Theory of Digital Natives in the Light of Current and Future E-Learning Concepts

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***Abstract*—The digital generation has many names: Net Generation, Generation@ or Digital Natives. The meaning behind these terms is, that the current generation of students is digitally and media literate, technology-savvy and are able to use other learning approaches than former generations. But these topics are discussed controversial and even the cause-effect-relationship is not as clear as it seems. Did the digital generation really have other learning approaches, or do they have only the possibility to live other learning modes? Against this background this article tries to shed some light on this debate. Therefore we use current and future projects performed at RWTH Aachen University to illustrate the relevance, value and significance due to the theory of the digital natives.**

***Index Terms*—Digital Natives, Net Generation, Web 2.0 knowledge map, simulation games**

I. INTRODUCTION

The digital generation has many names: Net Generation, Generation@ or Digital Natives. The meaning behind these terms is, that the current generation of students is digitally and media literate, technology-savvy and are able to use other learning approaches than former generations.

Based on these conceptual and theoretical constructs the Institute Cluster IMA/ZLW & IfU of the RWTH Aachen University does steady research for some years. One of these investigations refers to Web 2.0 applications in the form of a Knowledge Map and is used in an academical setting of a lecture. Another approach encompasses the development of a simulation game portal that will be also used at the RWTH Aachen.

In this article these approaches will be highlighted namely in the context of Prensky's theory of the Digital Natives and Digital Immigrants. For this purpose we will give an overview about the theory of the Digital Natives and Digital Immigrants. After that we will mirror the theory in the context of our research efforts.

II. DIGITAL NATIVES IN CONTRAST TO DIGITAL IMMIGRANTS

A. Short overview about the digital generation

They are called Net Generation ([1]), Generation@ ([2]) the Millenials ([3]), Homo Zappiens ([4]; [5]) or Digital Natives ([6]) and they have in common that they are digitally literate, technology-savvy and appurtenant to a generation which populates the lecture rooms - currently and in future.

Despite may authors support the theory of a current digital generation there are a lot of critical voices. The criticism is inter alia directed at the designation as one generation, the lack of a unique definition and its weak empirical foundation (cf. [7]). Nevertheless the following aspects form an integral part in the different approaches and theories mentioned above and other publications:

- First, the digital generation is born after 1980.
- Second, since their early childhood the digital generation is closely connected with and socialized by digital media and information and communication technologies such as TV, video games, computer and later the internet and mobile communication.
- Third, the digital generation has a different learning approach than former generations, e.g. non-linear learning or multi-switching and multi-tasking.

In this article we will focus on Prensky's ([6]; [8]) notation of the digital generation as Digital Natives. He defines the Digital Natives as "native speakers" of a digital language (ibid. [6]). However, Prensky has not only considered the younger generation; he has also concentrated on the parental generation, which is not original digital – this generation is named „Digital Immigrants" (ibid.). This dichotomous notation allows us to focus on and to analyze these two different groups in the next chapter.

B. Digital Natives und Digital Immigrants[1]

The following remarks will picture the Digital Natives' and Digital Immigrants' specific characteristics in general and their learning modes in particular separately. Therefore the following questions will be answered:

What are the Digital Natives and for what - that means which characteristic properties - talents and abilities this concept stands for? Who are the people which do not fall into this category, and for what reason? What are the Digital Immigrants?

1) Digital Natives

The term Digital Natives[2] goes back to Mark Prenky ([6], [8]). As mentioned above Digital Natives speak a digital language[3]. In this context a digital language means the "language of computers, video games and the Internet" ([6]).

The concept of the Digital Natives implies that todays students are more familiar with new information and communication technology (further: ICT) than former

[1] As an alternative notation Schomburg [24] has chosen the terms "Digital Residents" and "Digital Visitors". But the naming with "Digital Native" and "Digital Immigrant" is the mostly used one.

[2] Already in 1997 Don Tapscott has used the term Net Generation resp. Net Kids [1]

[3] The question is: What is the digital language?

generations. The early and intensive experience with digital technologies affects the ways of learning, working and communication (cf. [7]).

But as Prensky states this is not only a superficial phenomenon; the intensive use of information and communication technology, the digital input they receive day by day causes a change in thinking patterns of the students today (cf. [6], [8]). This is attributed to the fact that the students socialization today is vastly different from the socialization of their parents – above all due to the technological development.

