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## THE TWOBILITY FACTOR

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**Abstract:** *The unprecedented growth of the Web 2.0 led to the evolution of learning methods and the introduction of the Learning 2.0 as well as Informal Learning. Yet besides the fact that numerous Learning Management Systems (LMS) exist there is a lack of any kind of classification related to the learning era and the learning formality they incorporate. This paper introduces and describes a ranking method both for the Learning Era and the Learning Formality of an LMS and finally introduces the "twobility" classification factor.*

**Keywords:** *elearning, web2.0, twobility, lms, informal learning, learning2.0.*

### I. INTRODUCTION

During the last decade the Web went through a great shift from its "read only" phase to the current one, commonly described as the "read-write" one. Various authors [1], [2], argue that the "Read-Write" Web has altered the Internet thus advanced the Web to its 2.0 era. The user has the leading role and he is the one who gives value to a service. This is particularly true for services that exploit social networking and allows users to connect, collaborate and exchange information and experiences with others sharing some common values and interests. Even if one accepts the criticism that Web 2.0 is not the new Web but just the implementation of Web 1.0 in its full potential, it is a fact that the transformation of the Web to be user-centric has been a revolution. The rapid growth of Web 2.0 consequently affected a number of areas and encouraged users to actively participate. Consequently researchers began to study the Web 2.0 effect to traditional Learning Management Systems as well as to the learning process in general [3]-[5]. This led to the term Learning 2.0 and a whole new view of the learning process as not only an instructor-led method but mostly as a lifelong and learner-led process.

Learning is an ongoing process which occurs anywhere and anytime and usually is not intentional. Formal learning is a learning process which is performed intentionally from the learner's point of view and typically leads to some kind of certification [32]. On the other hand, informal learning is the result of daily activities related to work, family or leisure [31]. While formal learning can be measured and is intentional, it contributes only one fifth of the total knowledge acquisition of an individual [35]. While this fact pinpoints the importance of informal learning it is not taken into consideration in the design process of Learning Management Systems or learning activities. There are also no existing methods or factors to measure whether a learning environment encourages informal learning and in which extent. This paper is an effort to bridge this gap and introduces the term "twobility" as a classification method for learning management systems. The twobility of an LMS is the resulting vector of a two dimensional ranking based on the ability of an LMS to incorporate Web 2.0 characteristics and incorporate and enhance informal learning. The ranking in each dimension is based on a number of crucial factors, as those are identified in previous sections.

The structure of this paper is the following. In the next section there is a presentation of the path towards the Learning 2.0 era. In this section there is a brief presentation of what is the Web 2.0 and how this affects services and users's attitude. Then there is a description of how this shift drives

the evolution of Learning towards its 2.0 era and finally there is an identification and description of the major Web 2.0 tools that can be provided by an LMS. The third section of this study describes formal and informal learning along with their main characteristics. In the fourth section there is the introduction of the twobility factor and an extensive description of the two dimensions that characterize it. Moreover there is a presentation of the methodology used to construct the twobility vector. Finally in the last section there is a presentation of the ongoing research related to the twobility factor and some overall conclusions regarding Learning 2.0 and the twobility as a means to classify LMSs.

