



EC Project 687916

## D4.2 - Report on the analysis of self-organization

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## Change Log

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## Executive Summary

According to the co-evolution model of learning and knowledge construction [CK08], learning on the side of individuals and knowledge construction as a social phenomenon are structurally coupled. Knowledge communities as social systems provide their members with a system of shared knowledge and meaning to facilitate communication, cooperation, and collective problem solving. Whenever such a social system is irritated, for example, by means of statements of individuals that question established ‘common sense’, values, and attitudes, the social system will engage in self-organization processes to restore functionality. More precisely, the social system will regulate which information can be communicated among its members and how such information is to be processed.

After summarizing the theoretical, background, we compare five social media websites (Youtube, Facebook, Twitter, Reddit, Didactalia, IMDB) with regard to processes of self-organization. In all communities, the regulative mechanisms of ‘law, norms, market, and code’ [Les99] are employed to different degrees. Most communities rely at least in part on collaboration with their users in identifying unwanted content and in deciding how to deal with such content. The emergence of ‘echo chambers’ — knowledge communities of individuals with very similar values and ideologies that are prone to increasing radicalization as a consequence of continuous self-reinforcement — can be a problem for social media sites.

We present findings from an empirical study on contributor and discourse characteristics that have a positive or negative effect on the quality of Wikipedia articles. For the present study, we analyzed the edit history of more than 18.000 health-related Wikipedia articles. Only relatively few of them (99) received at some point in their edit history a tag or template message that indicated bad quality of the respective article (e.g., neutral point of ‘view violation’, ‘confusing content’, ‘inaccurate content’). Compared to the authors of those articles that were not tagged negatively, the authors of the tagged articles were less experienced and had a lower breadth of interests as indicated by a smaller number of articles to which they had previously contributed. We also found evidence that the growth rate in terms of added characters, references, or sections per edit of the ‘bad’ articles is lower compared to the other articles. This may be an indicator for a higher prevalence of ‘edit wars’.

In the final section, we discuss implications of the aforementioned studies for the AFEL project. On the one hand, our findings regarding patterns of self-regulation in successful social media communities and our study on contributor and discourse characteristics that have a positive or negative effect on the quality of Wikipedia articles shed light on factors for the successful (self-) management of social media communities in general. On the other hand, our research will have an impact on the visualization of contested knowledge and meaning making processes in WP3.

# Table of Contents

1. [Self organization in the co-evolution model](#)
  - a. [The co-evolution model of learning and knowledge construction](#)
  - b. [Assimilation, accommodation, and equilibrium](#)
  - c. [Self organization in the social system](#)
2. [Self organization in different social media communities](#)
  - a. [General outline and rationale](#)
  - b. [Youtube.com](#)
  - c. [Facebook.com](#)
  - d. [Twitter.com](#)
  - e. [Reddit.com](#)
  - f. [Didactalia.com](#)
3. [Self organization in Wikipedia](#)
  - a. [Previous empirical research](#)
  - b. [The effects of user and discourse characteristics on the quality of Wikipedia articles](#)
  - c. [Results from a first study](#)
  - d. [Discussion and directions for future research](#)
4. [Implications for AFEL](#)
  - a. [Facilitating the self-organization of knowledge communities](#)
  - b. [Positive and negative factors in collaborative knowledge construction](#)
  - c. [Visualizing contested knowledge and processes of meaning making](#)
5. [Conclusion](#)
6. [References](#)

# 1. Self organization in the co-evolution model

The goal of this deliverable is to provide an overview of the theoretical background and ongoing research on self-organization processes in learning and knowledge construction in the context of the AFEL-project. Our theoretical framework will guide data collection (WP1), data enhancement (WP2), the development of tools for visual analytics (WP3), and it will open up chances and possibilities for the application of AFEL technologies (WP5). Findings from our empirical research will also influence on the development of tools for learning analytics and their application in real world contexts. As we will outline below, self-organization is one of the key concepts in the co-evolution model of learning and knowledge construction. A substantial amount of the actual behavior on platforms such as *Facebook*, *Youtube*, or *GNOSS/Didactalia* that is related to learning and knowledge construction can be understood and explained as a consequence of self-organization efforts.

## a) The co-evolution model of learning and knowledge construction

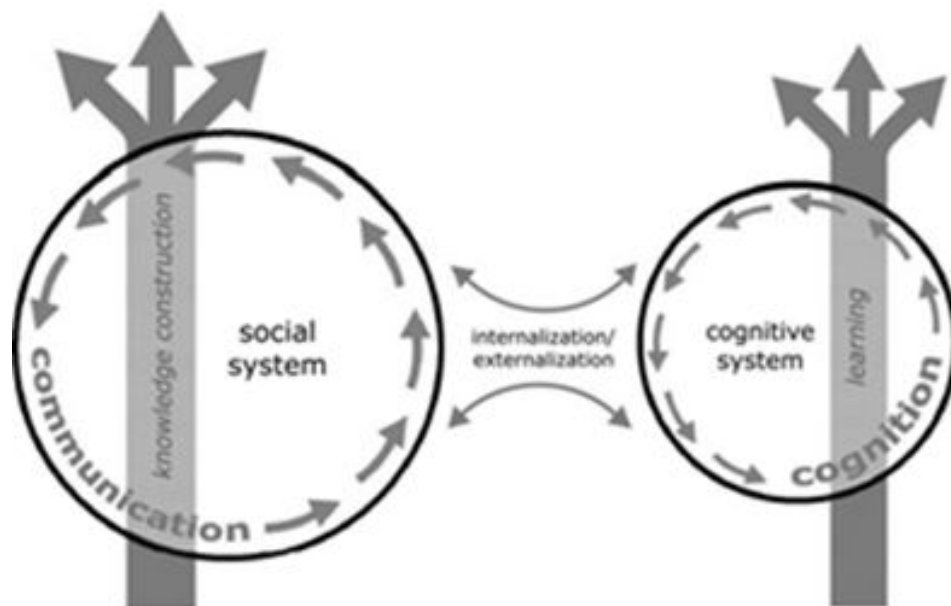
The co-evolution model of learning and knowledge construction [e.g., [CK08](#)] serves as the guiding theoretical framework for the AFEL project. It posits that learning and knowledge construction are both the result of the structural coupling of individuals' cognitive systems with the modus operandi of 'thinking' and a social system with the modus operandi of 'communication'. Both systems main function is to reduce complexity as means of maintaining their functionality and securing their further existence. In systems theory, this maintaining of the own existence is called autopoiesis [[Mat75](#)]. Cognitive and social systems serve as environment for each other and are continuously exchanging information. Whenever information that is taken up by an individual from the social system (internalization) or communicated by an individual to the social system (externalization) goes against established beliefs or conventions, such information can irritate the other system and cause reactions as means of restoring functionality [see D4.1 or [HKCur](#) for a more extensive summary of the co-evolution model].

For example, an interesting and previously unknown statement that an individual encounters in the course of an everyday learning activity—for example, in the course of browsing the internet—can disturb the individual's cognitive system in the sense that suddenly previously held beliefs, attitudes, and opinions are questioned. This creates the need to restore a coherent concept of the world as means of maintaining the system's functionality in terms of being able to cope with the environment in a way that ensures survival. On the other hand, a statement by an individual, for example in form of an edit on a knowledge constructing website such as Wikipedia can disturb the social system by questioning beliefs, values, and attitudes of the respective community. In turn, this irritation can trigger communication processes as means of restoring a coherent worldview within the community in order to ensure the community's survival (see Figure 1). If the community does not manage to restore

a common worldview, it may dissolve into several new communities in the sense of new representational projects [e.g., [BG99](#); [BG08](#)].

Over time, overcoming such irritations in a productive way, that is, a way that restores cognitive functionality in case of the cognitive system and that ensures the survival of a community as a representational project in case of the social system, leads to a system drift: On the side of the individual's cognitive system, this drift can be called 'learning' and it is characterized by increasing capabilities to cope with irritations from the environment; the corresponding drift on the side of the social system can be called 'knowledge construction'.

