# Millennial and Centennial Student Interactions with Technology

## Implications for Student Learning

Linda Crearie
School of Engineering and Computing
University of the West of Scotland
Paisley, Scotland, United Kingdom PA1 2BE
Linda.Crearie@uws.ac.uk

**Increasingly students spend a considerable amount of time online. Technological advances over the last few years have meant dramatic increases in the use of various technologies such as personal mobile devices, agent-based technologies, and advances in pervasive/ubiquitous computing. Social networking has led to enormous changes in the way students use the same technologies for both academic works and personal use. Recent advances in mobile technology, especially smartphones, with facilities such as Cameras, GPS tracking, and sensors has allowed constant access to the Web for many users. The widespread use of apps such as Facebook, Twitter, Skype, Instagram and many other specialized tools has also impacted on user experiences in this area. The smartphone is now a powerful personal computing device providing access to interactive services wherever you happen to be and the device of choice for many students.**

***Keywords- Millennials; Centennials; Natives; Immigrants; Visitors; Residents; online activity; Human Computer Interaction (HCI); smartphones***

## I. INTRODUCTION

Students may still attend face-to-face lectures, tutorials and practical sessions at University but may also be expected to be online, for example, to use a Virtual Learning Environment (VLE) such as Moodle, and other social media such as Facebook, YouTube, Linkedin, Twitter, and many others to enhance their learning. The distinction between technologies for learning and personal social activities is blurring, and many students may find that they are living a large part of their lives 'online'.

The UK Higher Education Academy (HEA) project HEA 'Working with new forms of online practice in the disciplines: the challenges of web residency' will be discussed in this paper with an emphasis on Computing. The other disciples or clusters under consideration in the project included Arts and Humanities, Social Sciences, Health and Social Care, Science, Technology, Engineering and Mathematics (STEM). The aim was to map student engagement with the web to better understand how advances in technology have impacted on students.

Initially, the team at UWS focused on undergraduate and post graduate students. However, much of the literature on different generations suggests that it may be worthwhile investigating this further given the fact that most of our students are Millennials at the moment but in a very shortly this will be Centennials. A better understanding of our students is always welcome but particularly since technological changes are having such a massive impact on student online behavior.

A recent article in the Telegraph [2] suggest that young people aged between 16 and 24 have increased their level of online activity to such an extent that they are now spending more than 27 hours a week on the internet. At least 2.5 hours every week online are spent *while on the move* - away from home, work or place of study. In general, twice as much time is being spent online compared to 10 years ago, but for 16–24–year-olds there is a five-fold increase. Ofcom research [3] suggests the following:

- Computers are still the primary device for accessing online content
- Tablet and smartphone use has been steadily increasing
- Two-thirds of adults now regularly use a smartphone to watch video clips online and play games
- Instant messaging use increased to 42% in 2014. This was driven primarily by services such as WhatsApp, Facebook, Messenger, etc.
- ¼ of internet users regularly use catch up services to watch TV and films online. This rises to 39% for 16-24-year-olds.

New technologies are opening up a myriad of other possibilities for young people: not just watching content, but messaging friends, texting, etc. at the same time. 80% of social media users log into these websites or apps including Facebook, Twitter, LinkedIn, Instagram and Tumblr - at least once a day. The Pew Internet Project's research on social networking in the US [4] estimates in Jan 2014:

- 56% users either "creator" or "curator" categories, 32% are both
- 46% users are "creators" posting original photos and materials
- 41% internet users are "curators" reposting material found on the web

## II. WHO ARE MILLENNIALS AND CENTENNIALS?

These terms are used extensively in the media. However, definitions are rather difficult to pin down since experts often use slightly different meanings. Kate Meyer [5] definition, when she examines millennials as digital natives (those who grew up with access to digital communications technology), is:

'*A Millennial is broadly defined as someone who became an adult around the year 2000'*.

Centennials are the generation following Millennials as illustrated below in Table 1.