## **II. SHIFT TO LEARNING 2.0**

### **2.1 The Web 2.0**

The first Web 2.0 sites emerged on early 2004 and Tim O'Reilly was the first to name the "Web as a platform" as Web 2.0 [6]. Four years later, the same person ascertained that "It's time to leverage the true power of the platform... the Web is now the world" [1]. The term Web 2.0 became a strong buzzword and marketing trend. Moreover a bloom of social networks occurred and a new type of web where the user takes control of its content has been formed. The initial definition of Web 2.0 was not accepted instantly and gained lot of criticism, mainly as being a marketing buzzword rather than something new. Tim-Berners Lee argued [7] that originally the web was created with the concept of connecting people. Furthermore he pointed that Web 2.0 utilizes Web 1.0 standards, so it should be thought more as an extension rather than something novel. Despite the criticism the Web 2.0 continued its evolution and Downes [8] described it as a short term for the movement, from what was called the "Read Web" to the "Read-Write Web". This movement gives to the user the role of the leading actor being not just a passive receiver of information, but mostly a self-publisher able to self-express himself. The capability of self-publishing gave users the ability to harness the power of the crowd. At this point it is important to note that harnessing the power of the crowd should not be limited to the concept of what is called the "wisdom of crowds". The term "wisdom of crowds" comes out of the idea of "why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations" [9]. The original concept of this idea was not meant to be applied on the Web but it has been very influential on the Web 2.0 style of thinking. On the same category belong both folksonomies, where users tag information and objects in a social environment [10], as well as crowd sourcing which represents the act of a company or institution to take a function once performed by employees and outsource it to an undefined network of people in the form of an open call [11].

The crucial factor that leads Web 2.0 to meet unprecedented growth and evolve as we know today is openness. Fundamentally Web 2.0 gains its power from open spirit, open attitude, open standards, open data formats, open APIs (Application Programming Interfaces) and ultimately open source software. Openness and especially open APIs and open data format, enable the Web to operate as a platform. It allows users and encourages developers to build services on top of Web 2.0 platforms. Those services can operate on top of existing ones, exchange data to each other and above all to add value. Openness and sharing as well as global act and peering are the key enablers that allow participants to exchange information freely in a straight forward and simple manner, thus promoting collective intelligence [12]. The Web 2.0 era is at its peak at the moment and there are already questions about the future of the Web and even for Web 3.0. O'Reilly and Battelle [1] argue that the Web is growing up, and all users are its collective parents. The Web is slowly moving towards intelligence and the Web learns. Data collected by and for the web transform it from an unstructured collection of information and knowledge to a structured ecosystem where people, services, business, data, content and ultimately content co-exist, interact, form each other and create value. These special characteristics formed in a Web 2.0 environment create the conditions for the "*emergence of new kinds of open participatory learning ecosystems that will support active, passion-based learning: Learning 2.0*" [5].

## 2.2 The Learning 2.0

The traditional means for knowledge transfer has been schools and classrooms. These are the leading learning process for formal knowledge acquisition and follow a one-to-many model where the educator leads the learning process with all the attendants present in the same time, on the same physical place. Yet along with the growth of Internet and digital media the learning process evolved as well to integrate asynchronous characteristics. Learners can gain access to the educational content not being necessarily to the same physical location and on the same time. Moreover, learners have the ability to follow the learning process on their own pace. However there is still the expert figure of the teacher who drives the learning process and defines the learning content. This new approach to learning can be called as the Learning 1.5 era as it does not represent a whole new learning process but instead overcomes time and place constraints existent in traditional learning.

"Web 2.0 is an attitude, not a technology" argues Ian Davis [13]. It led the web back to its roots where participation was encouraged and it was a socially open network. This social openness inevitably influenced e-Learning and in general the learning process. The learning process deconstructs to its elements and potentially every learner can be an educator. All participants take part in the learning process by contributing learning material and sharing learning experiences. Thus the teacher is not the ultimate expert figure but instead has the role of the coordinator of the learning process able to give the primary guidelines in a learn-centric rather than course-centric approach. In the Learning 2.0 era there are not expert-driven courses but social learning networks which can be formed remarkably fast [14]. In 2005 Downes [29], who first introduced the term e-Learning 2.0, pointed that learning content is created and distributed in the Web 2.0 manner. By the Web 2.0 manner, Downes means that the learning content does not follow the traditional route of compose, organize, repack and distribute but instead it is syndicated. Learners aggregate content from various sources and remix it according to their own needs and style. Potentially the content is enhanced with each learner's own knowledge and experiences to be then redistributed. This new "knowledge packet" becomes another source of knowledge for other learners interested in this topic. Thus while the impact of the "Read Web" to education enhanced learning to its 1.5 era, and considering that the Web itself has been transformed to the "Read-Write Web", in accordance with Tim Berners-Lee's original vision [3], then Learning 2.0 is the impact of the latter to education.