In economics, the concept of 'productive friction' has become popular over the last decade since Hagel and Brown's seminal paper [[HB05](#)]. In economics, 'conventional wisdom' holds that a conflict or friction between colleagues and/or business partners is necessarily a bad and unwanted phenomenon. Yet, in an economic environment with increasingly rapid cycles of innovation, friction should be perceived more as a chance and opportunity to quickly adapt to a changing environment. Still, friction is only 'productive' if a company is able to effectively solve the problems at hand at reasonable costs and without losing the organization's sense of coherence. We think that the metaphor of productive friction captures perfectly fine what is needed for learning and knowledge construction as productive ways of overcoming irritations [[HKCur](#)].



*Figure 1.* The dynamic processes of learning and knowledge construction [[KMOC15](#), p. 128].

## b) Assimilation, accommodation, and equilibrium

Other important theoretical predecessors for our conceptualization of the role and importance of productive friction for learning and knowledge construction are constructivist theories of learning as proposed by, for example, the two greats Jean Piaget and Lev Vygotsky. In line with Piaget, we assume that the cognitive as well as the social system strive to cope with ever-changing environments [[Pia87](#)]. They accomplish this either by assimilation, that is, the integration of new information into the existing structures (cognitive structures or ‘common knowledge’ in a social system) or by accommodation, that is, the change in existing structures as a consequence of irritating input into the system. A certain amount of accommodation is necessary to ensure growth in terms of increasing capabilities to cope with the environment. Too much accommodation, however, would equal chaos and constitute a danger to the respective system. Hence, individuals aim at an equilibrium between assimilation and accommodation [[Pia87](#), [HKCur](#)].

The focus of Piaget and other educational psychological researchers has most often been on individuals’ coping with irritations and their attempts to restore an equilibrium [[MGMS12](#)]. Although Piaget acknowledged the importance of social interactions for learning [[DeV97](#)], it would be difficult to explain the learning of elaborate language or scientific theories simply as a consequence of assimilation and accommodation on the side of an individual learner. In line with Vygotsky [e.g., [Vyg34/62](#)] we argue, that learning more complex patterns of cultural knowledge depends heavily on social interactions, during which the learners’ original understanding of the world is transformed into collectively shared scientific concepts by means of social challenge and support, thereby “scaffolding” [[Bru66](#)] the learner to the “proximal zone of development”. The learner is thereby enculturated into a knowledge community [cf. [HKCur](#)].

The focus of this deliverable will be on the social system: How do (for example) online learning and knowledge constructing communities deal with irritations in form of being confronted with statements that run to a certain degree against prevailing knowledge, attitudes, opinions, and values? Which are productive ways to deal with such irritations and which are ways that lead to a detrimental outcome? What are potential moderators of the effectiveness of self-organization strategies in organizations?

## c) Self-organization in the social system

Within Luhmann’s systems theoretical approach [e.g., [Luh95](#)], social systems are systems of communication. The most encompassing social system would be a world society; that is particularly true for the world of the information age [[Cas03](#)]. Within this super-system, societal subsystems can be differentiated from each other. These subsystems are defined by a shared knowledge or sense of meaning among their members. They are operationally closed in the sense that, although they are constantly engaged in exchange processes with their

environment, only selected pieces of information from the environment are processed within the system; furthermore, these pieces of information are perceived through the lense of common sense; thereby, they are appropriated by the social system and integrated into the communicational structures that set apart the system from its environment. In a nutshell, the social system filters out certain information and transforms the information it takes in into socially shared representational structures to ensure common sense as a shared sense of meaning that differentiates its members from non-members of the societal sub-system.

If we look more specifically at knowledge communities as social sub-systems, self-organization entails on the one hand processes of filtering out information that is not processed within the respective social system. As means of ensuring the system's survival, which depends on common sense and shared understanding, a system can only 'digest' a certain amount of information that defies socially shared structures of meaning. Hence, we hypothesize that every knowledge community in so far as it constitutes a societal sub-system, will devise mechanisms to reduce the amount of non-processable information to a tolerable limit. Presumably, this limit is related to a system's flexibility and its ability to deal with friction in a productive way. On the other hand, social systems will also develop specific means of processing information in a way that constitutes socially shared meaning among its members. These processes will be analyzed more closely in D 4.3 (report on the analysis of handling complexity) and D 4.4 (report on the analysis of the constitution of meaning).

Since the emergence of the internet as a mass phenomenon, several theoretical frameworks for the regulation of behavior on the internet have been developed. One of the most influential approaches is Lawrence Lessig's 'pathetic dot theory' [Les99]. Here, four factors are at play in regulating human beings' behavior inside and outside of cyberspace [see Figure 2]: One is the 'architecture', or in the case of the internet, the 'code' in the sense of what actions are made possible or 'allowed' by the 'technical infrastructure' and which are not. For example, possible interactions between users and Facebook are limited by means of Facebook's software architecture. A corresponding way of regulating behavior in the 'real world' would be, for example, the restriction of access to certain areas by means of doors and fences. Behavior on the internet (and outside of it) is regulated as well through the 'forces of the market' or supply and demand. On the other hand, there are implicit and explicit rules or, in other words, social norms and laws that regulate behavior. In internet communities, the term 'law' can on the one hand refer to the 'actual' law in a given state or the explicit rules and regulations that the operators of the webpage defined. In the case of social norms, Kittur and Kraut [KK08] further differentiated this aspect of regulation into implicit and explicit coordination. Explicit coordination relies on communication regarding specific aspects or the website's general policy. Implicit coordination concerns the acceptance and effective execution of the respective rules by means of unspoken expectations and shared knowledge. Such implicit coordination has been found to be particularly effective whenever a high number of contributors is involved.



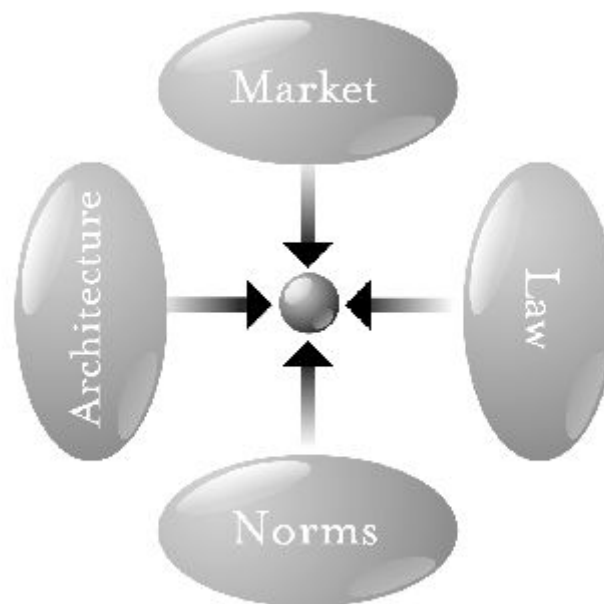


Figure 2. [Les99] as quoted on [https://en.wikipedia.org/wiki/Pathetic\\_dot\\_theory](https://en.wikipedia.org/wiki/Pathetic_dot_theory)

Within the main section of this deliverable, we will first present a descriptive summary of how different social media communities such as Youtube, Facebook, and Wikipedia decide, which information can be shared with others and which cannot, which rules they devise to deal with major irritations in the sense of information that goes against socially shared beliefs, values and attitudes, and how trespassing of these rules is sanctioned in the different communities. Here, we will consistently differentiate between implicit and explicit types of coordination as outlined above. Afterwards, we will focus more on the arguably most important knowledge platform at the present time, that is, Wikipedia. We will present results from a study on the effects contributor and discourse characteristics on the quality of Wikipedia articles in the field of medicine and health and discuss these findings in line with our theoretical reasoning on self-organization in social systems. In the end, we will discuss further implications for the AFEL-project and conclusions for research on knowledge communities in general.

## 2. Self organization in different social media communities

### a) General outline and rationale

In the following section, we will compare how users and operators of different social media websites that can either be used for everyday learning or that explicitly aim at learning and

collaborative knowledge construction (a) negotiate which type of information can and should be shared on the platform, (b) determine which formal and/or informal rules they devise, and (c) define how trespassing these rules is sanctioned in the respective communities. Therefore, we selected a couple of interesting and relevant social media platforms to compare their activities on the mentioned points. To identify the popularity of a certain website we focused on the data revealed by the website itself and, in addition, we used the ranking system of *Alexa.com* and other sources. It is our concern to give an overview about the various types of social media sites regarding their self-organization.

