

# Microblogging Practices of Scientists in E-Learning: A Qualitative Approach

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**Abstract**—Microblogging services, in particular Twitter, have experienced an explosive uptake in the last few years with a decelerated growth rate since 2010. Apart from celebrities, PR and news agencies, the bulk of user profiles stems from private individuals. Amongst them, individual scientists have started to make use of Twitter for professional purposes. This paper presents a qualitative approach of discovering microblogging practices and obtaining rich descriptions of few cases that give a deeper insight into how Twitter is used by scientists active in the field of e-Learning and how this practice shapes their social networks. The methodological approach is based on online ethnographic studies. Therefore Grabeeter, a tool for collecting all public tweets of a person in various formats, has been adapted in order to obtain the data appropriate for a qualitative analysis following a grounded theory approach. After an analysis of the current state-of-the-art we will outline the methodological approach for our qualitative analysis that focuses on discovering tacit aspects of microblogging practices such as value or purpose. Finally the results of the online ethnographic approach and individual cases will be discussed and compared to similar studies. This work presents the explorative phase of a detailed qualitative approach towards exploring microblogging practices of scientists.

**Index Terms**— e-learning; microblogging; Twitter; Science

## I. INTRODUCTION

Social Software or Social Media such as Weblogs, Wikis, online networking portals etc. have become an important means of communication and collaboration for knowledge workers around the globe. Scientists have long realized the advantages of these new technological landscapes for personal workflows. Twitter, the most popular microblogging tool, is also heavily used in scientific communities. This study sets out to discover and describe microblogging practices of scientists using Twitter.

The majority of recent studies dealing with the use of Twitter have chosen a quantitative approach focusing on different aspects such as publishing patterns, follower patterns, publishing practices, etc. [1] [2]. Apart from the fact that some of these studies are being criticized for their methodological approach, e.g. on the data reliability with regards to gender, the insights that one gains into the usage stay on a rather general statistical level. A deeper contextual embedding is hardly possible with such a method. Overall, there is less qualitative evidence and case studies on how Twitter is used by adults in their personal working

practices [3] [4] [5]. Thus this study sets out to add a qualitative view on microblogging practices.

The following state-of-the-art analysis will try to depict online personal web publishing with a special focus on microblogging and the usage of Twitter. In the methodological part the chosen approach for the ethnographic studies will be elaborated as well as the specific tool that has been adapted for data collection purposes. Finally a few cases will be presented and discussed.

## II. PERSONAL WEB PUBLISHING

At the end of the 1990s the term personal (web) publishing referred to technologies and tools that allowed technically skilled individuals for the first time to address a potentially broad public audience [6]. Numerous tools and services have spread over the years making it possible for anyone to create one's personal online presence and identity as well as to cultivate one's online reputation. Digital literates tend to use a combination of different tools that support their online presence, ranging from personal websites to file sharing services for photos, videos or music files, to social bookmarking services, etc. Actually it is rather common that one's online presence is the result of using a number of various publication channels at the same time.

While a few people might claim that they create online presence just for themselves, it is normally a means of communicating with others as well as establishing and maintaining social contacts. Paul McFedres called it a "virtual omnipresence" that some people tend to achieve by being present at different portal, publishing via different channels and trying to be "ultraconnected" [7]. Approaching the phenomenon from a different perspective, Caroline Haythornthwaite's speaks about "media complexity" [8] and refers to her findings that people who have a close relationship, or strong ties as social capital theory would call it, make use of a variety of media to stay connected.

### A. Weblogs

Weblogs may probably be considered as the "classical" personal web-publishing tool. Although there are numerous definitions on what the specific characteristics of weblogs are most authors tend to agree to Walker's definition that a weblog is "a frequently updated website consisting of dated entries arranged in reverse chronological order" [9] [10].

According to the weblog search engine Technorati there are currently about 100 million registered weblogs<sup>1</sup> with about 200 000 added every day. There have been various attempts to classify weblogs according to different parameter mainly depending on their usage. Karsten Ehms, who studied the usage of personal weblogs in organisations, suggests an approach via 3 dimensions, namely the size of the audience addressed, the thematic coverage and the thematic depths and lengths of entries [11]. This classification includes very personal life writings on the one end of the scale as well as journalistic writings in mass media on the other end. Microblogging, as it will be discussed a bit later on, is also included in this classification, as a special form of weblogging practice.

Thus, from any attempt to define or classify weblogs, it becomes clear that the range of usage is very wide and weblogs can be used in many different ways and styles. They may be maintained by a single author or may have multi authorship (cooperate blogging), making it also a communication tool for groups. As Efimova [9] puts it: "authors have different goals, uses, or writing styles with only one thing in common: format."

Weblogs have become a popular marketing means for all kinds of industry from banking to entertainment, etc. with journalism being one of the first segments to exploit their potential. Weblogs entered the field of science as well as education. There is probably no segment of our society where weblogs are not yet used for online communication. Still, according to Efimova, who studied in depth weblogging practices of knowledge workers, it is not the content per se that make the weblogs attractive to readers but the personalities behind them [9]. Ehms [11] confirm this analysis by stating that the majority of bloggers are still individuals.

