The State of Video-Based Learning: A Review and Future Perspectives

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Abstract— **The pedagogical strength of Video-Based Learning (VBL) is presenting knowledge in consistent and attractive manner. In recent years, the new forms and technologies of VBL such as flipped classrooms, and most prominently MOOCs, have had a remarkable impact on teaching and learning methodologies. A significant number of academic publications have investigated and analyzed VBL environments from different perspectives, including potential usage, effects on learning outcomes, satisfaction levels, and effectiveness. This study provides a critical analysis of the current research in VBL conducted from 2003 until today. We aim to help educators in building deeper understanding about the educational benefits of VBL. In this study, 76 peer reviewed papers are identified through journals and academic databases and they are categorized into four main dimensions: effectiveness, teaching methods, design, and reflection. In the scope of this analysis, we also provide future visions and research opportunities in VBL that support self-organized and network learning.**

Keywords-Video-Based Learning; VBL; MOOC; Review of Research; Blended Learning; Video Design; Flipped Classroom; Technology-Enhanced Learning.

I. INTRODUCTION

Video-based learning (VBL) is now recognized by Technology-Enhance Learning (TEL) researchers as a powerful learning resource in online teaching activities. This paper presents an extended and more detailed version of our paper presented at the sixth international conference on mobile, hybrid, and online learning (eLmL 2014), where we reviewed the existing methodologies of VBL research [1]. VBL has unique features that make it an effective learning method that can enhance and partly replace traditional classroom-based and teacher-led learning approaches. VBL can change the way we learn as well as how we teach [2]. Videos can help students by visualizing how something works [3] and show information and details difficult to explain by text or static photos [4]. In addition, videos can attract students' attention, thus motivating them and engaging them to increase their collaboration. Using videos thus can lead to better learning outcomes [5]. Moreover, video can support different learning styles, specifically students who are 'visual learners' [6].

Indeed, VBL has a long history as a learning tool in educational classes. First experiments started during the Second World War. Soldiers were then trained with a combination of audio and film strips [7]. As a result, the static film strips helped to increase their skills while saving a lot of time as well. By the late 1960s, educational television was used as an extra tool in classrooms. Also teachers were confronted with videos of their own lessons to reflect on their teaching methods and improve their performance [8]. In the 1980s, VHS videotapes meant a quantum leap as it became much easier to use video in classrooms. But, still, learners were rather passive and could only watch the video. This changed with the rise of digital video CDs in the mid-1990s. Teachers could now add multimedia control and assessment tools by using the video on a computer. Thus, learners became much more active than before. By the 2000s, classrooms got connected to the internet and interactive digital video as well as video conferences became possible. Since then, new technologies such as smartphones and tablets in combination with social media such as YouTube have contributed to increasing social interaction and have made it easier as ever to integrate video applications in education [9][10]. In recent years, VBL publications have increased in order to discuss how VBL can facilitate learning and enhance learner's outcome as well as teacher's performance. Thus, there was a need to collect existing research, document the benefits of video in improving learning, and explore the design and teaching methods in VBL environments. In this study, we critically analyze the research on VBL to answer the following research questions:

1. What are the educational benefits that VBL has on teaching and learning?
2. How VBL technologies enhance students' learning outcome?
3. How educators and researchers design VBL environments?
4. How is VBL used to improve teacher's and learner's reflection?
5. What are possible applications of VBL in open and networked TEL environments?

In order to answer these questions, this paper will discuss different angles of VBL. The remainder of this paper is structured as follows: Section II is a review of the related work dealing with the systematic review of research on VBL in the past ten years. Section III describes the research methodology, how we collected the research data, and how we categorized the VBL literature. In Section IV, we review and discuss the current research based on several dimensions. In Section V, we present recent implementations in VBL with a focus on the MOOCs and flipped classroom models. Finally, Section VI gives a summary of the main findings of this paper and highlights new research opportunities for future work with some guidelines for practitioners.

II. Related Work

This section surveys the previous work most closely related to the current study and place our contributions in the proper context.