## b) Youtube.com

Youtube, which has the slogan “Broadcast Yourself”, is the most famous video platform on the Internet. Youtube was first officially launched in 2005 and was founded by Chad Hurley, Steve Chen, and Jawed Karim. In 2006 Google acquired YouTube for 1.65 billion Dollar and in 2008 the website hosted over 85 million videos, numbers increasing. In 2007 already 43% of all shared online videos were uploaded on Youtube [Kim07] and 2009 the “internet market research company *com-Score* reported that the service accounted for 37 percent of all Internet videos watched inside the United States, with the next largest service, Fox Interactive Media, accounting for only 4.2 percent” [BG09, p. 2]. Today Youtube has more than 1 billion users and “every day people watch hundreds of millions of hours on YouTube and generate billions of views.” (<https://www.youtube.com/yt/press/statistics.html>) The platform is earning money by allowing private companies or users to show advertising. This means an advertising video clip is shown up before the actual video. Advertisers can determine their daily budget and decide which customer they want to reach based on age, gender, interests or location . Additionally, Youtube is selling its advertiser a support on creating their ad-video. (<https://www.youtube.com/yt/advertise/launch-ad.html>, <https://www.youtube.com/yt/advertise/make-video-ads.html> <https://www.youtube.com/static?template=terms>).

Youtube is also used for educational and everyday learning. By being the biggest provider of Video-Uploads, Youtube is a distribution place for all kind of learning videos, e.g. Tutorials, How-to-Videos or talks and events. The content is often not only viewable on the Youtube website, but also on other learning websites. This means people are uploading their video on Youtube, but they embed it on their own website as well. Youtube is providing a tool that allows for watching videos on an external site without visiting the Youtube-Website. Therefore, different learning platforms can evolve their own organisational structure on their website without relying on the structure of the Youtube website itself.

With regard to the the architecture (code) of the website, the tools to upload a video and even the video format and quality settings are provided by Youtube itself. Members can create channels, on which they can upload their own videos or recommend videos of other channels and where they can create playlists as another organisational tool to sort and categorize their videos. Users have full control over channels and playlists, as long as they comply with

Youtube's general guideline (see below). Apart from the front page, where Youtube is recommending channels and videos, the website has its own search engine to find content.

All content (videos) on the website is provided by private users, organizations, or companies, called Youtubers. All user-generated content (UGC) is for free and users don't even need to sign in on a membership to watch it. But to upload own videos, to subscribe to other channels, to like or dislike a video or to leave a comment under a video, a Google account is needed. Youtube is using views and likes to measure the popularity of a video and the number of subscribers to measure the popularity of a channel. Furthermore Youtube grants it's Youtubers a share of the advertising profit if their videos and channels are popular. Consequently, likes, views, and subscribers have a monetary value and it can be seen as an implicit rule that users are liking and subscribing videos and channels of Youtubers they want to support. In the context of supply and demand, popularity is a limited resource and the members compete for it. Videos rated as popular ones are appearing at the front page or in the recommended-video-list beside each video; hence, Youtubers are 'begging' their users for likes and subscribes [Pos16, p. 337-339].

Although Youtubers are basically free to broadcast whatever they want, there are incentives to share content that caters the needs of a target audience for example by following recent trends and fashion — if the Youtuber is interested in making money. The playlist and channel functions facilitate the emergence of sub-groups among the Youtubes that share an interest in a certain form of videos and potentially attitudes, opinions, and maybe ideologies. Recommender systems that recommend content from other users that is with regard to some features similar to previously consumed content, may even accelerate this trend. With regard to learning, these phenomena become particularly relevant whenever Youtube is used in the context of (at least partly) planned and learning activities, for example in MOOCs [GKR14].

The website's policies can be seen as explicit rules. As mentioned above, explicit rules can be understood in two different ways: 'Official' laws in the state in which the Youtubers and users live and in which Youtube itself is registered and the 'internal' rules issued by Youtube itself. Because of this ambiguity, there are often contentious issues whenever Youtube's policies are not consistent with the law of a specific country, for example, if there are differing views between Youtube and private companies with regard to copyright issues [SZ16] or different views regarding violent and pornographic content. Youtube relies heavily on the Youtubers' cooperation in identifying and removing unwanted content; every registered user is allowed to report content to the administrators. The final decision regarding the content is taken by the administrators, which are Youtube employees.

### c) Facebook.com

Facebook, the most famous social network page (SNS) on the internet, opened to the public in 2006. Worldwide, Facebook has more than 1.8 billion users every month and it's service is available in 70 languages (<https://www.facebook.com/business/measurement>). Facebook is

only accessible with an account (profile), where users have to provide some personal information [CFCSVB13, p. 983]. On Facebook, firms and companies (or private people as well) can also create their own business page and start advertising this page with the help of Facebook. Users can pay Facebook to promote their business page; the page will then be shown in the news feed of other users who consumed to some degree similar content.

(<https://www.facebook.com/business/learn/facebook-page-basics>)

In general, there are three different elements of self-organization provided by facebook: Every user creates his own profile, the users can create groups, where they can share information with other group members, and users can create public pages and reach more people with it. Furthermore, users can report content that they consider inappropriate to Facebook. The final decision regarding a potential removal of such content is taken by Facebook employees. Depending on the privacy settings, users have different access to profiles, groups, and public pages. Owners of pages and groups have administrative rights to structure content, remove posts, or to ban users. Users can be “friends” with others by sending and confirming friend requests. Facebook became popular in the past for its power organizing and mobilising people, e.g. during the protest in Egypt 2011. “The protests began on January 25, 2011, and during the following 2 weeks over 32,000 new groups and 14,000 new pages were created on Facebook in Egypt” [WGG12, p. 213].

Similar to other social media websites, Facebook policies prohibit sexual and violent content, as well as spam. A difference to other websites is that, Facebook explicitly prohibits fake profiles and abusing Facebook features, e.g. “sending friend requests to many people you don't know“ ([https://www.facebook.com/help/1735443093393986?helpref=hc\\_global\\_nav](https://www.facebook.com/help/1735443093393986?helpref=hc_global_nav))

In comparison to other social media websites, Facebook is very selective with its information. Algorithms decide which information will pop up on users’ news feed, based on the interests they showed in the past by ‘liking’ different pages or posts and based on information their friends are sharing. This means Facebook is deciding for its users which information could be interesting for them and which is not. The selective mechanism for the content is not community based. This means it is not transparent if the pages on someone’s news feed are recommended because of a paid advertising campaign, the news’ popularity, or because the algorithm decides that this content fits to the user’s interests. Various empirical studies have recently investigated the negative influence of selective information display and perception in social media communities [Grö14]. In the worst case, users with very similar attitudes and ideologies will bond together in groups, share only information that is re-enforcing their attitudes, and receive only information in their news feeds that further supports their views. These factors can lead to the so-called ‘echo chamber effect’: Under these circumstances, members of such communities are prone to increasing radicalization [BMA15].

Studies show that the content contribution of new users is influenced by social learning and social comparison. “Findings revealed that new members were closely monitoring and adapting to what their friends were doing and that the experiences in the first 2 weeks

predicted long-term sharing” [WGG12, p. 213]. This means that newcomers are adopting content contribution patterns from their friends. For example, if an inactive newcomer is getting a comment about a friend’s photo upload, s/he will be more likely to upload a photo as well. At this point it is worth to mention that Facebook has a variety of different communication tools, more than every other comparable website [Ste09, p.4]. Besides sharing, posting, and liking, methods of communication are private messages or group chats and recently, Facebook implemented a voice and video chat. But the use of these communication tools seems to be dependent on the social learning and comparison process, and is closely related to one's specific social environment.

Another interesting point is that approximately 47% of Facebook users say that they receive news from the website. But information on Facebook can originate from professional journalists but from friends as well, if they share content that appears on their news feed. This means with regard to everyday learning that not only professional journalists, but also Facebook friends can function as information gatekeepers. Turcotte et al found out that “a news story recommendation from a friend on social media will increase the intent to seek future information from the news outlet, compared to receiving the same story directly from the traditional news outlet where it appears.” This can lead to a new form of opinion-leadership on Facebook [TYISP15].