Apart from the broad range of usage, personal weblogs are a popular instrument for establishing personal online presence and reputation.

### B. Other Personal Web Publishing Tools and Practices

Although the starting point and focus of interest for this study lies in the way people make use of microblogging practices it is important to analyse similar practices in their contextual settings. As mentioned above, there are various experts who claim that people tend to use a mix of tools for creating their online presence. The following is not an attempt to cover extensively the big variety of tools and services that are currently available for personal online communication, it is rather intended to outline a few examples of tools and practices that might come up during the field studies of different cases and might constitute important contextual elements that need to be taken into consideration. It should basically show the contextual awareness of this study.

Whereas a great number of people are still stick to text as their main communication format other content formats have gained popularity and are used for personal web publishing. Photo sharing tools such as Flickr<sup>2</sup> or Picasa<sup>3</sup> are very popular amongst web users. They are often used in combination with weblogs or other personal publishing tools, where different formats can be embedded. Although they are usually classified as social media and more spe-

cifically as photo sharing tools, we would also count them in our definition of personal web publishing tools, since one may also be able to communicate via images and create an online presence and reputation via images only (portfolio).

A more recent format is video, which has gained influence rapidly with the rising popularity of Youtube<sup>4</sup>. Similar to most social media applications, Youtube and others are experiencing a so-called "power law" distribution when looking at their usage patterns. There are a lot of people using it for accessing content, but there are only few active content contributors, approx. 10%. This usage pattern can be seen in many social media applications, one of the most prominent one being Wikipedi<sup>5</sup>, where the number of distinct authors per Wikipedia entry follows also a power law distribution with few articles having many authors while a long tail of entries being edited only by one single author [12] [13].

Generally, one may observe that with the rising popularity of social media and their ease of use for any specific format or specific genre, specific online communities have started to spread, each with their own specific portal. Myspace<sup>6</sup> has e.g. become one of the popular places for music, where local artists, amateurs, etc. can create their own web presence and make their music accessible all over the globe. Online identities are created and expressed via the content itself, e.g. the music files, as well as via certain design elements and the way the whole profile page is presented.

The listing of social networking portals created for specific interests might be endless with new community portals being created every day. It is typical for this wide variety of social networking or community portals that users create their own profiles there and publish personal histories. Facebook<sup>7</sup> is currently the most popular social networking site with more than 500 million active users in July 2010 according to statistics published on Facebook<sup>8</sup>. Although we will not go into further detail regarding Facebook or any of the other online social networking portal we find it important to mention them here as examples of personal online identity creation and management and to argue that personally managed weblogs or microblogs are by far not the only means for personal web publishing.

Apart from the wide range of tools and services that one may use to create online presence technological developments in the last few years have also made it more convenient and easy to participate online from anywhere at any time. Especially the numerous applications that make it possible to publish and receive online content from mobile devices have added to the attractiveness and popularity of social media. Twitter statistics, which will be discussed in more detail in one of the following chapters, say that 46 percent of active users twitter regularly via mobile applications and 16 percent of all new users to Twitter start on mobile which means that the total mobile users has jumped 62 percent since mid-April 2010<sup>9</sup>. Even Williams, CEO of Twitter, recently posted these figures.

<sup>4</sup> <http://www.youtube.com> [2011-04-27]

<sup>5</sup> <http://www.wikipedia.org> [2011-04-27]

<sup>6</sup> <http://www.myspace.com> [2011-04-27]

<sup>7</sup> <http://www.facebook.com> [2011-04-27]

<sup>8</sup> <http://www.facebook.com/press/info.php?statistics> [2011-04-27]

<sup>9</sup> <http://blog.twitter.com/2010/09/evolving-ecosystem.html> [2011-04-27]

<sup>1</sup> <http://technorati.com> [2011-04-27]

<sup>2</sup> <http://www.flickr.com> [2011-04-27]

<sup>3</sup> <http://picasaweb.google.com> [2011-04-27]

As already outlined previously it is often the combination of various formats and tools that constitute a personal online presence. Now we have a closer look into microblogging practices as these are in the core interest of this study.

### III. MICROBLOGGING

Microblogging is a special form of blogging, where the content is usually restricted to a certain amount of characters ranging usually from 140 to 200 characters. A microblog entry typically includes a short sentence or fragment of a sentence, sometimes an image or an embedded video, and often includes a link to a more elaborate content. People mainly make use of this service for staying in contact with friends and family, for searching for information and for providing information to others [14].

Twitter is currently by far the most popular service for this type of communication. Thus, most research and existing studies on microblogging concentrate on Twitter, which will be discussed in more details a bit further down as it is also the microblogging service that this work is going to put its focus on.

#### A. Microblogging Tools and Services

There are a number of services and tools available for microblogging and the life cycle is quite diverse with new services coming up and disappearing frequently. Apart from Twitter, it is Jaiku<sup>10</sup>, Tumblr<sup>11</sup>, and Plurk<sup>12</sup> that are recurrently mentioned on the diverse listings of microblogging services. These are all rather similar services, offering their users the possibilities to share a variety of content formats such as text, photos, quotes, links, music files, videos via various interfaces, such as web browser, phone, desktop, or email.