Tuong et al. [11] conducted a systematic review of 28 VBL studies in order to examine the effectiveness of the instructional videos in modifying health behaviors. The main findings of this review show that instructional videos interventions appear to be effective in the general self-care testing (e.g., breast self-examination, heart failure and treatment adherence).

Greenberg and Zanetis [12] reported the positive impact of video broadcast and streaming in education. As a result of their study, the authors encourage teachers and educators to use interactive video training materials in classes especially with children.

Borgo et al. [13] conducted a study to provide an overview of the major advances in automated video analysis and investigate some techniques in the field of graphic design and visualization.

Tripp and Rich [14] reviewed 63 studies in order to understand the ability of teachers to reflect on their teaching through video recording. The result of this study was that teachers prefer to use video recording for reflection in collaboration with colleagues than reflecting individually. Also, teachers report that the use of a guiding framework (e.g., rubric, checklist, teaching principles) helps to focus on their reflection by focusing their attention on certain tasks.

Although these studies asserted that the video is a powerful tool in TEL and that videos enable teachers to reflect on their teaching, they do not take into account the teaching methodologies, design approaches, and the impact of teachers' reflections on their students' learning outcomes. As compared to the above studies, our study adds a wide range of peer-reviewed studies that have been conducted between 2003 and 2014 and provides a quantitative as well as qualitative analysis of the VBL literature. Moreover, we apply a cognitive mapping approach to categorize the VBL publication into several dimensions. The study further provides critical discussion according to each dimension and suggests new opportunities for future work.

III. Methodology

The research methodology was carried out in two main phases including identification of eligible studies followed by a cognitive mapping approach to categorize the VBL literature into several dimensions.

A. Identification of Eligible Studies

The significant research method of identifying papers from Internet resources was applied to collect data in this study [15]. This method was carried out in three rounds. Firstly, we conducted a search in 7 major refereed academic databases. These include Education Resources Information Center (ERIC), JSTOR, ALT Open Access Repository, Google Scholar, PsychInfo, ACM publication, IEEEXplorer, and Wiley Online Library.

Secondly, we searched 23 academic journals in the field of educational technology and TEL indexed by Journal Citation Reports (JCR) including Australasian Journal of Educational Technology, British Journal of Educational Technology, Canadian journal of learning and technology, CITE Journal, Computers in Human Behavior, The Electronic Journal of e-Learning (EJEL), European Journal of Open, Distance and E-Learning (EURODL), Instructional Science, Interactions Journal, The International Journal of Instructional Technology and Distance Learning, International Review of Research in Open and Distance Learning (IRRODL), Journal of Asynchronous Learning Networks, Journal of computer assisted learning (JCAL), Journal of Computing in Higher Education, Journal of distance education, Journal of Interactive Media in Education, Journal of Interactive Online Learning, Journal of Learning Design, Journal of Online Learning and Teaching (JOLT), Journal of Technology, Learning, and Assessment , Learning, Media and Technology, and Turkish Online Journal of Distance Education (TOJDE), using the keywords (and their plurals) "Video-based learning", "VBL", "teaching with interactive video", and "Video Instruction". As a result, 127 peer-reviewed papers were found.

Thirdly, a set of selection criteria were identified as follows:

1. Studies must focus on VBL in educational development. Studies on video coding and semantic retrieval of video were excluded.
2. Experimental or empirical case studies on how learners learn with and from videos were included. Studies of video recording strategies were excluded.
3. Studies that focus on ability of teachers to reflect on their teaching via video recording were included.
4. Studies evaluating the VBL activities and effectiveness in education were included. Studies that focused on video-games and video conferencing tools were excluded.

This resulted in a final set of 76 peer-reviewed studies, which met the selection criteria above. Fig. 1 shows the number of VBL publications between 2003 and 2014, which were found to be relevant for this study.