TABLE I. STUDENT GENERATIONS

| **Generation** | TABLE II. CATEGORIES OF GENERATIONS | | |
|---|---|---|---|
| | ***Birth Date*** | ***Age at 2017*** | ***Factors*** |
| Centennials, Generation Z, Gen Z, or iGen | The 2000s to today | 0–17 | Bon in social media era so tend to live much of their lives interacting with friends/family via smartphones. Higher levels of technology are making significant inroads in academia allowing customized instruction and data mining of student histories to enable pinpoint diagnostics and remediation or accelerated achievement opportunities. |
| Millennials, Generation Y | 1980—2000s | 17–37 | Millennials have matured in a time when the world they live in has seen dramatic technological change. Many used texting and instant messaging as their preferred mode of communication, often from an early age. Smartphone adoption among these students has increased substantially, and mobile access to the internet is pervasive. |
| Generation X | 1960s-1980 | 37–57 | They are also known as "Lost" generation or "latchkey" kids, and are the first group who grew up with household computers. The gave us Google, YouTube, and Amazon, among others. |
| Baby Boomers | 1946—1964 | 53–70 | Initially, described those born in the aftermath of World War II. Boomers 1:1946-54, Boomers 2:1955-65. Familiar with technology and used to this enhancing their lives – but wary of broad impact on society |

## III. WHO ARE DIGITAL NATIVES AND IMMIGRANTS?

Digital natives were born after the widespread adoption of digital technology and refers to those who have grown up using computers, mobile devices and the Internet. The term was first used by Marc Prensky [6] in Digital Natives, Digital Immigrants Part 1.

A Digital Natives can viewed in the same way as a "native speakers". In this context the language relates to the digital language of computers, video games, and the Internet. Those not born before this digital world (digital immigrants) tend to adapt to new environments but have a 'foot in the past' for example, a tendency to read the manual first and resort to the internet second, almost like a language learned later in life.

Prensky noted that students had changed radically through the generations. He describes the arrival and rapid dissemination of digital technology in the last decades of the twentieth century as a "singularity" – an event which changes things so fundamentally that there is no going back. He suggests that at that time the average college graduate has spent fewer than 5,000 hours of their lives reading, but over 10,000 hours playing video games and 20,000 hours watching TV. Prensky's Digital Natives:

- are used to receiving information at fast speeds,
- like to parallel process and multi-task,
- prefer their graphics before text,
- prefer random access (like hypertext),
- function best when networked,
- thrive on instant gratification and frequent rewards,
- prefer games to "serious" work

## IV. WHO ARE DIGITAL VISITORS AND RESIDENTS?

The 'Visitors' and 'Residents' model was proposed by David White and Alison Le Cornu [7] as an alternative to Prensky's Digital Natives and Immigrants. The Visitors and Residents project was based work originally funded by Jisc. Although there is a similar purpose of mapping engagement with the Web, it took into consideration the use of technology today, particularly social media. They suggest that people behave in different ways when using technology, depending on their motivation and context rather than age or background. The resulting model of online behavior should, therefore, be much wider.

### *A. Visitors and Residents Model*

The Visitors and Residents' paradigm [7], [8] aims to provide a better understanding of the role of technology in learning to allow faster, more flexible educational provision of modern virtual 'learning spaces'. An investigation of the tools students choose to gather information for learning, and changes over time, should provide valuable a valuable resource for educators. Learners from the UK and the US were involved in the research to allow an investigation into possible cultural differences. Categories of participation, or 'modes of engagement' were identified, and the concept of 'Residency' was identified. Resident learning strategies include:

- De-compartmentalization - remove time / focus boundaries;
- Social media - collaborative approach to learning;
- Visibility –using 'open' practices to gain visibility and build reputation;
- Performative aspects - having an 'audience';
- Building a lasting professional profile and resources - 'Out on the web';
- Managing tensions around emerging forms of promoting integrity in student engagement.

## B. *Methods and Analysis*

Methods employed in this project are similar to those used by Connaway, White, Lanclos, & Le Cornu [8] during their investigation of what motivates engagement with the digital information environment. Their three-year study attempts to eliminate any assumed links between age and technological engagement by working with users over time, tracking the shifts in their motivations and forms of engagement as they progress through these educational stages. The study is using the visitors and residents principle, described in this paper [7], as an overarching framework to contextualize motivations to engage with the digital environment. The research described in this paper includes Online Activity Maps produced by computing students followed by semi-structured interviews to gain further information. Computing student responses to the 2017 survey of student expectations and experiences of technology [9] will also be analyzed to obtain current data on access to digital devices and course-related online activity. Additional surveys will be conducted at a later stage to test the findings from the interviews and student experiences and explore possible changes in behavior over time. Analysis was carried out using the *visitors and residents model* [7]. This theorizes that whether a student is a *visitor* (logs on, performs tasks, logs off, *without* leaving a social trace) or *resident* (active or emergent online presence *with* social trace) is not merely related to age or gender, but rather is determined much more by context and motivation.