The Digital Natives were born after 1980[4]. This dating is no coincidence, as it marks the emergence and expansion of information and communication technology and the penetration of those technologies in all social areas and individual spheres of life. The persons born from this period on are related to ICT in a special, a close way and have an in-depth understanding to use digital technologies (cf. [9]). The Digital Natives spend a lot of time with digital technologies. This also implies, that digital media has a significant impact on the identity formation and the personal development. Furthermore they are highly connected and prefer acting in networks (keyword: peer-orientation). They manage their contacts digitally, are always available, always online using the internet or recently the mobile phone and smart phones. Students acting in this way have also another, a non-linear handling in searching, producing, evaluating and using information and knowledge (cf. [9]). The emergence and the early and increased usage of ICT are also linked with other learning modes, that mean linear learning modes are expanded through non-linear, linked learning modes by using computer-based-, web-based-trainings or blended learning systems (cf. [10]) In this regard visual presentations become more important. Thus, the self-evident use of new digital media in the younger generation causes a changed learning culture and learning behavior (cf. Kuhlmann/Sauter 2008:8). As Prensky stresses, one finding is that "[t]hey (Digital Natives, S.F.) prefer games to 'serious' work" ([8], emphasis in original). It is noteworthy that not only the current generation but also former generations are more likely to learn and work with playful elements. So this statement needs to be discussed further down.

In this context the proponents of the Digital Native theory ask for fundamentally new didactical-methodical teaching contents and concepts on the ground of a young growing generation with changed learning habits.

2) Digital Immigrants

The generations who have not grown up with and are not used to digital technologies but take on recent technology applications like email, instant messenger or social networks in both their everyday and working world, are called digital immigrants.

Presky gives some examples to clarify the digital immigrant's peculiarities: "They include printing out your email […], needing to print out a document written on the computer in order to edit it […]; and bringing people physically into your office to see an interesting website […]" ([6]).

[4] 2009 Don Tapscott identifies Americans in the age of 11 to 31 as the Net Generation (cf. [25]).

What makes this group so special is – as with all immigrants – that they gradually adapt the language and the culture of the target society over a shorter or longer, more or less intensive time, but keep a foot in the home culture (cf. [11]; [12]). In our context, immigrants have to adapt the language of the information society but always retain in the pre-digital age – this is what Prensky ([6]) called "digital immigrant accent" (ibid.). The language differences – as Prensky continues - between the Digital Natives and the foreign-language, digital immigrants induce misunderstandings. Especially in educational institution, where Digital Immigrant instructors bounce against a population with "new" interaction, communication and learning methods it becomes obvious. With the dichotomous construction of Digital Natives and Digital Immigrants Prensky criticizes traditional learning methodologies. In this interpretation linear learning modes using a step-by-step logic and lectures are no longer contemporary.

But the main reason to implement digital information and communication technologies in educational institutions should not be the fact of the assignment of a special generation as "Digital Natives" that is believed to have other learning modes. It is rather a value in itself and the expectation of advantages and benefits, it is the opportunity for mobile, time-independent and user oriented learning environments given by innovative technologies.

Thus, ICT is able to optimize current teaching contents to reach a methodological-didactical rearrangement and to keep ready a lot of advantages – for so called Digital Natives at the universities but also for Digital Immigrants.

III. TWO E-LEARNING TOOLS FOR DIGITAL NATIVES

According to the thesis of the Digital Natives, universities are well advised to adjust their educational offerings towards the requirements and needs of this new target group. Within the world-wide research also the Institute Cluster IMA/ZLW & IfU of RWTH Aachen University has answered the call and has developed and implemented new communication and information technologies, such as Web 2.0 applications, in the area of teaching for some years. With digital applications, the IMA/ZLW & IfU is convinced to support the students learning behavior and to improve the academic teaching. Thus, the following chapter presents two applications developed in the Institute Cluster; the first one, a Web 2.0 knowledge map, is used actually in a lecture; the second one, a simulation game portal, is currently under construction and will find the way to the teaching conceptions shortly. Both case studies will be firstly portrayed against the background of the theoretical foundation of Digital Natives and will be discussed secondly with regard to their relevance in academic settings.

A. Current: The Web 2.0 Knowledge Map

In 2010 the knowledge map received the "Runner-Up"-Award in the field of blended learning of the International E-Learning Association.

The knowledge map is currently characterized by four main topics. The knowledge map…

… is developed for Digital Natives.

… visualizes explicit knowledge in a non-linear way.

… comprises semantically linked content.

… is continuously developed further.

These main topics will be elaborated in the following paragraphs.

Based on the idea of the Digital Natives and was developed in the project WeKnow (2005-2007). This project focused on research for a method to transfer knowledge from experts to members of the "new generation" – the Digital Natives. Here, a web-based knowledge map has been constructed. The basic idea of the knowledge map is to realize a non-linear learning approach by a semantic net. As described in the second paragraph, non-linear learning approaches are definitely relevant for Digital Natives.