Apart from these “classical” services there are numerous services and additional tools for microblogging that cater for specific purposes or specific communities. One may assume that this multitude can be depicted as a so called “long tail” with very few services taking in most of the users and a long tail of specialized services and tools catering for small numbers of users. In accordance with the fast growing and rapidly changing World Wide Web the landscape of microblogging tools and services is in a continuous flow. New tools and services are being launched almost daily, while others disappear, are merged or acquired by other service providers. Thus, this section is just giving a few examples to show the sample range of technologies for microblogging.

Location-based microblogging services such as dailyplaces<sup>13</sup> allows users e.g. to update certain locations in real time with short messages. Other services offer specific privacy settings, where you can chose to communicate with a specific group of self defined members or restrict the usage e.g. within an organisation. Examples for such restricted microblogging are Whispurr<sup>14</sup>, Plum<sup>15</sup>, Flokio<sup>16</sup>, Yammer<sup>17</sup>, or Presentlyapp<sup>18</sup>.

Then there are specific services available that specialise in voice interfaces. Via mobile devices or regular phone users can leave or listen to short spoken messages (e.g. MySay, Audioboo<sup>19</sup>, or Bubbly<sup>20</sup>). More recently also video microblogging services such as 12 secondsTV<sup>21</sup> have been established.

While many microblogging platforms are built on (partially) proprietary software with open APIs (Application Programming Interface) there are also a number of completely Open source versions. StatusNet<sup>22</sup> and Sharetronix<sup>23</sup> are two popular examples. Both offer a free software version for download as well as hosted solutions. identi.ca<sup>24</sup> and Whatyadoing<sup>25</sup> are two examples of microblogging services that are based on Statusnet.

Apart from stand-alone microblogging services many social networking sites, such as LinkedIn<sup>26</sup> or Facebook, have a microblogging feature. They are often called “status updates”. Very similar to microblogging users can send short messages. Depending on privacy settings these updates are available for a certain audience.

#### B. Twitter

Twitter is currently by far the most popular microblogging service with more than 106 million accounts (website-monitoring.com, 2010). The service was launched in 2006 and experienced its enormous growth in the first half of 2009. Being such a popular means of online communication makes Twitter also omnipresent in the media. Numerous articles are written about Twitter daily, which makes it impossible to follow everything that is beings said about Twitter and hard to sort out relevant information.

Although Twitter still records its greatest popularity in North America (see Fig.1) the service is growing especially in European countries such as United Kingdom or Germany, as well as in Brazil, India and Indonesia [27].

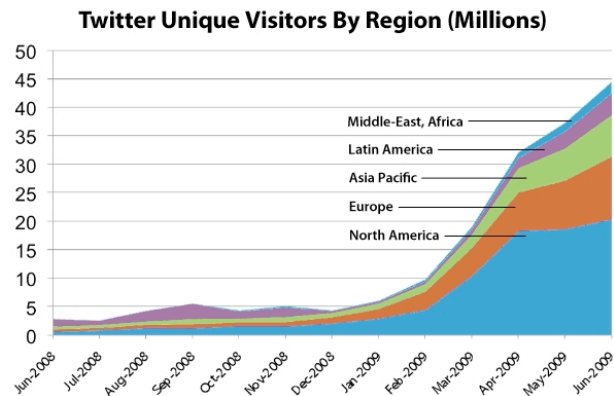


Figure 1. Twitter’s Boom around the World<sup>27</sup>

<sup>18</sup> <http://presentlyapp.com> [2011-04-27]

<sup>19</sup> <http://audioboo.fm> [2011-04-27]

<sup>20</sup> <http://www.bubblemotion.com/products-bubbly.html> [2011-04-27]

<sup>21</sup> <http://12seconds.tv> [2011-04-27]

<sup>22</sup> <http://status.net> [2011-04-27]

<sup>23</sup> <http://sharetronix.com> [2011-04-27]

<sup>24</sup> <http://identi.ca> [2011-04-27]

<sup>25</sup> <http://whatyadoin.com> [2011-04-27]

<sup>26</sup> <http://www.linkedin.com> [2011-04-27]

<sup>27</sup> source: <http://www.businessinsider.com/chart-of-the-day-twitters-boom-around-the-world-2009-8> [2011-08-27]

<sup>10</sup> <http://www.jaiku.com> [2011-04-27]

<sup>11</sup> <http://www.tumblr.com> [2011-04-27]

<sup>12</sup> <http://www.plurk.com> [2011-04-27]

<sup>13</sup> <http://dailyplaces.net> [2011-04-27]

<sup>14</sup> <http://www.whispurr.com> [2011-04-27]

<sup>15</sup> <http://www.plum.com> [2011-04-27]

<sup>16</sup> <http://flokio.com> [2011-04-27]

<sup>17</sup> <https://www.yammer.com> [2011-04-27]

The short messages with a limitation of 140 characters that one can send via Twitter are called “tweets”, people signing up to read these tweets are “followers” and people that someone has signed up to are “followees”. In addition to pure text format the messages can also include links, images, videos, etc.