In sum, Facebook devised efficient tools to facilitate the development of sub-communities that share interests in certain topics, attitudes, and/or opinions. The emergence of echo-chambers and radicalization processes within these chambers have recently given rise to concerns about the self-segmentation of the Facebook community and discussions began if and how self-organization processes can or should be controlled and tamed by Facebook administrators.

#### d) Twitter.com

Twitter was first launched in 2006 and its popularity grew rapidly over the last decade. [AG10, p. 222]. The online service is called a “microblogging site” [Ste09, p. 4], where people are permitted to create a channel and post messages on it up to 140 characters a text [AG10, p.222]. Twitter has 1 billion unique monthly visits of sites with embedded Tweets and has about 300 million active users (<https://about.twitter.com/company>). The messages (‘tweets’) are produced by private people as well as by companies. To earn money the website is offering an advertising service for its users.

From an infrastructural perspective (code), the website is very simple, but this also limits its possibilities for the user. The self-restriction allowing only short text messages determines the communication behavior of its users. Therefore “the platform is an ideal environment for the dissemination of breaking news directly from the news source and/or from the geographical point of interest” [BGRT13, p. 262] or for sharing references/URLs and linking to external content. Otherwise in a tweet itself the amount of information, that can be shared,

is limited. There is also the opportunity of simply copying a tweet of somebody else, to share a specific message with one's own followers, which is called retweeting. Because of the multiplicity of connection between the users a message can easily reach a lot of people only by retweeting.

There are two main organisational structures. The first one is the following system, which means that people can follow one's channel and the second one is the hashtag. "In twitter, hashtags are a community-driven convention for adding additional context and metadata to tweets." [WWLZZ11] Originally it was implemented by the creators of the platform to categorise messages and highlight topics, by prefixing a word with the hashtag symbol (e.g. #hashtag). Furthermore the hashtag is not only used as a self-organization tool but also expands its attribution of meaning. For example a hashtag can be used to express a certain sentiment (e.g. #love or #sucks). [WWLZZ11]

As most other social media websites twitter has its own policies, which can be described as explicit rules for the behaviour of the whole community. People can either report content to the administrators or just ban specific user or post on their own overview. Twitter has a detailed reporting system, so they even have some tutorials on their website to explain how to deal with different policy violations. In the same way as every website, which is dealing with Big Data, Twitter is highly relying on the reports of its users, but also using algorithms to delete unwanted content.

With one specific policy Twitter is going much further than comparable websites. The platform is banning posts which are linking to content on other websites that is violating Twitter's policies. There were several noteworthy cases in the past in which Twitter banned posts from health-organisations about sex education, because they linked to websites where, according to Twitter, sexual content can be seen. The problem is that with the enormous amount of traffic that social media platforms such as Twitter are generating, they are overstrained to control or check their content or react to rule violations individually. An overly strict enforcement of such rules can impede learning processes and lead to a biased representations of contents [Mad15].

Similar to Youtube, popularity is an important resource, which can be measured with the number of followers a channel has. An interesting self-organizational structure, which can be seen as an implicit rule, is that some channels function as gatekeepers. "The more followers a Twitter user has, the more likely it is that their tweets will be retweeted" [BGRT13, p. 263]. This means that that new channels depend on the support of more famous channels. Actually, famous channels supporting newcomers is a common practice and is called "shoutout".

It is interesting to note how a service that restricts the possibility of the users to share content massively by restricting it to just 140 letters could become that popular. It seems that the limited size of the messages allows for a constant flow of easily digestible pieces of information that establish a bond between the sender and the followers. Approximately 80% of all tweets comprise just status updates in the form of short expressions of thoughts and

feelings [NBL10]. However, the other 20% that are related for example to societal and political topics have recently been in the focus of scientific research and societal debates in the aftermath of Donald Trump's presidential election campaign. Commentators have expressed concerns that spreading political information and news in the form of short informal status updates promote oversimplification, impulsivity, and incivility in the political arena [e.g., Ott17]. It can be assumed that these potentially detrimental developments also affect processes of everyday learning that draw upon Twitter information.

In the context of structured learning activities, Twitter is mainly used to facilitate communication among the learners. However, Twitter's hashtag function is used as well to identify and to organize related learning content and to organize knowledge communities in the sense of learners or even scientists that are interested in similar topics. The selection of appropriate hashtags itself can also be used in a didactic sense to facilitate summarizing the main points of an educational activity [vTE13].

## e) Reddit.com

Reddit, proclaiming itself "Front Page of the internet", is an example of a highly community dependent platform, where members cannot only share their content including stories, links, and images. It is also possible for members to create their own sub-communities (subreddit) for a specific topic, where they can establish their own rules and observe them. Furthermore, Reddit is a so called "social voting site" [Gil13, p. 803], which means that users can up- or downvote every incoming content and the most upvoted ones will automatically appear on the first page under a certain topic.

According to *reddit.com* itself, 2017 the website has about 900,000 unique users every day and the total number of visits per day is 3.5 million (<https://www.reddit.com/r/AskReddit/about/traffic/>). The rating system *Alexa.com* places *reddit.com* by popularity on number 7 in the United States and on number 22 worldwide. The Website was co-founded in 2005 by Steve Huffman and Alexis Ohanian; a year later, Condé Nast Publications acquired it. Reddit became a subsidiary of Advance Publications. Since 2012, the Reddit is an independent company again, but Advance Publications is still the largest shareholder. The Reddit Company is located in San Francisco, California. (Sources: <https://en.wikipedia.org/wiki/Reddit>, <http://www.inc.com/magazine/201206/christine-lagorio/alexis-ohanian-reddit-how-i-did-it.html>, <http://www.investopedia.com/articles/investing/093015/how-reddit-makes-money.asp>)

Reddit has different financial models to earn money. Apart from raising a lot of funding in 2014, one way of Reddit to make money is to allow users to create advertising campaigns and to present them as marked-ads on the webpage. Reddit differentiates between managed or self-serve ads, which means that you can let reddit do your campaign, but you have to pay more for the service, or you can create the ad on your own. All advertisements permitted by Reddit are clearly marked and there are no flash or auto-play ads according to their

firm-policies (<https://www.reddit.com/advertising/>). A second way for Reddit to earn money is a membership system. By paying a monthly or yearly rate, users have access to some premium features, like the permission to remove all ads or filter content by their own criteria. This premium membership is called Reddit Gold (<https://www.reddit.com/gold>).

The organisational structure of Reddit is, in comparison to other social media platforms such as e.g. Facebook, very open and less regulated. Every user has nearly the same administrative level and the organisation and allocation of the content is almost completely regulated by the community members themselves. Each member can create and moderate his own subreddit and is allowed to comment every submission. Regardless of all that, Reddit has its own content policy, too. “Content is prohibited if it: is illegal, is involuntary pornography, encourages or incites violence, threatens, harasses, or bullies or encourages others to do so, is personal and confidential information, impersonates someone in a misleading or deceptive manner, is spam” (<https://www.reddit.com/help/contentpolicy/>). In addition to that, they demand a certain behaviour from members, e.g. not asking for votes or not creating multiple accounts to “evade punishment or avoid restrictions”. To enforce their rules Reddit reserves the right to suspend people permanently or remove content. Beyond these rules from Reddit itself, every subreddit can have its own specific rule, enforced by the moderators of each subreddit. Users are also able to report posts, to show that something is spam or otherwise violates the rules of the Reddit policies. According to Reddit a person or a program will review the reported entries and decide occasionally. In comparison to the other social media sites, Reddit does not have that many rules. Hence the two key aspects are spam and the differentiation between adult and non-adult content.

One main problem of the up-down-voting system of Reddit becomes apparent whenever only a small group of members is actively searching for new postings. The focus of the whole community is on shares, which are already popular (up-voted) and new postings, which can potentially be “important” as well, have little to no chance to be seen. Eric Gilbert found out in his study *Widespread Underprovision on Reddit* that more than 50% of the most popular links on Reddit had been posted at least one time before they became popular on the Reddit frontpage. In the same way, the total page view of popular posts is four times higher than that of new posts [Gill3, p. 805]. This can cause problems for users who want to embed new information to the site. Another potential issue is related to the fact that Reddit users can either post external links or they can directly upload textual content to the reddit server, which is called self-submission. A problem Singer and Co pointed out in their study “*Evolution of Reddit: From the Front Page of the Internet to a Self-referential Community?*” is that Reddit is evolving towards a self-referential website over the years, because their users are only reposting content which was already on Reddit and that is not including other content from other parts of the web [SFMZS14]. In line with the co-evolution model [CK08], we can hypothesize that by becoming increasingly self-referential, Reddit is in danger of missing out on too much external information that could provide important irritation for the further development of the knowledge that is represented by Reddit itself.