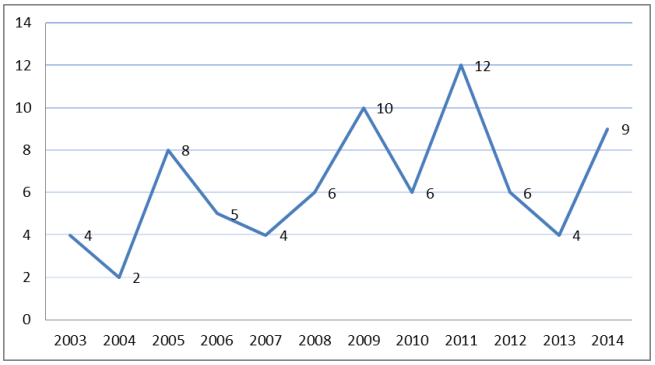

Fig. 1. VBL studies by publication year.

B. *Cognitive Mapping Approach*

Cognitive mapping approach is a method enabling the researchers to clarify and categorize the research literature conceptions into several dimensions regarding to the research questions. These dimensions are recorded in graphic flowchart to show the hierarchy of VBL terms [16]. We applied the cognitive mapping approach as a classification technique for dividing the VBL literature into four dimensions relevant to the research questions, namely effectiveness, teaching methods, reflection, and design (see Fig. 2).

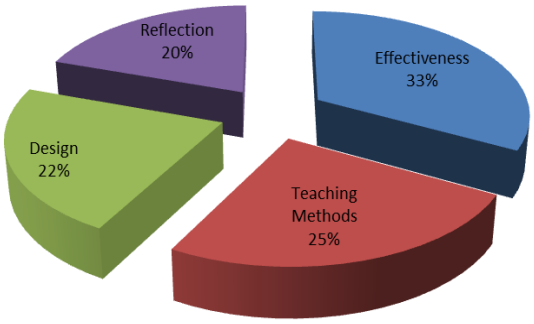

Fig. 2. Visual representation of the VBL dimension.

In order to capture the information gained from the literature analysis, we created a VBL field diagram (see Fig. 3), which has been partitioned into four categories and thirteen sub-categories.

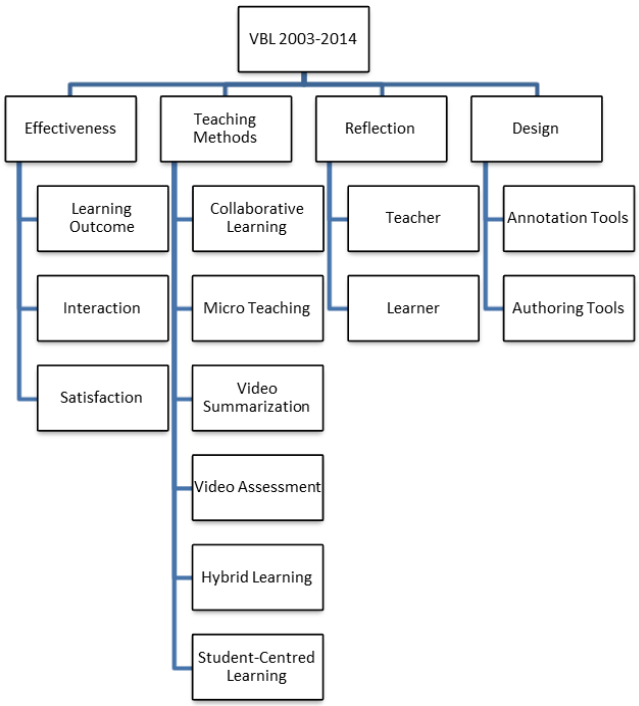

Fig. 3. VBL cognitive map

IV. DISCUSSION

In this section, we critically discuss in details the VBL literature based on the cognitive map dimensions that have been identified in Section III, namely effectiveness, teaching methods, reflection, and design. For the critical discussion part, we apply the meta-analysis method, which aims to contrast and combine results from several studies into a single scientific work [15].