Similar to other microblogging services mentioned above, Twitter combines elements of social networking services and weblogs, however with some important differences [15]. With regard to weblogs the clear difference is set by the limited number of characters for Twitter users and the missing comment function for individual tweets. Regarding the social networking aspects the main difference compared to other services is the fact that Twitter connections do not need to be reciprocal. Users may decide to follow someone, who in return does not have to confirm this connection nor does the other need to reciprocate.

Apart from the web interface many people use Twitter via third party applications, such as TweetDeck. According to Cheng & Evans [2] more than 50% of all updates are published using tools, mobile and Web-based, other than Twitter.com. TweetDeck is the most popular non-Twitter.com tool with 19.7% market share. Twitter recently announced that its open API has already triggered almost 300,000 applications<sup>28</sup> that run on all types of devices and Web services.

The range of third party Twitter applications is very wide. Photos and Videos can be easily added to a tweet via e.g. TwitPic<sup>29</sup>, services like bit.ly<sup>30</sup> offer the shortening of long links, while TweetStats<sup>31</sup>, Twitter-Grader<sup>32</sup> or Tweet-Level<sup>33</sup> help users in measuring their popularity and influence. TweetPsych<sup>34</sup> offers a psychological profile of a Twitter account, other tools offer visualisations of follower, contact or communication patterns.

While some of these applications are very popular, such as mobile applications, there are likewise a great number of applications that are dedicated to only a very select group of users and some that might be hard to grasp for the majority of Twitter users.

There are different opinions whether Twitter is a social network or not. Holger Schmidt e.g. published an article in the online FAZ (Frankfurter Allgemeine) in May 2010 where he takes up a study which argues that Twitter is not a social network. He builds his argument on a scientific study performed by Korean researchers from the KAIST research centre who claim that only about 22% of Twitter users are following each other. They stress the importance of “retweets”, where a message from one author is forwarded by another users. Via these retweets they claim the emergence of a collective intelligence [17] [18]. Another argument against the social network characteristics of Twitter is the low reciprocity that Kwak et al. identified in their quantitative study on the entire Twittersphere [18]. Other scholars have identified Twitter as one of the most popular online social networks besides Facebook and Youtube and studied its network structure in much detail

[19] [20]. First of all any such statement depends of course on the definition of what constitutes a social network. We would still argue that Twitter is used for social networking, at least for individual users. As the following short overview of some microblogging practices will show, the networking aspect has been identified by various scholars looking into Twitter usage as one of the main drivers for people to use Twitter.

### C. Microblogging Practices

Scholars have started to capture the popularity of Twitter and to detect the main intentions and motivations for people to microblog. According to McFedries [7] people use microblogging for achieving a level of online presence. Lee Humphreys [21] places microblogging into a longer historical context. He claims that microblogs have certain similarities with historical diaries, which had both an important personal as well as social function. Microblogging thus serves the long-standing desire of people to chronicle and share every day life events, only with different technologies.

Zhao & Rosson [4] conducted an exploratory research project to gain a deeper understanding of why and how people use Twitter. In their qualitative approach they tried to better understand the role that microblogging plays in informal communication at the workplace. They describe personal and relational benefits of using Twitter as a means of informal communication such as real-time information (no time lack) and frequently updates of their personal and trustworthy contacts. Apart from identified benefits, the authors also detected some issues such as data security or the boundaries between work and personal content. However, as they point out themselves, we are just at the beginning of understanding microblogging practices [4].

Java and his colleagues have chosen a quantitative approach to get a deeper understanding of why people twitter. By analyzing a dataset of over 1.3 million posts from over 76.000 distinct users they conclude that people’s main intentions for microblogging are daily chatter, conversations, sharing information and reporting news [14].

Twitter research also includes various attempts to classify Twitter users. Java et al. distinguish between three types of users. *Information Source* are those who mainly distribute information, *Friends* are those who establish social connections and *Information Seeker* are using the service primarily for gaining access to information [14]. Naaman et al pin it down to two types, the *MeFormers* and the *InFormers*. While the former concentrate on the “self” and their own personal interest, the latter are driven by information sharing behavior and thus have more social contacts [28].

Generally speaking, quantitative studies involving large datasets seem to dominate the current research on microblogging practices. Sysomos, a social media analytics company, has e.g. published a study in 2009 about Twitter usage by analysing 11.5 million Twitter accounts. Apart from some doubtful results such as that there are more women (53%) on Twitter than men (47%) - since Twitter users may not reveal their real identity - the authors identified once more a power law distribution regarding Twitter users. According to the authors 5% of Twitter users account for 75% of all activities [2]. Another study identified a 10:90 distribution [1].