During the Learning 1.0 era the means to enable the learning process has been classrooms, teachers and physical equipment. In the Learning 1.5 and 2.0 eras these have been replaced by tools and environments that utilize existing networks and infrastructure originally built for other purposes. These tools associated with e-Learning are developed in order to serve as the environment over which the learning process occurs and these environments are usually called Learning Management Systems (LMS). The term LMS is used to describe software to deliver and manage educational content and material. However, by design focus on delivering courses and the learning content gets organized in a standard way similar to the way a course is divided into modules and lessons. Besides the educational material, these courses usually include exercises, practice tests, self-evaluations as well as discussions forums and chat rooms. In other words, an LMS provides static educational material with relatively poor opportunities for interaction, content-creation and collaboration among the participants. Moreover these systems are typically integrated with an organization's informational system to provide extended functions such as the measurement of effectiveness and the impact of courses as well as the overall cost of training initiatives [15]. The reference to Learning 2.0 leads to the concept of Personal Learning Environments (PLEs). PLEs are systems that help learners take control of and manage their own learning [16]. This term is the evolution of what Downes [3] named personal learning portfolios which are described as a personal online space where a learner creates, maintains and presents his work. PLEs consist of various tools and modules already existent in LMSs, but in a less structured manner along with social characteristics as those are available on the Web 2.0 platform. This fact offers increased adaptability to different learning approaches. It is clear that in the Learning 2.0 era there is a shift from course and content oriented learning to a people-centric learning. Thus instead of the traditional top down approach to learning there is an adoption and shift to the bottom up. Learners collaborate and interact with each other, with tutors and instructors and they actively participate and often shape the learning courses and material. Moreover learners actively create and contribute learning content being active members of a learning network. A learning network is like an

ecosystem; it constantly changes, it is defined by interactions and knowledge is emergent and complex, therefore it has more in common with how human beings learn compared to traditional approaches to knowledge and learning [8].

### 2.3 Web 2.0 services for learning platforms

There is no clear definition as to what a "Web 2.0 service" yet it is generally accepted that a Web 2.0 services is either a service that allows a user to enhance it by contributing to it with his own content or a service which exploits other services to collect, process and redistribute content. To date, there are numerous Web 2.0 services and the vast majority of them can be integrated into any learning environment. Yet according to Brown & Adler [5] the major Web 2.0 services that can be provided by a LMS are wikis, blogs, fora, glossaries, RSS, multimedia sharing and audio/video conferencing.