## f) GNOSS (Didactalia.net and other platforms)

GNOSS is a technology platform for semantic and social software which was developed by the Spanish company RIAM I+L LAB. The main focus of the company is to “help in building the Semantic Web, to help people and organizations to turn human intelligence into technological intelligence, To promote the deployment of the social-digital life, extending the life of people and organizations on the web“ (<http://www.gnoss.com/en/sobre-la-empresa>). The idea of GNOSS is to collect all content, documentaries and social resources of an institution (e.g., a company or an educational institution such as a museum), connecting them in an unified Knowledge Graph, and presenting them semantically. “The semantic representation of the contents allows the machines to be able to identify entities, attributes and their properties, and the set of relations that exist between them” (<http://www.gnoss.com/en/why-gnoss>). This method and representation is said to be more cost and time-efficient, related to the processes of interrogation, information retrieval and knowledge discovery.

GNOSS is supporting the social media website didactalia (*didactalia.net*). Didactalia is an educational community for parents teachers and students providing “educational resources, from pre-school education to high school, structured according to the standards of the semantic web (OWL/RDF) and the principles of Linked Open Data Web” (<http://www.gnoss.com/en/resource/didactalia-improve-and-accelerate-the/87bcf385-7669-472b-a239-5accc1dca98c> ). According to the website itself, in 2013, Didactalia had 8 Million visitors who consumed 25 Million pages. Most of the visitors are from Spain, Argentina, Mexico, Colombia, Peru, etc (<http://www.alexa.com/siteinfo/didactalia.net>). Spanish is the default language for the website. However, there is also a substantial amount of English language content. Apart from user generated educational content, Didactalia features other dedicated websites, such as Interactive Maps, MisMuseos (MyMuseum) or Edublogs. This means that didactalia is linking information of various different sources on its website and is providing tools for social interaction such as publishing and sharing, liking or commenting.

The website has a specific organisational structure. All data on the website is expressed in an educational graph, which integrates different informations distributed by creative teachers, educators, and cultural agents. The educational graph is emerging from the connection between Didactalia resources and DBpedia entries. DBpedia is “a crowd-sourced community effort to extract structured information from Wikipedia and make this information available on the Web” (<http://wiki.dbpedia.org/about>). This offers a way to structure the information natively through a basic set of vocabularies, that is helping users to navigate through the site and improves the search engines.

Although GNOSS/Didactalia is less community driven than the other pages we studied, there is an explicit code of ethics that asks users for example to identify themselves, to only share appropriate and legal content, not to abuse the GNOSS infrastructure for unintended purposes, not to defame, harass, intimidate or threaten others, and to choose wisely whom

they invite to the community (<http://www.gnoos.com/en/terms-of-use>). However, ideally GNOSS would “favor the free exchange of knowledge without any kind of restriction” (ibid.). Since, GNOSS only intervenes whenever they think that the code of ethics or legal requirements have been violated.

Didactalia is sorted by articles or posts. A post can be a link, a video, an interactive map, or just a text. Most of the content is only linked or implemented at the page but hosted somewhere else.

## g) Summary

In the previous paragraphs, we analyzed self-organization in online communities with regard to (a) the type of information that can and should be shared, (b) formal and/or informal rules, and (c) sanctions against trespassing these rules. We can summarize that all these aspects of self-organization can be identified in all of the analysed platforms. If we look at a), the different platforms are locating themselves on a scale from one pole, where mostly every content sharing act is managed by the platform itself, to the other pole, where almost all of the content distribution is managed by the users. The content on Didactalia is almost completely selected and presented by GNOSS. On Facebook, there is an organisational mix; information distribution can be managed by users in personal groups or private chats, but there are also the news feed and the recommendations which are managed by Facebook itself. In a similar vein, there is a high level of user self-organisation on Youtube but the search engine, which is the main tool to find content, is based on the Google algorithm. Twitter, in comparison, has a higher level of user self organization, because all information has to be found and distributed by users; however, Twitter provides only a very tight infrastructural frame for the creation of content. On the other end of the scale, Reddit is located. Beside the infrastructural limits, every content distribution is managed by users. In the case of Reddit, it is interesting to see that a higher level of user-organisation in general can not prevent a platform from echo-chamber effects.

Many rules and regulations (b) are implemented in the same way on every platform. Basic ethical rules and general policies are at the core of the informal rules of each of these social media websites. Apart from that, we can observe how idiosyncratic forms of behavior are emerging within the different social systems. For example, users may copy only some of the general rules of conduct and use them within the sub-communities that they started and compliment them with other rules. Depending on how strict the infrastructural rules and the examination of these rules are on every platform, this can potentially influence different aspects of everyday learning.

Looking at the third aspect of dealing with unwanted content (c), some of the platforms are counting more on their algorithms and administrators while other platforms are relying completely on user participation. It will be interesting to see how social-media platforms will deal with the problem of Big-Data in the future and with the enormous amount of content

distributed on their platforms. When discussing the topic of everyday learning in social media communities, we have to keep in mind that those who decide which content can be shared and found on the respective websites exercise a strong gatekeeper function with regard to information that could easily turn into censorship or propaganda.

### 3. Self organization in Wikipedia

Over the last years, Wikipedia emerged as one of the most important — if not the single most important — knowledge resource on the web [cf. [DBZPSCSQ16](#)]. Wikipedia relies on the one hand on social control / social norms to ensure the quality of the information that is shared there; on the other hand, software tools (‘code’) such as the ‘WikiScanner’ are (or at least were for some time) used to detect acts of fraud and vandalism and poor quality information in general (<https://en.wikipedia.org/wiki/WikiScanner>). It comes to no surprise that, Wikipedia has been in the focus of academic research over the last years as well.

#### a) Previous empirical research

Already by the year 2005, empirical studies found information from Wikipedia to be comparable, in terms of reliability, to established knowledge resources such as the Encyclopedia Britannica [[Gil05](#)]. Similar results were found for a comparison of the German language Wikipedia and several established German language encyclopedias such as ‘Der große Brockhaus’ [[Wie07](#)]. Since then, a large number of studies has corroborated the fact that—by and large—Wikipedia does not seem to be less reliable than its commercial competitors.

The fundamental principles that guide Wikipedia are summarized in the ‘Five Pillars’ of Wikipedia ([https://en.wikipedia.org/wiki/Wikipedia:Five\\_pillars](https://en.wikipedia.org/wiki/Wikipedia:Five_pillars)). In view of self-organization, pillars 2, 4, and 5 seem to be most relevant. Pillar 2 represents Wikipedia’s ‘neutral point of view policy’ and provides abstract guidelines how conflicts between divergent opinions are supposed to be resolved:

“We strive for articles that document and explain major points of view, giving due weight with respect to their prominence in an impartial tone. We avoid advocacy and we characterize information and issues rather than debate them. In some areas there may be just one well-recognized point of view; in others, we describe multiple points of view, presenting each accurately and in context rather than as “the truth” or “the best view”. All articles must strive for verifiable accuracy, citing reliable, authoritative sources, especially when the topic is controversial or is on living persons. Editors’ personal experiences, interpretations, or opinions do not belong.”  
[ibid.]

Pillar 4 specifies the etiquette for Wikipedia contributors in broad and general terms:

“Respect your fellow Wikipedians, even when you disagree. Apply Wikipedia etiquette, and don't engage in personal attacks. Seek consensus, avoid edit wars, and never disrupt Wikipedia to illustrate a point. Act in good faith, and assume good faith on the part of others. Be open and welcoming to newcomers. Should conflicts arise, discuss them calmly on the appropriate talk pages, follow dispute resolution procedures, and consider that there are 5,337,914 other articles on the English Wikipedia to improve and discuss.” [ibid.]

Pillar 5 emphasized the dynamic nature of a collective knowledge construction endeavour such as Wikipedia. A project, which is in essence only what it's contributors make of it, needs a certain flexibility in terms of rules and regulations as well:

“Wikipedia has policies and guidelines, but they are not carved in stone; their content and interpretation can evolve over time. The principles and spirit matter more than literal wording, and sometimes improving Wikipedia requires making exceptions. Be bold but not reckless in updating articles. And do not agonize over making mistakes: every past version of a page is saved, so mistakes can be easily corrected.” [ibid.]