<sup>28</sup> [blog.twitter.com/2010/09/evolving-ecosystem.html](http://blog.twitter.com/2010/09/evolving-ecosystem.html) [2011-04-27]

<sup>29</sup> <http://www.twitpic.com/>

<sup>30</sup> <http://bit.ly>

<sup>31</sup> <http://www.tweetstats.com/>

<sup>32</sup> <http://tweet.grader.com/>

<sup>33</sup> <http://tweetlevel.edelman.com/>

<sup>34</sup> <http://www.tweetpsych.com/>

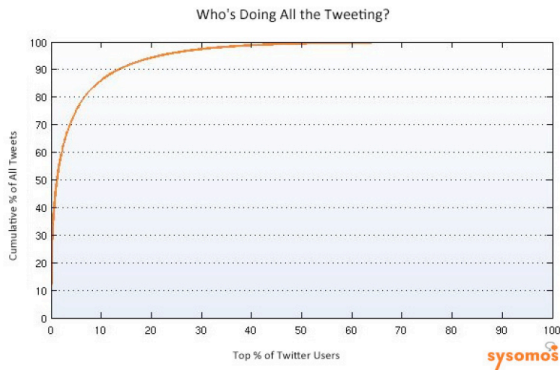


Figure 2. Twitter activity according to Sysomos Study

The Pew Internet Project, which is dedicated to observe the impact of the Internet on American life (families, work, children, political life, etc.) observed in its 2009 Twitter report that Twitter and other microblogging services are often used in combination with other social media. People who microblog are more likely to also keep a weblog and consume weblog contents. In addition, Twitter users seem to communicate and access online content more via mobile devices than the average online population [22].

Overall, quantitative research seems to prevail the current knowledge base on the use of microblogging. The lack of more qualitative evidence on Twitter usage has been criticized by qualitative scholars such as Honeycutt & Herring who demand ethnographic studies and interviews with Twitter users and non-Twitter users to confirm and expand their findings on the collaborative and communicative aspects of Twitter usage [3]. Stephen Dann provides a good overview of previously performed Twitter research and similar addressed the lack of more in depth analysis of individual histories [16].

#### IV. METHODOLOGY

This research effort is mainly exploratory. There is no strong hypothesis that has to be tested, but it is rather driven by the interest to explore hidden aspects of microblogging practices and jointly discover tacit aspects of microblogging and its values for the individual users with a number of interesting cases.

Internet research, which treats the Internet and the forms of social interaction performed on the Internet as the topic of research, has brought forward research methods that are based on traditional methods, but cater for the specific needs to grasp online social phenomena. Whereas in its beginning scholars were focusing on the online social interaction in isolation critics of such an approach have started to stress the importance of the embeddedness of the Internet in everyday life and suggest a combination of approaches that consider and explore also the offline context in which online activities take place [23]. Although microblogging is a purely online activity we also believe in the importance of context, online and offline, as the driving research questions already imply. Thus the suggested combination of different methods, or concurrent mixed methods [24], in order to understand the experience of microblogging will be considered in this work.

The following empirical part is based on interpretive qualitative research and initial data has been obtained mainly via observations or in this context better called

online ethnography. Since the approach is very much explorative future work will also include some experimentation with participatory methods, on the one hand via self-reflective writing and on the other hand consider the data collection phases as phases of co-construction together with the participants in this study. Twitter itself will also be used to get some reflections on microblogging practices from participants in the case studies. In addition, Twitter may also be used to publish important aspects of the research work itself, such as interesting/contradicting findings or additional questions and issues that might come up during the data analysing phases. Experimenting with microblogging practices for communicating research results may add additional insights for the further research work itself.

Following a grounded theory approach there is no clear hypothesis that should be verified or falsified [25] with the cases explored here, it is rather an attempt to start with a few cases and try to build some theoretical framework from these cases.

#### A. Online Ethnography

Online ethnography studies mainly look at the content that is available online and has been archived. Often it is text and hyperlinks that are in the centre of analysis. Thus many scholars have applied methods similar to classical content or document analysis when looking at online content. Still the methods in online research have evolved from more traditional methods taking into account the complexity of multimedia, multimodality, hypertextuality, hyperlinks, etc. In the case of microblogging and more specifically the use of Twitter this work is facing some additional challenges:

First of all tweets are not purely text, they often include hyperlinks that lead to multimedia content including images and sound. The hyperlinks itself are already a challenge for the analysis since they may link to very extensive content and the decision has to be taken how to handle hyperlinks in tweets. A current proposition is to identify the theme or topic the hyperlink point so, but not go into any further detail of analysis concerning the linked content itself.

Second, unlike purely static content, which does not involve any interaction of users, tweets are often part of a conversation and might thus be more subject to discourse or interaction analysis than pure document analysis. Hewson [24] stated a similar case for weblogs that can also not simply be categorized as one or the other. In the case of microblogging the interactive element might even be stronger than in weblogs, due to the different characteristics of these personal web-publishing tools. Thus tweets can be analyzed either from a more static point of view or from an interaction perspective.

Third, apart from the tweet messages that are published by the individual author there is also an online artifact that might be considered from an ethnographic point of view. Since Twitter offers the possibility to their users to create their personal Twitter page by choosing from a wide range of designs or by adding personal elements, such as images. These artifacts may be approached via an artifact analysis and may add some additional insights into the values of microblogging for the individual participant.

The online ethnographic study that has been performed so far follows a grounded theory approach [25]. Following

this theory the coding process was initiated without any predefined codes. Only by exploring the tweets of the four individual cases a set of codes that will be discussed here has emerged. In grounded theory the data gathering and data analysis tasks are very closely connected and take part in parallel. In addition, based on the findings of the analysis the empirical context may be fine-tuned. Thus this first attempt of analysis is based on few cases, but is an important contribution to shape the future work.