- *Wikis*: A wiki is a collection of web pages designed to enable anyone with access to contribute or modify content. Wiki services are often provided by collaborative websites and aim to power community websites [24]. Tools embedded wiki's creation capabilities, giving the end-user the opportunity to exchange opinions on a topic, moving to a new situation where educational material is authored collaboratively, knowledge is dynamic and intelligence is collective.
- *Blogs*: According to T. O'Reilly [1], "*One of the most highly touted features of the Web 2.0 era is the rise of blogging*". Weblogs cannot be used only as an information database, but are also used as a medium for community building, communication and reflection. Among the various possibilities for interaction, weblogs usually offer a commentary function for feedback from readers and the opportunity for different authors to interconnect with one another's contribution. Learners on a course can use a personal weblog to document their own work or texts chronologically and publish their methods or results for their classmates or ask them for feedback and thereby gain new input and perspectives for the continuing learning process [24]. According to Downes [3], "*blogging is very different from traditionally assigned learning content. It is much less formal. It is written from a personal point of view, in a personal voice*".
- *Fora* (Including any service that provides time-based asynchronous discussion): Similar with blogs, fora contribute to the facilitation of asynchronous communication among end-users, while they permit them to exchange opinions, ideas and finally knowledge regarding a topic. They contribute also to the creation of a social network of members with common interests. If this social network comes out of the boundaries of a university class for example, it can drive to what Etienne Wenger called in the 1990s "Community of practice". According to Wenger [25], "*a community of practice is characterized by a shared domain of interest where members interact and learn together and develop a shared repertoire of resources which is hold together due to passion and commitment*".
- *Glossaries* (With Wikis can be referred under the generic term co-authoring services): Along the same lines with wikis, blogs and fora, glossaries can also be created by all end-users. Many platforms afford glossary modules that allow users to describe collaboratively new terms regarding a topic. Therefore, learners or teachers participate to the creation of knowledge.
- *RSS for Content Syndication*: One of the aspects that define Web 2.0 is content syndication through technologies such as RSS "Really Simple Syndication" which "*is used to push out blogs updates. RSS allows someone not just to link to a page, but to subscribe to it, with notification every time that page changes*" [6]. RSS allows updated information from Web pages to be aggregated in one place using RSS aggregator software. As updates happen in online social network sites or new sites, for instance, RSS feeds enable learners to stay more attuned to friends or world events, respectively, though the range of multimedia information posted [6].
- *Multimedia sharing*: Another aspect of Web 2.0 is interactivity. The new era does not require sophisticated technical expertise but allows users to publish, share, consume and remix content through features that are facilitated [29]. File-sharing, for example, evolves not as a sudden criminality among today's youth but rather in their pervasive belief that

information is something meant to be shared. Open content is viewed not merely as nice to have but essential for the creation of the sort of learning network [3]. Multimedia sharing has been divided into two sub-categories, file sharing (such as documents, presentations etc.) and application sharing.

- *Audio and Video Conferencing* (For communication and creation of reusable content): Web 2.0 supports knowledge creation collaboratively, using applications such as blogs and wikis but also audio and video conferencing as objects can be recorded, reused and redistributed [30]. Furthermore, audio and video conferencing contributes to the elimination of geographical barriers, since many of the related platforms provide synchronous communication among the participants.

### III. FORMAL AND INFORMAL LEARNING

It is common to consider learning as the outcome of any formal procedure which has as its purpose a specific learning outcome. Although this is true it can give a false impression of the amount of learning one acquires through other means. Cross [31] argues that most learning today is informal and states that "we learn more in the break room than in the classroom". By definition Informal Learning (IL) is the result of daily activities related to work, family or leisure. In terms of objectives, time and learning support is not organised or structured and in most cases it is unintentional from the learner's perspective. It should also be noted that IL typically does not lead to any kind of certification. On the other hand Formal Learning (FL) occurs in an organised and structured environment either physical or virtual. In any case it is explicitly designated as learning in terms of objectives, time and resources. Moreover FL is intentional from the learner's point of view and typically leads to some kind of certification [32]. The main characteristics of formal and informal learning can be summarised in the chart "Formal and Informal Learning Characteristics" [33], [34].

#### Formal and Informal learning characteristics

<b>Informal Learning</b>	<b>Formal Learning</b>
Resulting from daily life activities related to work, family or leisure	Typically provided by an education or training institution
Voluntary, unplanned and mainly unintention	Compulsory, planned and intentional
Unstructured and unsequenced	Structured and sequenced
Non-assessed and typically does not lead to certification	Assessed and typically leads to certification
Undirected and inherently open	Directed and potentially closed
Learner led and learner centric	Teacher led and teacher centric
Occurs anywhere	Classroom (physical or virtual) and institution based
Many unintended outcomes	Fewer unintended outcomes

The most interesting aspect of IL is the fact that occurs anywhere and in any time. From the simple observation of others, to discussion during work and from reading a newspaper to searching on the Internet, one is a receiver of new information that can enhance his knowledge and move his learning on an area further. Various researchers have adopted the iceberg metaphor to describe the IL impact on knowledge acquisition of any individual. Similar to an iceberg, where almost 90% of it is existent but invisible, learning through informal channels is close to 80% of the total. The rest 20% is learning acquired through formal channels within a physical or virtual classroom led by an institution. It should be noted that self motivation and self education can also fall into the category of formal learning especially when it can lead to any kind of certification [35]. Yet there are no boundaries between formal and informal. Both can and usually occur, concurrently and complementary to each other.