A positive example for successful self-organization in Wikipedia was found in a case study on developments within the Wikipedia article on the Fukushima Daiichi nuclear power plant shortly after the 2011 Tsunami and the ensuing nuclear fallout [[OHKC14](#)]. After a large number of edits added rather unreliable information to the article in the direct aftermath of the catastrophe, other contributors were rather quick and efficient in consolidating the article as soon as new reliable information on the disaster and its consequences became available. In a similar vein, several studies found that outright vandalism in form of contributors editing nonsensical or provocative information is usually fixed rather quickly on Wikipedia [[VWK04](#); [VWKH07](#)].

Nevertheless, a number of other studies could show convincingly that, in spite of all efforts to ensure knowledge quality, there are still measurable biases in the knowledge that can be found in Wikipedia. For example, achievements of men are discussed in more depth and are given more prominence than comparable achievements of women [[WGJS15](#)]. This *gender bias* may be related to the fact that the majority of Wikipedia contributors is male [[SH07](#)]. Another study showed that Wikipedia articles can create a *hindsight bias* in the sense that versions of Wikipedia articles on natural disasters from after the event give the readers a stronger impression that the disasters was foreseeable and inevitable than Wikipedia versions of the same article before the disaster [[VdBOCBN15](#)]. There is also empirical evidence that — when comparing different language versions of Wikipedia articles on an international conflict — there is a tendency of Wikipedia contributors to depict their own nation (the *in-group*) more positively than the opponent in the given conflict (the *out-group*); this phenomenon is known in psychology as *ingroup bias* [[OCBN16](#)].

Within the AFEL-project, we conduct an empirical research project that addresses another form of biased information that has moved in the focus of empirical research recently: The echo-chamber effect.

## b) The effects of user and discourse characteristics on the quality of Wikipedia articles

### *Echo-chamber effects<sup>1</sup>*

Enlightenment philosophers (e.g. Diderot) believed that the availability of a comprehensive, easily accessible collaboratively created and administrated knowledge corpus in form of an ‘encyclopedia’ should bring the end of superstition and ignorance and would consequentially lead to the disappearance of radicalism and violent conflicts. In the late 20th / early 21st century, this optimism has apparently faded away quite a bit. We observe that the huge increase in available knowledge resources via the internet has not led to such unanimously positive consequences. We still have wars and radicalism and we arguably have more issues with man-made catastrophes than at any time before. Why is that so? One possible reason may be related to what psychologists call “confirmation bias” [[JSFT01](#)], that is, the rather ubiquitous tendency of human beings to be much more open (willing to take up, process, and pass on) toward information that is confirming one’s beliefs and compatible with one’s previous knowledge than one is open toward incompatible and disconfirming information. Another problem could result from human’s tendency to bond together with ‘like-minded’ others and to form communities based on mutual understanding and shared knowledge resources [[BG99](#); [BG08](#)]. As a result, the vast availability of knowledge and the technical possibilities for collaborative knowledge construction could (in the worst case) cause the formation of more and more isolated and radical ‘echo chambers’ [[DBZPSCSQ16](#)] instead of mutual understanding of all humanity: Like-minded individuals form knowledge communities within which only knowledge that is compatible with the group’s beliefs and ideology is taken up and echoed in comments and discussions. From the perspective of our model of individual learning and collective knowledge construction [e.g. [CK08](#)], such echo chambers are very unfavorable because of a lack of irritation of both the cognitive and the social system.

### *Objectives and hypotheses<sup>2</sup>*

The main objective of this study is to shed light on such processes of isolation and, in contrast, openness to others’ by studying the edit histories of different Wikipedia articles in relation to estimates of an article’s quality. We aim at understanding the differences between

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<sup>1</sup> This paragraph is based upon the respective paragraph in D 4.1; parts of the two paragraphs were ‘simply copy-pasted’, because the theoretical background and rationale for the study did not change substantially between D 4.1 and D 4.2.

<sup>2</sup> This paragraph is based upon the respective paragraph in D 4.1; parts of the two paragraphs were ‘simply copy-pasted’, because the theoretical background and rationale for the study did not change substantially between D 4.1 and D 4.2.

more closed and more open communities of people who contribute to an article. We will analyze as well other antecedents (predictors) of positive and negative developments in the construction of Wikipedia articles. We hypothesize that a certain degree of heterogeneity among contributors prevents radicalization and leads to a larger growth of knowledge and to higher quality knowledge. This may be the case in particular, if a topic is controversial.

More concretely, we hypothesize that Wikipedia articles with more diverse contributors (in the sense that they contributed to a larger number of different Wikipedia articles before) and more experienced contributors (e.g., in the sense of a higher number of previous contributions; cf. [Kan11]) grow faster, last longer (less risk of being closed by admins), and produce higher quality knowledge. We will primarily use Wikipedia template messages or ‘tags’<sup>3</sup> as proxies for an article’s quality: Wikipedia articles that are tagged as ‘neutral point of view violation’ or that are marked for ‘speedy deletion’, can be regarded as low quality articles (at least at the point in time, when they were tagged); in contrast, articles that receive recommendations and distinctions constitute cases of high quality articles.

We already know from previous studies that the number of contributors at time 1 predicts the number of contributors at time 2 [e.g. Per14]: The more people contribute to a Wikipedia article or a knowledge domain, the larger is the probability that the number of contributors will grow in the future (this is sometimes called the ‘Matthew-effect’). In contrast, the effects of more subtle author and discussion characteristics on the growth and survival of article or domains at Wikipedia was to our knowledge not studied extensively before.

### *Results from a first study*

In a first study, we mined data for 18,805 Wikipedia articles that are related to the Wikipedia categories *Health*. Therefore, we sampled articles from the Wikipedia domain ‘health and fitness’<sup>4</sup>, tying in with previous studies of our research group on the collaborative construction of Wikipedia articles in the health domain [e.g., HC14]. We also chose ‘health’ because there is a considerable amount of controversial topics within the health domain, for example, with regard to debates between proponents of ‘scholarly’ and ‘alternative’ medicine [JKHHMCur].

Within these articles, we identified on the one hand the occurrence of ‘tags’ or template messages that were provided by contributors to indicate good or bad quality of the article. These template messages were:

- Featured content (as a proxy of a positive quality)
- Marked for deletion (like all other tags, an indicator of negative quality)
- Neutral point of view policy violation
- Contradictory content
- Unbalanced content

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<sup>3</sup> [https://en.wikipedia.org/wiki/wikipedia:template\\_messages](https://en.wikipedia.org/wiki/wikipedia:template_messages) ; last retrieved Oct. 11th, 2016.

<sup>4</sup> [https://en.wikipedia.org/wiki/Portal:Contents/Health\\_and\\_fitness](https://en.wikipedia.org/wiki/Portal:Contents/Health_and_fitness) ; last retrieved Oct. 11th, 2016.

- Confusing content
- Inaccurate content

Unfortunately, there were only comparatively few instances in which the aforementioned tags were applied. No article was tagged as good and featured content and all in all, only 99 articles received at some point in time one of the tags indicating a negative quality. The total number of articles featuring at least one negative tag was 99 (see Table 1).

On the other hand, we mined for every article several contributor and discussion characteristics:

- The total number of revisions.
- The total number of editors.
- The average number of edits per editor as an indicator for some degree of diversity among the editors.
- The average change in text per edit (growth rate) as an indicator for possible controversies or ‘edit wars’ that resulted in frequent re-dos of previous edits and administrative revisions.
- The average change in article sections per edit; also an indicator of fast or slow progress.
- The average change in references per edit; also an indicator of fast or slow progress.
- The average total number of articles that were edited by a contributor to the respective article; a proxy for an editor’s broadness of interests and experience.
- The average total number of contributions of the respective editor to other articles; a proxy for an editor’s experience.