#### B. Participatory Observation

As a first step to get acquainted with the subject of this study the e-Learnig or TEL Twittersphere was actively observed. The authors have been using Twitter to a varying degree, from an experienced active use to a rather exploratory approximation and establishment of first contacts. Exploring the tool via participatory observation has proven a good means to grasp the idiosyncrasies of this microblogging tool and to get a first idea what scientists in TEL are communicating via Twitter.

During a first period of self-experimentation with the tool and the observation of some peers and their Twitter behavior the usage patterns described by Java et al. such as daily chatter, conversations, sharing information and reporting news [14] became quickly visible. However, the motivation to go into further details about the microblogging practices of scientists from this specific target group led to a more detailed analysis of some few cases as described in the following.

#### C. Manual Coding

Coding is an integral part of almost any qualitative research. It is part of the analysis to assign tags or labels to units of meaning. These are called codes [29]. They can be either predefined or emerge during the first steps of analysis of the gathered data. In the case of this study the researchers started their analysis without a pre-defined set of codes. By going through all the individual microblogging posts a first set of codes emerged. These were modified and restructured during the course of the data analysis and by going through the different cases. With the restructuring of the codes a shift from descriptive to interpretive and pattern codes was observed.

#### D. Grabeeter

Our main module that serves data acquisition is called Grabeeter. Grabeeter was developed at Graz University of Technology and aims to grab Twitter user timelines using the Twitter API [26]. Every user that owns a Twitter account should be able to initialize and grab his/her data. The architecture of Grabeeter consists of two main parts. The first part is a web application and second part of Grabeeter consists of a client application developed in "JavaFX6" technology for accessing the stored information on a client side. The Grabeeter web application uses the Twitter API to retrieve tweets of predefined users. The tweets are then stored in the Grabeeter database. The Grabeeter client application provides an easy way to store the retrieved tweets on the user's local file system for later offline processing. So it can be summarized that Grabeeter is simply a possibility to store tweets for own purposes or for further analyses, due to the fact that the number of accessible tweets on Twitter is restricted.

## V. ANALYSIS

### A. Analysis of TEL-researchers – Study A

The first analysis, called *study A*, includes four cases of researchers, two female and two male, in the area of Technology Enhanced Learning (TEL). Two of these individuals are currently based in the UK and tweet in English. One researcher is working in Austria and tweets mainly in German and finally there is one case of a researcher based in Spain, who tweets mainly in Spanish. However, both the Spanish as well as the German case also include some tweets in English. Three of the cases are holding senior positions at university while the fourth case is someone who recently finished her PhD.

In three cases the analysis includes all tweets that these researchers have published during the second half of 2010. In the fourth case an analysis of such a long period of time was not possible due to the sheer amount of tweets this person is producing. While the first three cases might produce up to four or five tweets on intensive days followed by longer periods of silence the fourth cases publishes at least over 10 tweets daily and reaches up to 60 tweets on days of heavy Twitter usage. Thus the fourth case has been coded only for a few days. Still, the overall amount of tweets that have been coded is similar to the other three cases.

What is common in all cases is a clear tendency to tweet around events. The complete frequency report including all four cases confirms this behavior (see Fig. 2). As previously mentioned the codes presented in Fig. 3 have been extracted from the tweet texts of the four cases. Whereas some qualitative researchers start with a set of predefined codes we have chosen a completely open approach allowing that the codes emerge from the text only. Having selected TEL researchers as our target group it is not surprising that TEL topics are dominating across the cases. Content related to technology and education is also frequently found in all cases. In two cases references to technology are often coupled with personal experiences regarding the technology in question. Going into the four cases in more detail the following observations have been made:

The first case mainly twitters around events. The style can be described as a sort of broadcasting of what is being presented or discussed during events in order to allow other people to follow the event via Twitter. The analysis shows some intensive Twitter activity during and around events followed by longer periods of no Twitter activity. Apart from this event tweeting practice some direct communication with others can be noted. This case does not refer to anything private; we only identified work related tweets that are mainly dealing with TEL topics, including theoretical approaches and education.

The second case is also tweeting a lot about events, but in addition personal experiences are frequently addressed. These tweets about personal experiences are often coupled with the usage of new technologies. Again, in this case there is very little private content, although not completely excluded. The personal experiences that are rather frequent may reveal some private aspects but are usually still somehow related to a professional topic. There is very little direct communication with others and the main content topics are related to education, university administra-