An attempt to map formal and informal learning to the various learning eras as those present in previous sections would be inadequate and misleading. Informal learning is closer to the Learning 2.0 era as it incorporates social interaction characteristics and loose connections between learners and

learning sources, learning producers and learnings consumers, learning material and information sharing. However as it has already been mentioned informal learning goes far beyond and exists in far more cases and even in traditional Learning 1.0 and Learning 1.5 environments. The same also applies to formal learning which despite the fact that is closer to Learning 1.0 and Learning 1.5 it can also exist in more open and loose environments. There is ongoing research and efforts to study formal learning over informal environments, such as social networks.

## IV. THE TWOBILITY OF LMSs

### 4.1 General

In previous sections there is a reference to the platforms over which learning content is delivered to learners which are the Learning Management Systems. Those environments consist of various modules and independent services integrated into the same system and under the same user interface in order to provide the end user with a smooth experience. A presentation and recording of the Web 2.0 characteristics of current LMSs is available in a recent study [36] and indicates that those range from ones that are considered to be traditional and well-established, either from commercial or users' perspective, to more recent ones which tend to integrate more Web 2.0 characteristics. Yet there is no classification of these tools related to the integration of Web 2.0 characteristics, as well as to define their level of formality. The aim of this study is to present an innovative yet simple two dimensional ranking system to classify the e-learning platforms under investigation according to Learning 2.0 and informal learning characteristics.

### 4.2 Ranking

The concept of Learning is abstract and can be examined and analysed through various different perspectives. In previous sections two of them has been presented, the "Learning Eras" (LE) and the "Learning Formality" (LF). Both these factors can be helpful while evaluating a LMS as they affect its orientation, purpose and relativeness to various learning scenarios. However LE and LF cannot be mapped nor derived directly one from the other. Instead they can be used as a joint pair to give for an LMS a measure of its social ability, 2.0 attitude and informal learning encouragement. Thus we propose a 2 dimensional ranking method for LMSs in order to present their "*twobility*" (2.0bility). The twobility of an LMS is the vector that indicates how well it integrates Learning 2.0 characteristics in relation to its ability to be used for formal learning activities. This term does not evaluate the overall quality of a LMS but instead it can be used as the classification factor to indicate how close to every day learning and modern web technologies a platform is. The twobility of various LMSs can then be presented on a graph where the X-axis represents the incorporation of Web 2.0 tools and how close a LMS is to the Learning 2.0 era while the Y-axis indicates the amount of formality of each tool in terms of the learning outcome.

In order to create the twobility vector we have to measure for each tool their scores in the individual factors of LE and LF. The LE factor is the indicator of how close a learning platform is to the Learning 2.0 era and depends on the existence of the seven individual web 2.0 characteristics presented in the previous section. Those characteristics do not have equal weights as they do not contribute equally towards the Learning 2.0 era. The values of the LE factor range from 0 to 1 in total. Obviously 0 indicates the complete absence of Web 2.0 characteristics, while 1 indicates full incorporation of the Web 2.0 characteristics under research. On the chart "Learning Era Factors" we propose weights we for each module along with a brief rationale behind every weight proposal.

#### Learning era factors

Module	Weight	Rationale
Wiki (LE1)	0.17	Encourage collaboration and utilize collective intelligence. Allow easy use, enhancement and reuse of content through lightweight and easy to use and understand GUIs.