**Table 1: Occurrence of tags indicating positive or negative quality of the articles**

| Featured | Deletion | NPOV     | Contra.  | Unbal.   | Confus.  | Inacc.   | Total     |
|----------|----------|----------|----------|----------|----------|----------|-----------|
| 0/18805  | 0/18805  | 42/18805 | 13/18805 | 12/18805 | 17/18805 | 23/18805 | 107/18805 |

Descriptive statistics for the discourse and contributor characteristics can be found in Table 2 underneath.

**Table 2: Descriptive statistics for the contributor and discourse characteristics**

|                                          | <b>Mean</b> | <b>Median</b> | <b>SD</b> | <b>Min</b> | <b>Max</b> |
|------------------------------------------|-------------|---------------|-----------|------------|------------|
| <b>Number of revisions</b>               | 54,36       | 12            | 230,01    | 1          | 11167      |
| <b>Number of editors</b>                 | 17,05       | 7             | 44,03     | 1          | 1450       |
| <b>Revisions per editor</b>              | 2,57        | 1,67          | 27,04     | 1          | 3622,5     |
| <b>Growth rate (characters per edit)</b> | 23,90       | 6             | 413,22    | -45743     | 16601      |
| <b>Sections per edit</b>                 | 0,02        | 0             | 0,19      | -0,18      | 4          |
| <b>References per edit</b>               | 0,01        | 0             | 0,62      | -0,85      | 4          |
| <b>Total N articles per editor</b>       | 1129,92     | 865           | 1221,55   | 1          | 9610       |
| <b>Total N revisions per editor</b>      | 25420,39    | 14827         | 32348,73  | 0          | 348012     |

From Table 2, specifically from the descriptive statistics, we note that in some cases we may get negative growth rate as is in the case for '*Growth rate (characters per edit)*'. This particular feature for instance is computed as the difference in terms of character length between two revisions, e.g.  $growth = len(r_2) - len(r_1)$ . The reason for this is due to the length in terms of characters for a Wikipedia article when it was first created. Consequently, between any two revisions, the '*Growth rate*' may be negative in the case of *revision wars* where subsequent edits are removed, hence, the minimum negative growth rate.

For further analyses, we only took into account articles that comprised at least 10 revisions. This reduced the total number of occurrences of negative tags from 99 to 96. The total number of articles was reduced to 10265. Table 3 shows the means and standard deviations (in brackets) of the contributor and discourse characteristics for those articles, in which at least one of the negative tags was applied and for the other articles. We used the SPSS 22 software to analyze the statistical significance of the mean differences using an independent sample t-Test.



**Table 3: Mean differences (independent sample t-test) between the articles that received at least one negative tags (neg. tag) and the other articles (rest)**

|                                     | Mean(SD) 'neg. tag' | Mean (SD) 'rest'   | t(DF)            |
|-------------------------------------|---------------------|--------------------|------------------|
| <b>Number of revisions</b>          | 969,75(1472,23)     | 88,13(257,66)      | 5,87(95,06)**    |
| <b>Number of editors</b>            | 49,17(253,81)       | 27,29(191,96)      | 6,36(95,07)**    |
| <b>Revisions per editor</b>         | 4,11(2,09)          | 3,49(36,73)        | 0,17(10263) n.s. |
| <b>Growth rate (char. per edit)</b> | 21,81(48,88)        | 35,51(120,84)      | 2,62(105,81)*    |
| <b>Sections per edit</b>            | 0,01(0,05)          | 0,03(0,09)         | 4,00(101,57)**   |
| <b>References per edit</b>          | 0,02(0,05)          | 0,02(0,07)         | 0,03(10263) n.s. |
| <b>Total N articles per editor</b>  | 517,71(476,92)      | 1038,29(648,18)    | 10,60(98,34)**   |
| <b>Total N revisions per editor</b> | 27740,64(18654,44)  | 32071,55(27580,53) | 2,25(98,96)*     |

Independent sample t-test; \*\* =  $p < .01$ ; \* =  $p < .05$ ; n.s. = not significant

We can see that the tagged articles ('bad articles') had higher numbers of revisions and editors. This is not surprising since more revisions increase the odds that at some point one of the editors feels urged to apply one of the negative tags. More relevant may be — particularly in view of the higher number of revisions in the tagged articles — the slower growth rate in terms of added characters and sections per revision for the tagged articles. This may be an indicator for a higher level of controversies in the construction of these articles, for example, in form of 'edit wars' between contributors with divergent opinions towards a topic.

The articles that received at least one negative tag were authored by less experienced editors with a lower width of interests as indicated by the lower scores for 'total number of articles per editor' and total number of contributions per editor'. Whereas the authors of the 'bad' articles had contributed to only about half as many entities (articles) as the contributors of the other articles, they had made only slightly less total revisions. This is an indicator that the width of interests of the contributors to the 'bad' articles was narrower than that of the contributors to the 'good' articles.

It should be taken into account that the distributions of most aforementioned variables are substantially skewed. Hence, we used Mann-Whitney's U-test for more conservative statistical estimates of the differences between the contributor and discussion characteristics of the 'bad articles' and the other articles. Here as well, the bad articles were edited more frequently by more editors than the other articles. The Mann-Whitney U-test did not yield a significant difference between the contributors to the bad articles and those of the other articles with regard to the total edits that the respective contributors made to any Wikipedia

article. However, for the total number of articles that the contributors had edited, the U-test revealed a significant difference indicating that the authors of the bad articles had previously contributed to a lower number of articles. With regard to the article's growth rate in terms of added characters per edit and added sections per edit, the significant difference between the two groups that we found in the above described t-test disappeared as well. Instead, the U-test for the different growth rates with regard to the average number of added references per edit yielded a significant result indicating a slower growth rate for the 'bad' articles. The U-test also revealed a significant difference with regard to the average number of edits per user: The editors of the 'bad articles' made on average less revisions than those of the other articles (see table XIII below).

**Table 3: Rank-based differences (independent sample Mann-Whitney U-test) between the articles that received at least one negative tag (neg. tag) and the other articles (rest)**

|                                            | Mean rank 'neg. tag' | Mean rank 'rest' | <i>U</i>   |
|--------------------------------------------|----------------------|------------------|------------|
| <b>Number of revisions</b>                 | 8719,71              | 5099,14          | -11,92**   |
| <b>Number of editors</b>                   | 8631,81              | 5099,97          | -11,63**   |
| <b>Revisions per editor</b>                | 7770,28              | 5108,10          | -8,76**    |
| <b>Growth rate (char. per edit)</b>        | 4853,67              | 5135,64          | -0,93 n.s. |
| <b>Sections per edit</b>                   | 4952,29              | 5134,71          | -0,63 n.s. |
| <b>References per edit</b>                 | 6378,64              | 5121,24          | -4,9**     |
| <b>Total <i>N</i> articles per editor</b>  | 2348,23              | 5159,29          | -9,25**    |
| <b>Total <i>N</i> revisions per editor</b> | 4872,88              | 5135,48          | -0,86 n.s. |

Independent sample Mann-Whitney U-test; \*\* =  $p < .01$ ; \* =  $p < .05$ ; n.s. = not significant

### c) Discussion and directions for future studies

The result of our study confirmed our main hypotheses: Apparently, 'bad' articles were indeed authored by less experienced contributors with a lower width of interests as indicated by a lower number of articles that they edited in total. We also found a slightly slower growth rate for the bad articles in line with our predictions, although in this case, many findings from the t-tests could not be replicated with non-parametric U-tests.

In any case, the low number of articles for which the tags that we analyzed as proxies for an article's quality were applied is a major limitation of our study. All in all, the number of 'bad' articles that could be compared to other articles was simply too low to draw firm conclusions

— not speaking of the complete lacks of articles that were tagged as ‘good’ or ‘featured content’.

In future studies, we will study a larger number of articles and use a broader range of indicators of a Wikipedia articles’ quality [[dSSEV17](#)]. For example, composite scores taking into account metrics such as the length of the article and the number of pictures and references would allow for a first estimation of Wikipedia articles’ quality that were not yet tagged by other users.

On the side of the user characteristics, we will in future studies also extract measures of the homo- or heterogeneity in terms of topics of interest and—if possible—beliefs and ideologies among the contributors to a given article. For the tag-based quality measures, we will increase the precision of our analysis by focusing only on contributions to the respective section that was tagged in temporal vicinity (e.g., the two previous months) to the application of the tag.

## 4. Implications for AFEL

In the following section, we will discuss implications of the foregoing sections on self-organization in different popular online communities and processes of self-regulation in Wikipedia.