## C. *Mapping Online Activity*

The process of online activity mapping that students carried out consists of producing a map using the template shown in Figure 1. The vertical axis representing a scale from 'institutional' (or other suitable terms the user is familiar with) to 'personal' activity. The horizontal axis ranges from 'visitor' to 'resident' modes of engagement.

The main feature of Visitor mode is that no 'social' trace remains online. Visitors regard the Web is a tool, like a telephone, book, pen, paper, etc. to use to achieve a particular goal, not a 'place' to think. Essentially they are users, not members, of the Web and do not greatly value feelings of 'belonging' online. An example would be going online to search for flight information. Residents, on the other hand, spend a fair proportion of their lives online where they increasingly blur the distinction between online and off–line. Residents happily go online simply to spend time with others and 'belonging' to a community is important to them. Online postings which anyone can find via a search engine such as Google, can be regarded as highly resident behavior. The mapping process is flexible enough to be modified to include aspects of online engagement which are relevant to an individual such as such as coding to identify the *device used* or *time spent*, etc.

Sample maps produced by a 3rd year Computing student are shown in Figures 2, 3 and 4.

Figure 1: Template Activity Map

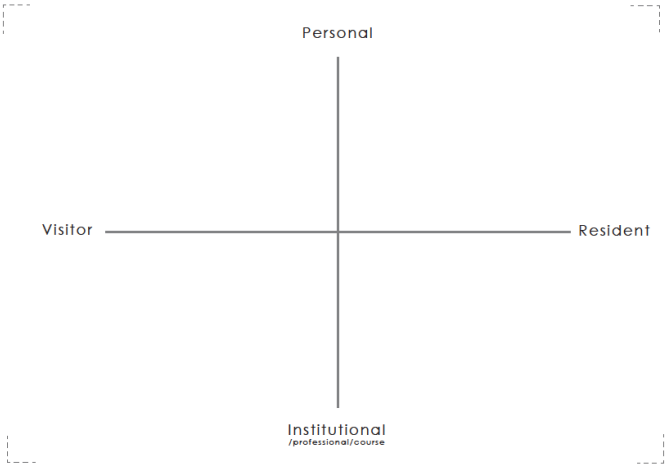



Figure 2: Student 1 Activity Map

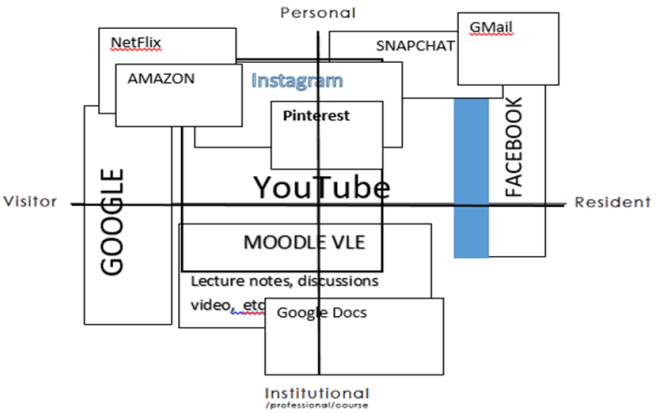



Figure 3: Student 2 Activity Map

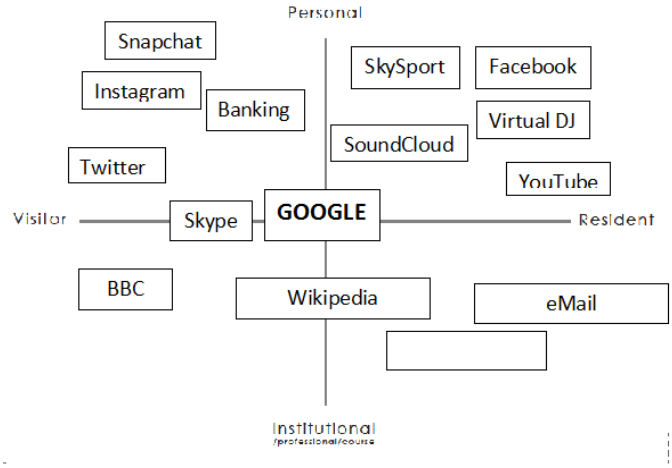


Figure 4: Annotated Activity Map

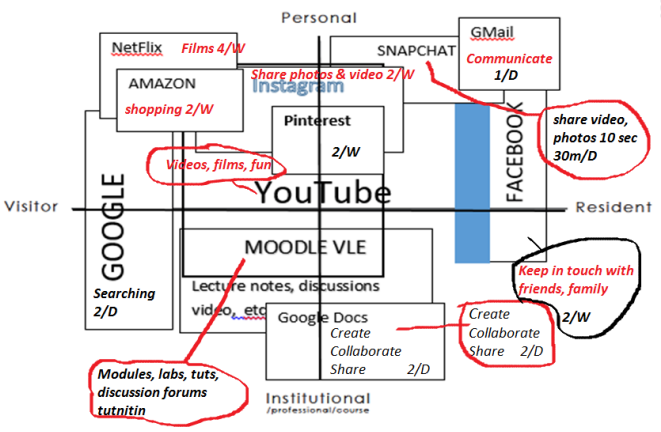



Figure 4 includes information on the type of tasks and amount of time spent on these. *2/D* represents 2 hours per day, 2/W represents 2 hours per week, etc. Many tasks overlap when students multitask.