Since its implementation, it is used and evaluated in the blended learning concept of the lecture "Computer Science in mechanical engineering" at RWTH Aachen University with more than 1200 students each term. The concept of the lecture contained a traditional lecture, a lecture accompanying exercises (called project task) and additional exam-preparation exercises. The knowledge map is one of the additional provided online-tools. There are also a Wiki called "eClara" and a forum called "Messageboard".

Similar to a map with visualizations of geographical indications as for example the location of cities and countries, the knowledge map visualizes explicit knowledge. Stocks of knowledge are linked together semantically and structured so that individual knowledge profiles of the experts are formed (cf. [13]). To disclose tacit knowledge, i.e. of empirical knowledge of experts the storytelling method was used (cf. [14]). This narrative method uses interviews to make tacit knowledge explicit (cf. [15]) which is particularly well suited to document important details and knowledge of experts. Thus, the transfer of process and experience-based expertise in-depth, scientifically knowledge is possible.

Course contents are semantically linked allowing the learners to "browse" through related content. In addition, the teachers, including contact details as a contact person and experts are represented inside the semantic net for certain teaching areas. The following figure (see figure 1) shows a portion of the structure of the knowledge map underlying semantic network in the university use.

Currently, the knowledge map is developed in the EU-founded project "Responsive Open Learning Environments" (ROLE, 2009-2013). In this project, the knowledge map is transformed from a standalone tool into a learning environment composed with different "Widgets", like a chat- and a history-widget. Widgets are important components of modern graphical user interfaces. The widgets are small programs with different functions provided by different websites. The user is able to select and arranged them individually.

1) Main results of the usage of the ***Web 2.0 Knowledge Map***

The user group of the knowledge map in the context of the lecture computer science in mechanical engineering is currently relative homogeneous, but relating their gender and (due to the change to Bachelor/Master-System with many new graduates) field of study it seems that the group is going more heterogeneous in future. From the homogeneity of the group we can consider these students as one group. This fact is helpful for every implementation of new tools. They are mostly male and on average between 20 and 22 years old (in 2010: 89.08%). The students are in

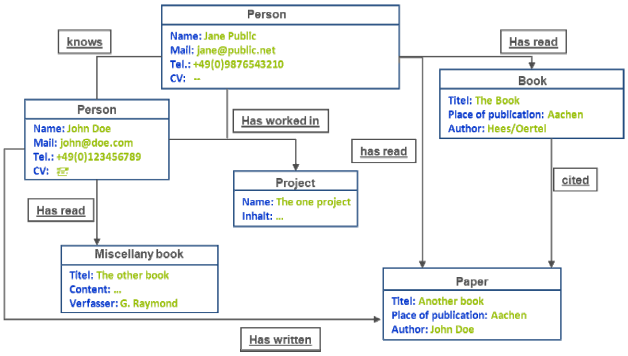

Figure 1. Snipped of a semantic net

the first or second semester (in 2010: 90.53%) and study almost exclusively mechanical engineering. One possible explanation for the high proportion of men in the user group is provided by Schulmeister [16]. He noticed that during childhood and youth men are more likely to use technical devices measured by the usage of video games, Gameboy and computer. It can therefore be deducted that the user group is probable highly technology-savvy and is suitable into the group of Digital Natives.

One main result of the survey at the end of each summer term is that the user group often uses pictures, video and audio files and animation in the context of the knowledge map. This supports the thesis that as described above Digital Natives often uses visual and auditory content. Furthermore the students answer that the usage of the knowledge map supports their dealing with e-learning tools as well as networking and – wherefore it is used – discipline-specific content. This shows that a lot of students use online tools for networking and subject-specific learning contents and recognize the benefits.

A significant amount of students have pleaded for various modifications of the knowledge map in different dimensions. Concerning the content the students want more simple examples, pictures and animations. Concerning the conception of the knowledge map the students animate us to look for more personalization of the knowledge map. This confirms the thesis that the new generation (Digital Natives) like visual and animated content for learning. But the requirement of such elements needs to be investigated in further research studies. We take into account this last mentioned request of the students by participation the EU-project ROLE where new techniques for those "Responsive Open Learning Environments" will be developed and tested.

One remarkable finding is that several learning channels and information structures are used. Beside the digital media, like the RWTH Aachen University learning portal L2P and other internet-sites (Google, Wikipedia, Wolfram Alpha, etc.) also traditional learning materials like books, scripts, a pen and an eraser are used. This finding suggests a coexistence of different learning models; the assumed homogeneity of the Digital Natives bears traditional traits and reveals more heterogeneous elements than one might expect at the first glance.