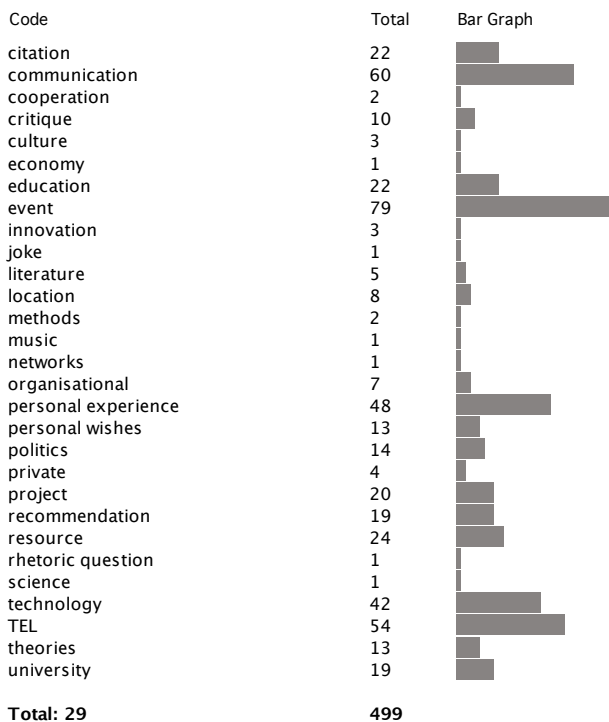


Figure 3. Frequency Report

tion and political issues, and theories such as innovation theories, pattern theory, and educational theories.

The third case follows again a broadcasting style with very little direct communication with others. Personal experience is usually related to the use of new technology. Apart from tweeting about events this person tweets a lot about specific research projects in the area of TEL, points to resources and gives recommendations.

Whereas the previous three cases show some similarities in their usage of Twitter the fourth case is rather different. Apart from the very high frequency this case is using Twitter as a means for direct communication with individuals and small groups of people. Although the content of the tweets is still dominated by work related elements personal experiences and personal wishes for other users are very frequent. This corresponds with the fact that this person uses Twitter primarily for direct communication with other users.

*B. A broader approach – nine scientists of different disciplines – Study B*

The analysis of TEL-researchers is not the first such attempt to discover microblogging practices of researchers, however it is unique in its specific target group of TEL researchers. Schmiermund e.g. described the Twitter usage of researchers from medicine, biology, social sciences and chemistry [30], while we opened a further similar approach to any discipline [31]. It should be taken a look if there are differences between our specific user group.

The complete analysis of the second study, called *study B*, contains 1350 different Tweets twittered by nine scientists and collected within the period of a year. The data extraction from the Twitter-Website was again carried out with the described application Grabeeter, coding and analysis of the Tweets were done as before manually. For the purpose of reproducibility the following three analysis

criteria of Schmiermund's study [30] were adapted: 1. Tweet content (if work-related or not), 2. the use of direct or indirect communication within Twitter and 3. information pass on through Re-Tweets with or without embedded hyperlinks. Additionally classification categories for the work-related Tweets are created to demonstrate different purposes for which scientific Tweets are written.

*1) Tweet content*

Within the analysed sample the proportion of work-related Tweets is 64,4% (Schmiermund collected 81,3%). The classification of the Tweet topics shows that the majority of scientific Tweets gets posted for the purpose of sharing resources with others (38,1%) like pictures, short videos or slideshares e.g. from scientific events like conferences, presentations or workshops or courses from university. This number gets followed by work-related conversation or discussion with other Twitter users (26,9%), mostly within the same field and about work-related topics. The third purpose of using Twitter in science is the function of a personal, but public note-tool (14,4%). Thoughts and ideas are written down quick and easy and can be shared in real time with the own group of followers. In higher education Tweets can in this way used as documentation for the own working process. 9,6% of work-related Tweets are written in the context of scientific events for arranging organizational issues like planning the journey from and to the venue where a conference takes place, beginnings of workshops and presentations and so on. 7% of the work-related Tweets contain references to scientific publications within the own research or working-field, which are mostly new or notably interesting or worthful to read them. A very low number of Tweets contain personal experiences with tools or applications for scientific work (4%) and additional comments about their usefulness.

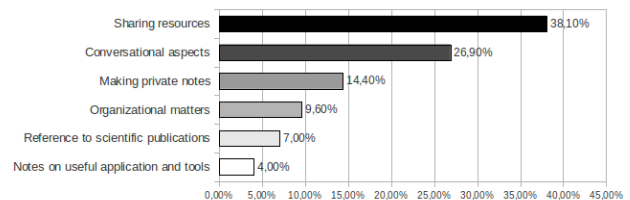


Figure 4. Classification categories of the work-related Tweets of nine scientific profiles of different fields

*2) Direct and indirect communication*

The @-sign within a Tweet message can be used for replying or mention other users. Both methods are common in general Twitter communication and so also used by scientific Twitter users. The data material of the present sample shows a general @-communication proportion of 52,1%, consisting of 30,8% direct communication (in form of replies) and 21,3% indirect communication (in form of mentions). Schmiermund detected in his study from 2009 a proportion of 50,7% @-communication containing of 31% indirect communication and 19,7% direct communication. We can see that using the @-sign for addressing other users is a very popular communication method within Twitter. In this sample about every second Twitter message contains the @-sign and shows the obvious tendency to exchange with others, which is an important part of collaborative working.