## V. JISC STUDENT DIGITAL EXPERIENCE TRACKER [9]

This 2017 survey of student expectations and experiences of technology includes questions on access to digital devices and course-related activity as well as institutional and support. The Tracker builds on resources such as the Jisc *guide to enhancing the digital student experience: a strategic approach* [10]. Questions cover issues important to learners and staff with a focus on the learning experience. The student digital experience tracker allows universities, colleges and skills providers to:

- Get digital experience data, and track changes over time
- Make better-informed decisions about digital environment
- Target resources for improving digital provision
- Plan research, data gathering and student engagement

Figure 5: Responses to digital technology on courses [11]

| When digital technology is used on my course... (positive statements) | % learners that AGREED | | | |
|---|---|---|---|---|
| | ACL and skills learners | FE learners | HE learners | Online learners |
| I understand things better | 57.8% | 64.0% | 58.5% | 34.4% |
| I am more independent in my learning | 63.3% | 69.1% | 71.3% | 85.6% |
| I feel more connected with my lecturers/tutors | 50.3% | 42.2% | 43.9% | 20.0% |
| I feel more connected with other learners | 37.8% | 45.9% | 40.4% | 27.0% |
| I can fit learning into my life more easily | 62.0% | 65.3% | 72.8% | 80.8% |
| I can access learning that would be impossible to access physically | - | - | - | 75.3% |

Figure 5 shows typical data collected from the Tracker.

"*Online learners appear less likely to say that they understand things better when digital technology is used, or that they feel improved connections with their lecturers and peers. They are also more likely to feel isolated and to struggle with information overload. This may present a challenge to students as digital technology provides their predominant experience of learning. So online learning may offer these benefits at the expense of others, such as deep understanding and a sense of connection. 25% never work online with others leading to the suggestion that content-based learning, although continuing to drive a significant percentage of online provision, may not serve well those learners who need more social interaction and interconnection.*" [11].

Responses of UWS Engineering and Computing students to the Jisc Digital Student Experience Tracker are shown in fugures 5, 6, and 7.