B. Prospective: RWTH Academic Simulation Game Portal (ASiGo)

The current critic of the "German Chamber of Industry and Commerce" (DIHK) displays that the education of German universities is too theoretical ([17]). According to

the underlying questionnaire the main reason for layoffs inside the trial period is the inadequate implementation of technical knowledge into business practice. In the context of the German excellence initiative it is the duty of RWTH Aachen University to convey more practical teaching experience. One approach to improve the situation is the development of a new portal for simulation games. The objective of this project is to support and to intensify the theoretical content of different lectures by simulated practical experiences. Other objectives are to strength on the competence in the students' group- and project-work and to make task roles and problem-solving strategies tangible for them. Students should also learn to recognize of interdependencies of complex communication processes.

RWTH University will use the new portal with a simulation game for the lecture "project management for physicists" in the summer term 2011. The structure of the game follows the structure of two previously developed simulation games called "Q-Key" [18] and "Micro-Key" [19]. These two games are board games and are played with five persons in a face-to-face situation.

As the students who are listening to the lecture are "Digital Natives", to use a web-based portal is a good approach to transfer the theoretical content into simulated practical experiences. Furthermore the students will learn to work together in virtual groups. This includes that they learn more about the dynamic of groups especially of virtual groups. Hereby the students learn to manage projects where no face-to-face communication is possible and necessary. The simulation game makes it possible to simulate working and situations detached from time, space and face-to-fact-interaction. The students which should use the simulation game additional to the lecture have the option to call a planned or spontaneous (virtual) meeting.

Furthermore the students learn to work in virtual working environments where they must cooperate in a virtual way, like using email, Instant Messaging, etc. oriented towards the ruse of this specific stetting. Through this the students learn to use - so far used private – communication tools in a simulated working area.

Another aspect is that in a real and concrete project no one is able to overlook the whole project with its high complexity in all details. In a face-to-face *board based* game it is not possible to simulate the complexity and contingency. This is caused by the conceptual model of a broad game where for each team member a situation is pictured on one board. In this respect the simulated *online* game is a more realistic portrayal of the complex situation in that project management takes place.

Due to the experiences from the surveys of the knowledge map a new platform should not be developed especially for the Digital Natives, because not all users born after 1980 are familiar with ICT on the same level. Thus ASiGo provides learn chances for Digital Natives and Digital Immigrants. Digital Immigrants can – beside the mediated content – e.g. train their usage of modern information and communication techniques – skills which are highly appreciated and in great demand. Since several years simulation games are used to teach practical experiences in a protected environment, to promote cross-linked, integrated thinking and a more practical dealing with complex problems [20]. These traditional targets of simulation games are also targets of ASiGo. Even the field of adult education and training offers many links, e. g. when setting up a business or with regard to further education on distance universities.

IV. OUTLOOK AND SUMMARY

The remarks above show two things very clearly: Firstly, the dichotomous usage of the designations Digital Native or Digital Immigrant has some difficulties ready in its exclusivity. This dichotomy is useful with regard to analytical proposes, e.g. to develop new teaching or learning concepts. But one has to consider that is does not mirror the reality. Secondly within and between these two groups various nuances are probable. For the Digital Natives this is verified by the described research results as well as those of other authors [7]. For the Digital Immigrants further, especially empiricalresearch is needed. By developing new learning concepts the heterogeneity of these groups has to be taken into account.

As the results depicts within the Digital Natives non-linear and linear learning modes coexist. This is also verified by other authors (cf. [7]). The addition of non-linear to linear learning modes is related to new opportunities given by digital media.

Another aspect refers to the knowledge concerning the usage of digital media. It is known from the literature (cf. [16]; [7]) that many Digital Natives do not have the digital and technological background knowledge. Furthermore it is not certain whether a "digital language" really exists. It is also questionable whether it is necessary to speak this language or whether it is sufficient to understand the language. The latter seems to be the case. Both the existence and nature of a digital language and the relationship between technological background knowledge and pure application know how deserves a closer attention.

A further important aspect aims at the process of identity formation (cf. [21]). Digital media play a not to be underestimated role in the formation of the (juvenile) self. There are allegations that Digital Natives have at least one real identity and one online identity (cf. [9]). But the relationship between potential online and "offline" identities have not been supported enough by research at all.

Moreover playful elements in learning and working settings are relatively old. In western societies games (chess) exists since 800 before Christ [22]. So it is most likely that games have always been playing an important role at least in a learning context and not only since the emergency of the Digital Natives. This does not preclude implementing more playful (and digital) elements in learning and working environments.

With regard to the vision of lifelong learning [10] digital learning methods like e-learning concepts are attractive for both Digital Natives and Digital Immigrants. Because lifelong learning goes beyond the school career, studies and education approaches and solutions are necessary. Innovative and digital learning applications pave the way for a competitive and well educated knowledge society.

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