### 3) *Information pass on*

Next to the conversational aspect stands the eminent demand of distribution within Twitter. A possibility to pass on received information is the Re-Tweet, sometimes added with an own comment, which underlines why it is worth retweeting. Hyperlinks within a Tweet, mostly shortened because of the limited number of Tweet-characters, are also very popular as a possibility to show further information or an information source. Both, Re-Tweets and Hyperlinks within Tweets are indicators for intended information transfer among others. The proportion of Re-Tweets within the sample is 15,4%, whereof 6,2% of these Re-Tweets have an additional annotation of the user who retweeted it, mostly explaining the reason why the Tweet is worth being retweeted. This number goes approximately with Schmiermund's results: he noted a Re-Tweet proportion of 17,2% within 7,6% Re-Tweets annotated. Impressively high is the proportion of Tweets with embedded Hyperlinks: more than half (52,5%) of the work-related Tweets contain information source or additional information to the written messages. This rate comes up by far higher as in the study of Schmiermund: he noticed a hyperlink proportion of 13,6% which means that every seventh Tweet contains information to a continuative source.

Another popular method in meaning of a social convention among Twitter users is the habit to use „hashtags“ for marking specific words or terms in the meaning of „tags“ with the hash-sign (#). Every Twitter user can search for hashtags and in this way join conversations and get to know new users for possibly further exchange on Twitter. So we can say that hashtags are important for building groups of interests, which can also be important related to scientific or work-related exchange. The proportion of hashtags within the work-related Tweets of the study was 57,13%. This very high number can - amongst other reasons - be explained by the common use of hashtags in the context of scientific events, for example the conference-related hashtag #edmedia for the annual upcoming conference for „Educational Multimedia, Hypermedia and Telecommunication“.

It is evident, that the main purpose of scientific Twitter posts is distribution and conversation of specific information. First, work-related information, either related to research resources or to events, gets passed on from one to many users on Twitter. Because of individual groups of followers and connections between them, knowledge can get widely spread in the mode of the pyramid scheme, mostly supported by Re-Tweets. Second, scientific Twitter users make conversation using different communication forms like direct/indirect but public or private/non public communication for exchanging ideas, making or answering questions, demands and so on. Regarding the fact that communication is always the key, Twitter communication can be seen as an additional communication channel, which can be beneficial for collaborative working.

## VI. CONCLUSION

Our two studies as well as Schmiermund's one have noticed the fading distinction between private and work-related content, which depends in part on the individual decision if some private content would be beneficial for gaining new followers and/or preserving existing follow-

ers. On the average the proportion of private Tweet content is lower than one third of the whole amount of Tweets in a scientific profile. But at last it depends on the user who is responsible for the written content. *Study A* noted that three of four analyzed profiles are in a certain way similar to the others and one differs because of a different Twitter behavior like doing a lot of direct communication with others and having a high Tweet rate in general. Furthermore *study B* tried to detect some kind of prototyp of a scientific Twitter-user by analyzing nine different profiles of tweeting researchers and getting together all data for an average-type. But similar to *study A* it can be stated a strongly individual Twitter behavior, depending on general motivation and interest in Microblogging and also on the contextual situation when Twitter gets used, for example twittering a lot when being on a conference but sending only a few Tweets if there is no such event. The result is, that an average-type can only show tendencies of a scientific Twitter behavior because of too many personal divergences. This fact is in part responsible for the different results of the three studies shown below. Both, study A and B made an open approach to the data material, based on the grounded theory, where the codes emerge from the text during the analysis. The results diverge in a certain way because study A concentrated on TEL researchers and so her most frequent topics are (in downward order): event, communication, TEL and personal experience/technology. Study B concentrated on receiving information about the intentions why Twitter is used by researchers and scientists in general. It can be noticed that sharing resources and doing conversation easily, followed by using Twitter as a personal note-tool and as a tool for managing organizational issues are the main amenities in her study. Interestingly the experience gained with new tools that might be interesting for the peer community for their scientific work and teaching are rated lowest in study B while in the described cases of TEL researchers the personal experience with tools and services is a frequent subject matter of Twitter posts. In the TEL cases the broadcasting style is dominating over direct communication with others which goes with the finding of study B that approximately one third of all Tweets contain direct communication in form of an @-reply. Disregarding divergences coming up from taking only a snapshot of current practices in research microblogging, sharing information and doing conversations are the key aspects.

Finally we would like to stress that all described analysis are based on few cases and so can not intent to draw any conclusions regarding the Twitter behavior of researchers in general. Still the qualitative analysis of individual cases depicts a snapshot of the temporal usage of Twitter that reveal some idiosyncratic microblogging styles.

## VII. FUTURE WORK

This paper presents an initial approach to qualitative analysis in order to gain a better understanding of microblogging practices of scientists, specifically in the TEL research community. Four individual cases in study A and further nine in study B have shown some commonalities as well as diverging practices. Interestingly, three cases are similar in applying a broadcasting style with little direct communication while the fourth case is characterized by intensive direct communication. The three similar cases are all individuals at a similar stage in their careers,



holding a high position at university, while the fourth case is a younger researcher in an earlier stage of her career.

When comparing the results with similar approaches applied to a wider target group of scientists a number of similarities arise. One of the main motivations of researchers for using Twitter is clearly the fast information distribution and exchange that is achieved via microblogging.

We are currently at an initial stage of a longer research endeavor to gain insights into microblogging practices of scientists. Future work will concentrate on analyzing more cases, conducting open-ended interviews and reflective talks with members from the target group. We would like to get a better understanding of the contextual embedding of microblogging, its purpose and value for the individual and the specific scientific community.

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