Figure 5: UWS BI Dashboard: Use of Digital Devices

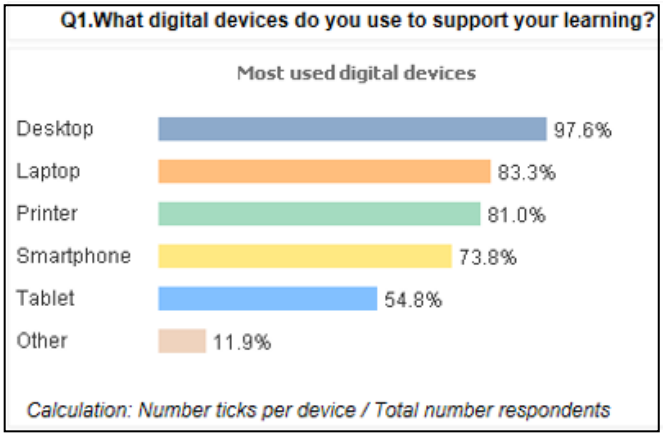



Figure 6: UWS BI Dashboard: Online Activities

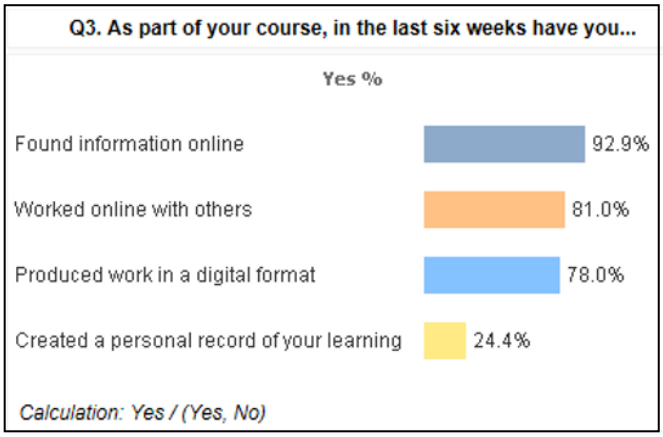
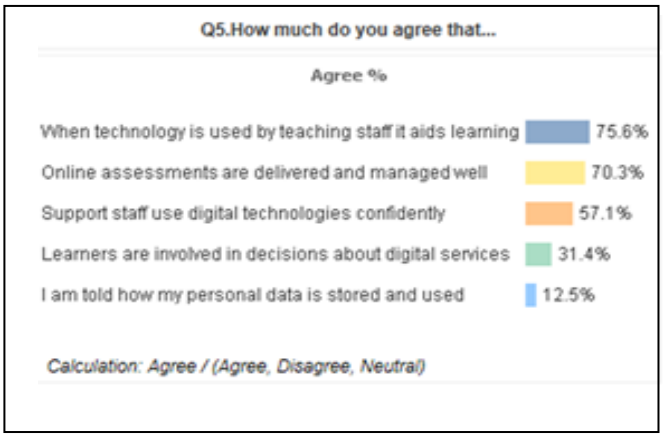



Figure 7: UWS BI Dashboard: Technology & Teaching



## VI. STUDENT ENGAGEMENT WITH TECHNOLOGY

Martin Weller, Professor of Educational Technology at the Open University in the UK [12] has investigated the impact of new technologies on both students and teachers. He describes how technology is transforming student learning and suggests that three factors are significant:

- The quantity of information: there has been a dramatic increase in the volume of online information.
- The online network: Global peer networks, in particular, are an invaluable information source with links to resources, debates, comments, videos, and audio that are accessible from many locations.
- The range and variety of content: Diversification has taken place in content, for example, blogs, video, online publications, etc.

Today there is an increasing emphasis on technology in the learning process. There, may therefore, be a benefit in considering how lessons from Human Computer Interaction (HCI) can be applied to improve student engagement in learning.

HCI provides many relevant theories that are significant in the context of learning and retrieval of knowledge as well as influences that are important for pedagogies. Research, including work on making training and technology interactive, suggests that:

*When users are properly cognitively involved, engaged, and challenged the outcomes are better*

Challenges include creating memorable learning experiences to encourage long-lasting mental representations that enhance learning [1].

Pew [13] has found that "smartphones are nearly ubiquitous among younger adults, with 92% of 18-29-year-olds owning one". Today, 69% of U.S. adults are social media users. Social media is especially popular among younger adults, as 86% of 18- to 29-year-olds are social media users. 80% of 30-49-year-olds and, 64% of those aged 50-64, also use social media. Tablet computer use has also become widespread in a short period of time (51%).

Research from the Centre for Generational Kinetics [14] has some useful data on Millennial and Centennial generations, who are likely to form the majority of current and future students, which may be particularly useful when considering student learning. Their findings include:

- Millennials and Centennials favor Facebook. Centennials views Facebook as being for "older generations." They tend to prefer more peer-to-peer social media and messaging apps, such as Snapchat, Vine, and Instagram. Some have anonymous Instagram accounts so they can share without the fear of damage to their online reputation.
- 25% of teens left Facebook in 2016 suggesting a move to apps that are more instantaneous, use less personal information and are more visually appealing to users.
- Centennials tend to be expert at web-based research and are often self-taught, mostly online, using resources like YouTube and Pinterest. They do have knowledge of traditional research methods, but value *fast access* to the right information above whether or not they *know* the right information.
- Centennials are more diverse than Millennials. The enormous diversity may have a profound impact on education.
- Centennials have had a different experience with technology than Millennials, which will affect every area of their life. The differences and similarities will become clearer in time as well as the impact on learning.
- Centennials are more diverse than Millennials. This is a significant factor which is often ignored. The enormous diversity may have a profound impact in education.
- Centennials have had a different experience with technology than Millennials, which will affect every area of their life. The differences and similarities will become clearer in time as well as the impact on learning.