### a) Facilitating the self organization of knowledge communities

Our review of self-organization processes in different Social Media websites provides an overview of the different ways in which social media communities do make use of the different ways of regulating the content that is produced by and shared among their members via code, norms, rules, or the forces of the market. Taken together, we have seen that all of the aforementioned regulation mechanisms are at play to varying degrees in the different platforms. Most of the platforms we study aim at making money by displaying advertisements and many websites allow successful contributors to benefit from this business model as well; hence, generating traffic and clicks is one of the main driving powers behind the (self-) organization of these communities. Particularly in the case of facebook, this may have adverse consequences in the form of the emergence of ‘echo-chambers’ in which only like-minded individuals share and discuss contents that are in line with their attitudes and their ideology.

It is surprising to note that in the case of Twitter, limiting the freedom of the users in terms of what can be shared seems to have contributed to the medium’s popularity. In terms of the ‘forces of the market’, Twitter seems to have found a format and to have established a form of communication that caters the needs of its users. It remains to be seen if and how this new form of communication will have a profound effect on political communication and societal debates as well [[Ott17](#)].

In comparison to the other platforms, GNOSS/Didactalia does not only rely on user generated content, but provides semantic web technology to facilitate collaborative knowledge building as well as the structured and planned presentation of information on or of a given institution. In further studies we will investigate how and under which circumstances the technological features of GNOSS/Didactalia do facilitate learning and knowledge construction, for example, by visualizing knowledge graphs on a given topic.

## b) Positive and negative factors in collaborative knowledge construction

Our research on echo-chamber effects in Wikipedia — or more broadly the influence of contributor and discourse characteristics on the quality of Wikipedia articles — can be of relevance for the development of technology to monitor processes in collaborative learning and knowledge construction. Overall, we found that more experienced contributors are less likely to produce bad quality Wikis and we found indicators that a certain amount of variety in terms of interests and previous experiences can be beneficial for collective knowledge construction.

Our research will on the one hand influence the development of technology for connecting users via recommender systems [see D5.3]. For the second phase of developing analytics for the GNOSS platform, it is planned to include recommendations of connections to other learners who are interested in similar topics. In those recommendations, we will take into account the learner's experience and we will facilitate a certain degree of heterogeneity among learners forming a learning community to prevent the emergence of echo chamber effects.

Our findings can also be used in devising rules for sharing/creating resources in knowledge management platforms. Our findings may justify the preference for a rank-based model in which users acquire more and more rights in terms of being allowed to create content without supervision with growing experience. The planned studies for the near future will allow us more fine-grained insights into the relations between article quality and the experience and width of interest of its contributors.

It could be beneficial as well to include more contributor characteristics in fact verification or 'fact checking' algorithms [CJP16] in the future. So far, fact verification software relies mostly on text features and features of the source (e.g., the website) of the information. As our research shows, previous behavior of the contributors as well allows for insights into the quality of the information in digital artifacts.

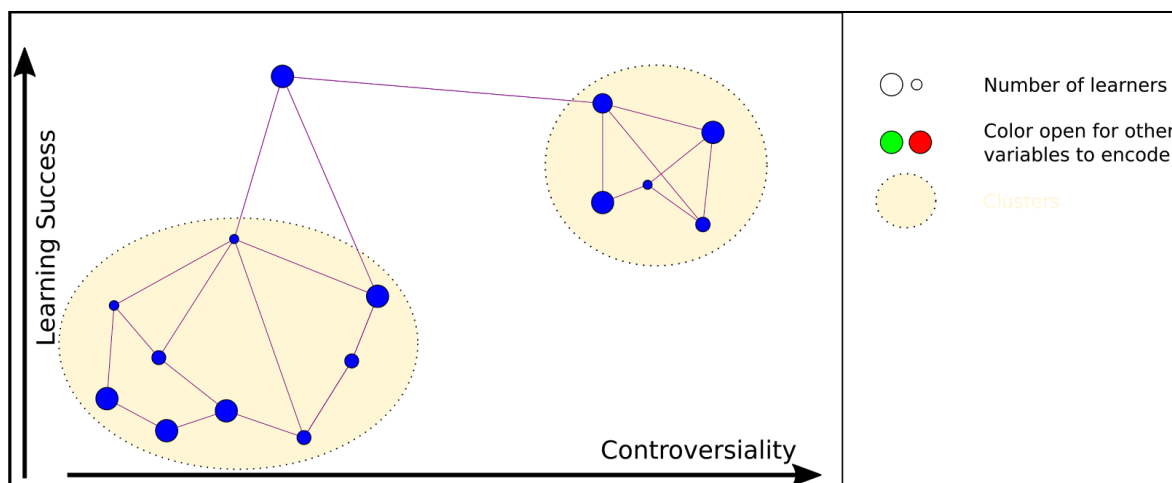
## c) Visualizing contested knowledge and processes of meaning negation

As outlined in D3.2 (p. 13ff), the visualization of a topic's "controversiality" and "fragility" and possible "Conflicts, Problems, and Barriers" (p. 18) for a learner will be an important element of work package W3. Teachers as well as learners and administrators will be interested in getting to know which parts of, for example, a knowledge graph are 'solid' (in

the sense of a broad consensus) and where there are fragile and potentially unreliable or contested knowledge elements. That means that different communities (in the sense of a social sub-system that shares certain attitudes, values, and a certain knowledge) regard different statements to be ‘true’ with respect to a given topic; they cannot agree on the ‘facts’ that apply to the phenomenon in question.

As means of visualizing controversiality and also in view of taking into account the controversiality of information in recommender systems, a controversiality index must be calculated for pieces of information. Such an index will take into account a) the popularity of the information, b) its source, and c) information about those who propagate it. Already in 2007, Thomas and Sheth [TS07] measured the reliability of Wikipedia articles by measuring the semantic stability of different subsequent versions of the article: Article that do not change substantially over a given time-span; articles that vary a lot are less reliable. In our approach, the focus is on distinguishing those elements of the knowledge graph that remain relatively stable from those that are rather fragile and fluent.

A mockup from such a visualization of controversial or contested knowledge can be found below [D3.2, p.20]. It shows different more or less controversial resources as nodes that are larger the more learner consume the respective resource. Similar resources with regard to content are clustered. The diagram below is meant to help administrators, teachers, and learners those resources that are most likely to lead to a positive learning outcome in a given learning task.



**Figure X (D3.2 p. 20):** Visualizing the relation between resources controversiality and learning-success in *GVF*. Similar resources may be clustered for further investigations (see Section [Approach](#)). The resource-nodes’ size is used to visualize the number of learners consuming the resource.

## 5. Conclusion

The self-organization of social media platforms can take many different shapes and forms. Most social media sites rely on a combination of rules, norms, market, and code to regulate which content can be shared among their users and which content is unwanted or inappropriate. Potential issues are related to the emergence of ‘echo-chambers’ of users with similar attitudes and opinions and to a simplification and emotionalization of political and societal debates.

Our research on factors that have a positive or negative influence on collaborative knowledge creation in Wikipedia shows that low quality articles are more often produced by less experienced contributors with a narrower width of interests. These findings highlight the importance of merit-based user rank systems that grant more rights in terms of sharing and editing content to more experienced users. Another important finding is that in using recommender systems to connect learners with comparable interests to learning communities, one should be aware that too high a degree of homogeneity in terms of similar attitudes and knowledge can have a negative impact on collaborative knowledge construction. These results can be of relevance for WP2 insofar as extracting user features such as their consumed/edited resources and the similarity of these resources can be of relevance for a number of research tasks such as the identification of potentially biased material and the analysis of collaborative processes in general. We will follow up on these first preliminary studies in the course of the project by means of taking into account a larger width of indicators of a Wikipedia article’s quality and by focusing on a more diverse sample of articles on more and less controversial topics.

Another extension of our research on the self-organization of social media communities will be related to work package WP3’s efforts to visualize learning communities and to visualize contested or controversial knowledge. Our summary of social media communities’ efforts to exercise a certain degree of control over the contents that are shared among its members while at the same time leaving as much freedom as possible at their users to facilitate intrinsic motivation, shows that it knowledge communities can be defined as groups of people that share an interest in the similar topics and who consume and/or create resources that are related to these topics.

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