to make a ‘rewind’, i.e. to reflect on their digital practices. Being born or grown digital does not mean to be digitally competent. Students need to reflect on the way the use technologies in order to use them in a critical, creative and ethical way.

Many students chose to reflect upon their digital identity, taking into account all their data on the web (both formal and informal data), all the ‘traces’ left on the web (in social networks, blogs, forum etc.) and tools and strategies to manage their reputation and protect their digital data. It emerged that identity is an elusive concept, with no single clear definition. It is used in many different contexts and for a variety of purposes, ranging from authenticating to a bank to be allowed access to our money, to our understanding of who we are within a community. The social aspect is an essence of identity and this is why the management of one’s reputation on the web is a key issue.

Digital practices

The questionnaire and the assignments were designed to stimulate students’ reflection on digital literacy issues in their practice.

Analysis of the quantitative data across the different subgroups reveals a number of interesting results, which give us a valuable insight into students’ current practice in using technologies and their experiences. The data show that students are using a range of different types of learning strategies, appropriating the tools to meet their own needs in relation to the kind of activity they are performing. On the other side, our study confirms once more that there is a gap, a ‘dissonance’ between the ‘officially prescribed’ learning technologies and the way in which students use technology outside the classroom.

It is significant that only one group – in the two years – decided to describe their PLEs. This probably means that the concept of PLE is more a ‘theoretical’ construct than a useful tool for students.

The need for designing adequate technology enhanced learning environments has often been stressed in pedagogical literature and in teaching practices. This means, on one side, that tools should not be selected on the base of their availability and of teachers’ preferences, but to meet specific learning needs. We need to ‘rethink’ about our teaching through the lens of the technologies used by our students. We also discussed some of the ways in which students can operate as change agents in this area to improve not just their own digital literacies but those of other students, and of teachers and other members of University staff.

Environmental conditions and learning behaviours

The three case studies demonstrated that the acquisition of digital and PKM skills depends from personal and environmental conditions, from the decisions that both educators and the learners need to make to engage successfully in learning and from the characteristic behaviours of effective adult learning.

The map of ICT tools used by students for learning goals shows that ‘traditional tools’ (i.e. desktop, asynchronous tools, ‘passive’ functions and well-known software) are preferred when the focus is on productivity, while the stress on relational aspects lets a more variegated usage emerge. The Factor analysis demon-
strated that two of four identified areas are connected with University usage, i.e. Academic Use and Platform Use. This means that the tools available in their University and selected/used by their teachers model the majority of students’ uses. As a matter of fact, an integration of PLE (Personal Learning Environment, a concept that is quite ‘new’ for students) with the ‘institutional’ VLE, as illustrated in the first case study, is needed for an effective PKM, since the educational, technological and social aspects must integrate.

In the design and implementation of the courses, we considered a systematic and integrated use of information and communication technologies chosen to provide adequate environments and to optimize the processes of personal knowledge management. As the analysis of digital tasks shows, specific learning ‘behaviours’ were the expected outcomes of these activities, aimed at the development of many skills, far beyond the mere digital ones. Among these skills: creativity and innovation, problem solving, critical thinking and communication, collaboration/team working, responsibility and decision making, digital citizenship.

University students PKM

In the ‘knowledge society’ University students should not only learn the knowledge, but learn how to acquire knowledge, how to manage knowledge, how to ‘use’ knowledge, in order to face the pressure and challenges of transition to employment status. PKM is an emerging discipline and represents an important aspect both in University education and for lifelong learning. From the perspective of University teachers interested in enhancing in their students a PKM strategy, the following questions are crucial:

- How do students view their knowledge/learning and how do they learn and manage information?
- How can students, as ‘future’ knowledge workers, maintain knowledge currency in rapidly changing environments and anticipate the inevitable changes in environmental conditions?
- How do knowledge workers rise above the role of mere information-or-knowledge-processors?
- Can they become knowledge forecasters, brokers and creators?

We need to prepare today’s students for tomorrow’s challenges to let them become aware citizens, fully independent in accessing and using resources, tools and features of the ‘digital society’.

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