## VII. HCI ASPECTS

Meyer [5] suggest some myths around millennials:

- "Digital natives possess inferior social skills or are more likely to avoid personal interaction in u of digital interaction.
- Digital natives are much better at multitasking than digital immigrants.
- Digital natives have natural instincts about how to use or fix computers and other digital products".

### *A. Social Interaction Skills*

Concerns may be over-stated. In 2015, the Pew Research Center (Internet & Technology) carried out a study of smartphone use in the US [15]. The traditional view of online activity brings to mind computer (desktop or laptop), however, the reality is very different, with around 15% of Americans ages 18-29 heavily dependent on a smartphone for online access. They did send more text messages than older users. However, the study found that this supplemented vocal interactions rather than replacing them. Students use smartphones for much more than calling, texting, or basic internet browsing, for example, 30% of users use a smartphone to take a class.

Meyer [5] suggest that in a recent usability testing and interviews, when one millennial user couldn't find visitor information on a hospital website, he said, "By this time I would just call. I like calling more than searching because I

get better answers." In this case, social interaction was not something to fear or avoid.

### *B. Multitasking*

Ophir, Nass, and Wagner [16] reported that when students used media multitasking, they used, on average, about four other media concurrently. They found that heavy media multitaskers are more susceptible to interference from irrelevant environmental stimuli and representations in memory to such an extent that they performed worse on a test of task-switching ability. They took around 0.5 seconds longer than light multitaskers to re-focus attention. The suggestion is that this is likely due to reduced ability to filter out interference from tasks that are irrelevant.

Tran, Carrillo, & Subrahmanyam [17] investigated the learning effects of multitasking with online communication while reading an expository text. Their results suggested that student were comfortable with technology and reported that on average they multitasked with four other activities while reading. They found no evidence that multitasking while reading disrupted content learning, reading comprehension, and recall. They found a beneficial effect for easy tasks and moderately difficult tasks. They explain how multitasking might enhance performance at lower levels of cognitive load.

Meyer [5] concludes that digital natives may, therefore, be more likely to choose to multitask, but are not necessarily more efficient at multitasking.

Chart 1: Online Multitasking Sample

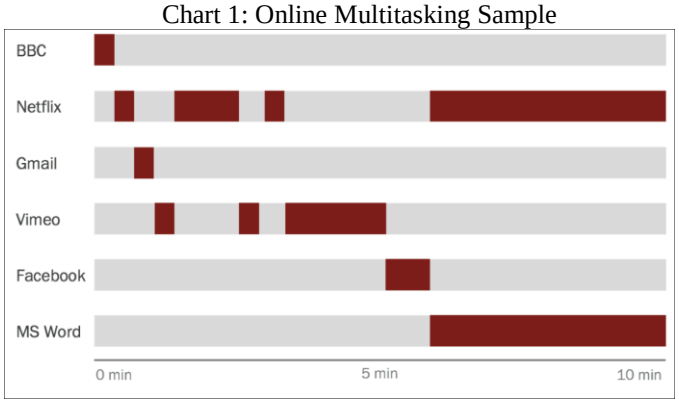



Chart 1 illustrates the kind of multitasking (10-minute excerpt). Meyer [5] observed in a self-recorded field study of millennial computer activities. The first 5 minutes switches quickly between activities (checking news, email, browsing Netflix, watching a video, checking Facebook.) before working on an academic paper while watching Sons of Anarchy on Netflix simultaneously.