Blog (LE2)	0.13	Useful for sharing content and ideas. Allows easy spread of ideas through aggregators and mash ups but does not encourage collaboration and communication.
Forum (LE3)	0.12	Easy and powerful asynchronous interaction and communication. It does not encourage content sharing or collaboration.
Glossary (LE4)	0.14	Collective intelligence is the key enabler for their success. Can greatly enhance knowledge and be used as source for other activities. However they do not incorporate the idea of content sharing.
RSS & Mashups (LE5)	0.14	Both services fully exploit the idea of "openness" in Web 2.0 and can be used as a knowledge storage area. Yet, by design, do not allow direct content sharing and collaboration.
Multimedia Sharing (LE6)	0.15	Inherently encourage content sharing and offer rich user experience but it can have compatibility issues. Although you can reuse multimedia content as is, in most cases it is not easy to alter it.
Audio/Video Conferencing (LE7)	0.15	The most powerful remote synchronous communication available which can enhance collaboration, knowledge sharing and learning enhancement. It is bandwidth and computationally intensive and requires special equipment, such as camera and microphones, to exploit its full potential.

The LF factor is the indicator of the ability of a learning platform to be used for formal learning activities. This factor also depends on the existence of the seven individual characteristics as those are derived from chart "Formal and Informal Learning Characteristics". As with the characteristics for the LE factor, those characteristics do not have equal weights. The values of the LF factor also range from 0 to 1 in total where 0 indicates the complete absence of characteristics related to formal learning and education, while 1 indicates full support of the characteristics of a formal learning activity. On the chart "Learning Formality Factors" we present the weights we propose for each module along with a brief rationale behind this weight proposal.

#### **Learning formality factors**

<b>Module</b>	<b>Weight</b>	<b>Rationale</b>
Instructor Led (LF1)	0.14	In Formal Learning environment an instructor figure is always present. During informal learning activities an instructor is usually absent but it can exist without the "official" instructor role.
Compulsory/Planned (LF2)	0.13	Informal learning is rarely planned and never compulsory.
Structured (LF3)	0.14	Informal learning is inherently unstructured but can also exist in structured content.
Directed (LF4)	0.11	Formal learning is absolutely directed by an organization or a group or an individual.
Predefined Learning Outcome (LF5)	0.16	Informal Learning does not have specific learning outcomes but rather a general concept. Instead any Formal Learning course is structured on specific learning outcomes.
Certification (LF6)	0.21	Certification is a proof of successful completion of a learning session or the ability to achieve a specific learning outcome. Both are strong characteristics of Formal Learning.
Quality Assessment (LF7)	0.11	In Formal Learning there can be quality assessment of the educational material, the course structure and the learning resources available.

As we have defined the weights of each individual factor, we are able for each tool to measure both the LE factor and the LF factor and find its twobility vector. It is crucial to note that the twobility factor is measured with the "out of the box" features of every platform. Also the LF factors LF1 through LF5 indicate whether a tool requires any of these features in order to be useful while the factors LF6 and LF7 indicate whether the platform has built in and clear support for these modules.

## V. CONCLUSIONS

This paper aims to make a step to depict and quantize the ability of LMSs to be successfully adopted into the Web2.0 era along with their Learning Formality level. This is conducted through the "Twobility Factor" that is coined in this paper. Twobility factor is a two dimensional vector which is the result of several individual factors with different weights. The first dimension is based on seven Web 2.0 characteristics that are measured through seven weights respectively, while the second dimension is based on the ability of an LMS to be used for formal learning activities. This is measured through another set of seven factors with different weights that correspond to seven characteristics of formal learning activities. The sum of the weights for each dimension corresponds to the coordinates of the twobility vector. Further research on the area aims to clarify and validate the proposed weights for each set of characteristics. The validation and clarification of each individual weight is going to allow the classification of Learning Management Systems according to their "twobility". The "twobility" of an LMS is the meter of it towards becoming a Personal Learning Environment and adapt to the needs of Learning 2.0 and informal learning.

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