### *C. Cognitive Load Theory (CLT)*

CLT aims to understand how the cognitive load produced by learning tasks can impede students' ability to process new information and create long-term memories. Cognitive load is increased when unnecessary demands, including distractions, are imposed on a learner. The task then becomes complex and diminishes the ability to be able to learn new skills. CLT was first outlined by John Sweller [18] in 1988. He built on the working memory model: Auditory and visual information is processed to a greater degree than other everyday observations to develop long-term memories [19]. Sweller [18] suggest there are factors that increase a person's cognitive load. These include making learning unnecessarily complex, and, distracting users from information they need to pay attention to. Higher cognitive load leads to a stimulus being more difficult to pay attention to, rehearse and remember. This makes learning less effective. Three forms of cognitive load are: intrinsic, extraneous and germane:

- *Intrinsic Cognitive Load* is the demand made of a learner by the inherent difficulty of the task and quality of information being learned. The cognitive load is influenced by the complexity of the task or concept being learned, and the ability of the student to understand the new information. The cognitive load can be reduced by breaking complex tasks down into smaller, simpler steps.
- *Extraneous Cognitive Load* is concerned with how the information is presented to the student, rather than the underlying difficulty of the topic, i.e. extraneous to the learning task. An example is distracting information which makes a task more complex. The instructor may choose to present the information in a diagram to ease the cognitive load.
- *Germane Cognitive* Load is concerned with organizing knowledge into schemas or units where information is stored. Students can gain expertise by handling information more efficiently in working memory so they know what to expect when they encounter similar situations in the future, i.e. learn from experience.

### *D.* Natural Instincts with Technology

Meyer [5] reports that Millennials frequently get stumped in usability testing when they encounter difficult user interfaces. Their interactions tend to be fast-paced. Because they spend less time on any given page, Millennials are more likely to make errors, and they read less than the average user.

"Millennials in our studies were distinctive in their attitudes towards communications technology, their preferences, and their information-seeking strategies (for example, they used browser tabs for page parking, and they had a slightly above-average ability to determine clickability).

Millennials seem to be highly confident with digital interfaces, even when encountering radically new design patterns. Hence they have a tendency to be error-prone."

Negroni [20] reports that some employers worry that dependence on technology can impair a candidate's ability to prioritize work and multitask effectively without becoming distracted. He advises Millennials:

"*Multi-tasking is a skill that many millennials possess, allowing them to dedicate their attention to a variety of tasks at any given moment. However, if you find yourself facing distractions, take the time to step away from technology and focus on the task at hand. If you can identify your biggest distraction, you'll be a more effective multi-tasker.*"

Cavanaugh, Giapponi, and Golden [21] note that while screen technology may offer select cognitive benefits, there is evidence in cognitive neuroscience literature that digital technology is restructuring the way students read and think. Research regarding the intensive use of digital devices suggests certain cognitive skills are gained while "deep thinking" capabilities deteriorate as a result of alterations in the neural circuitry of the brain. They "suspect a new digital divide cropping up in the classroom represents a timely opportunity for educators to reflect on how today's students read and learn, but equally, on what and how we teach."

## VIII. CONCLUSION

Digital technologies and the internet have transformed the many 'places' where learning may occur. Students are continuing to increase the amount of time they spend online. They may still attend lectures, tutorials, and laboratories at University but are also online for a substantial amount of their daily lives carrying out a wide range of online activities. This merging of personal social activities and academic life may lead to students living a large part of their lives 'online'.

A better understanding of the impact of the internet as a 'place' to 'reside' for students no matter what generation they may belong to is essential. Technological advances, alongside developing interfaces and interactions that are intuitive, usable and take account of students online practices and how they interact with new digital technology should influence how technology enhanced learning is evolving. The future is difficult to predict, however, something we can say with confidence is that it will continue to evolve and change rapidly.

## ACKNOWLEDGMENT

I would like to thank my supervisors, Dr. Mark Stansfield and Professor Moira Lewitt, for their expert advice and encouragement throughout my research and Milan Radosavljevic, Assistant Dean Research and Enterprise for his feedback and support. Much of the inspiration for my research stemmed from working on The UK HEA 'Challenges of Web Residency' project with David White and Alison Le Cornu, in particular, their work on Visitors and Residents. My colleague, Costas Iliopoulos, and I were the UWS team on this project, and I am grateful to Costas for his unfailing support, cooperation, and friendship.

## REFERENCES

[1] Crearie L. (2014), 21st Century Learning Spaces & Online Residency: Just How Much Time Do Students Spend Online. Available: http://www.icicte.org/Proceedings2014/Papers%202014/4.5%20Crearie.pdf [Accessed 17 July 2017]

[2] Anderson E., Teenagers spend 27 hours a week online: how internet use has ballooned in the last decade, Telegraph, 30.06/17 Available: http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/digital-media/11597743/Teenagers-spend-27-hours-a-week-online-how-internet-use-has-ballooned-in-the-last-decade.html [Accessed 17 July 2017]

[3] Ofcom Internet Citizens 2017, Available: https://www.ofcom.org.uk/__data/assets/pdf_file/0017/102761/internet-citizens-2017.pdf [Accessed 17 July 2017]

[4] Pew Reseach Center, Smith, Aaron, 11/1/17, The evolution of technology adoption and usage. Available: http://www.pewresearch.org/fact-tank/2017/01/12/evolution-of-technology/ [Accessed 17 July 2017]

[5] Meyer K. (2016) Millennials as Digital Natives: Myths and Realities, Available: https://www.nngroup.com/articles/millennials-digital-natives [Accessed 17 July 2017]

[6] Marc Prensky, (2001) "Digital Natives, Digital Immigrants Part 1", On the Horizon, Vol. 9 Issue: 5, pp.1-6, https://doi.org/10.1108/10748120110424816 Permanent link to this document: https://doi.org/10.1108/10748120110424816 [Accessed 17 July 2017]

[7] White, D., Le Cornu, A. (2011). Visitors and Residents: A New Typology for Online Engagement. First Monday, Available: http://firstmonday.org/article/view3171/3049 [Accessed 17 July 2017]

[8] Connaway, L. S., White, D., Lanclos, D. & Le Cornu, A. (2012). Visitors and residents: what motivates engagement with the digital information environment? Information Research, 18(1) paper 556. Available: http://InformationR.net/ir/18-1/paper556.html [Accessed 17 July 2017]

[9] Jisc Student digital Experience Tracker, Available: https://www.jisc.ac.uk/rd/projects/student-digital-experience-tracker [Accessed 17 July 2017]

[10] Killen C., Jisc Enhancing the student digital experience: a strategic approach, Available: https://www.jisc.ac.uk/guides/enhancing-the-digital-student-experience [Accessed 17 July 2017]

[11] Newman T., Beetham H., Student digital experience tracker 2017: the voice of 22,000 UK learners, June 2017, Available: http://repository.jisc.ac.uk/6662/1/Jiscdigitalstudenttracker2017.pdf [Accessed 17 July 2017]

[12] Weller, M (2011). The Digital Scholar: How Technology is Transforming Scholarly Practice, Bloomsbury Academic, 1-2.

[13] Madden M., Lenhart A., Duggan M., Cortesi S., Gasser, Pew Research Center: Internet & Technology, Teens and Technology 2013, Available: http://www.pewinternet.org/2013/03/13/teens-and-technology-2013/, [Accessed 17 July 2017]

[14] Centre for Generational Kinetics & Jason Dorsey, 2016 National Study on Technology and the Generation after Millennials, Gen Z – Tech Disruption, From: http://genhq.com/wp-content/uploads/2016/01/iGen-Gen-Z-Tech-Disruption-Research-White-Paper-c-2016-Center-for-Generational-Kinetics.pdf [Accessed 17 July 2017]

[15] Pew Internet. U.S. Smartphone Use in 2015 (2015). Available: http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/ [Accessed 17 July 2017]

[16] Ophir, E., Nass, C., Wagner, A. Cognitive control in media multitaskers. Proceedings of the National Academy of Sciences, 15583–15587 (2009).

[17] Tran, P., Carrillo, R., & Subrahmanyam, K. (2013). Effects of online multitasking on reading comprehension of expository text. Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 7(3) doi:http://dx.doi.org/10.5817/CP2013-3-2

[18] Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*. *12*(2). 257-285.

[19] Baddeley, A.D. and Hitch, G. (1974). Working Memory. *Psychology of Learning and Motivation*. *8*. 47-89.

[20] Negroni D., The Era of Millennial Multi-Tasking, Available: https://launchbox365.com/blog/the-era-of-millennial-multi-tasking/ [Accessed 17 July 2017]

[21] Cavanaugh M., Giapponi C., Golden T., Digital Technology and Student Cognitive Development: The Neuroscience of the University Classroom, Journal of Management Education, 30/10/15. Available: http://journals.sagepub.com/doi/pdf/10.1177/10525629156140 51 [Accessed 17 July 2017]