A. *Effectiveness*

Effectiveness of VBL has received a great deal of attention from academic scientists. 33% of the studies reviewed in this paper examined the effectiveness of VBL. Most of the reviewed case studies asserted the efficacy and usefulness of VBL as a powerful medium used in education. We analyzed each study for the following characteristics: research goal, subject, target group, sample size, and summary of results. In the following sections, we discuss the effectiveness of VBL in terms of learning outcome, interaction, and learners' satisfaction.

1) Learning Outcome: A learning outcome (or achievement) can be described as knowledge, skills, and abilities that learners have to achieve as a result of the learning process [2]. Many TEL scholars believe that VBL has the potential to promote the learning outcome. VBL can, for instance, present knowledge in an attractive and consistent manner [5][17]. Further, Kay and Edward [18] and Balslev et al. [19] compared VBL supported by a cognitive approach with text-based learning. The results showed statistically significant differences in improving learners' skills. Moreover, the authors reported that learners liked the followed cognitive approach in which knowledge was generated through step by step learning in video lectures.

In addition, Lin and Tseng [20] and Hsu et al. [21] conducted two studies to investigate the effect of different VBL designs to improve English language skills of K-12 pupils. The findings indicated that the groups which used VBL outperformed the other groups. Other studies reported the invaluable impact of using VBL in improving teachers' performance. The results asserted that using videos as educational tools improved teaching methods and increased the learning outcome [6][8][22][23].

On the other hand, some studies indicated that there were no statistically significant differences between teaching with videos and other methods, thus making them equivalent [24][25][26]. Moreover, Chuang and Rosenbusch [27] stressed the importance of the pedagogical aspect for an effective VBL experience. The authors pointed out that only using videos without pedagogical approach does not make sense. The authors emphasized that video technology should go side by side with pedagogy, and provided a constructivist framework to engage learners to learn with videos. Equally important, Giannakos et al. [28] highlighted the importance and benefits of applying learning analytics to support teachers and students. Learning analytics will help in

guiding the learners to the appropriate learning materials for improving the use of their courses. This can be achieved by aggregating and analyzing learners' interactions with other available learners' data. Learning analytics opens new research directions on VBL courses about accessing recommendations for future learning activities. This means, that issues related to data privacy, ownership, sharing, and access need to be resolved [29].

In sum, the reviewed studies indicated that there were conflicting results of using VBL in educational environments as some found it valuable while others reported no significant results. There was, however, an agreement among researchers that VBL in conjunction with appropriate pedagogical methods has the potential to improve the learning outcome.

2) Interaction: Improved interaction and communication among participants is another effectiveness aspect in VBL. DeLoache and Korac [30] reviewed some case studies of using videos with infants. The authors pointed out that video stories indeed improved communication between children. Hakkarainen and Vapalahti [31] investigated learning with video in the forum-theatre. This study showed that VBL can enhance interaction among learners and improve the ability to solve every day social problems. Recently, Shen [32] evaluated the effects of VBL in nursing simulation practice using the "experimental group and control group" method. The results of this investigation showed that, nurses in the experimental group received significantly higher scores in the final evaluation of catheterization, communication skills, and satisfaction than the nurses in the control group.

On the contrary, Muhirwa [33] investigated VBL in TEL environments in Africa and pointed out that VBL had a lesser role in increasing interaction among learners. This was due to the fact of poor internet connectivity, limited access to computers, and lack of trained instructors in Africa. Additional obstacle that might prevent learners from Africa to actively participate in VBL is the poor technology infrastructure, only 25% of Africa has access to electricity [34].

3) Satisfaction: The level of learning satisfaction is important in evaluating the effectiveness of VBL environments. Zhang et al. [5] examined the level of satisfaction through interactive VBL in a study involving 138 students. As a result, students who used a TEL environment that provides interactive instructional video reported higher levels of satisfaction than those in the control group without video.

Moreover, it has been shown that interactive videos have an impact on the emotional side of the learners' behaviour (e.g., real-life interaction, incorporate the different sound and musical effects that can fit the emotional contents of the learning subject) and that videos can improve the attention to the subject of the lecture in addition to the positive impact on the learners' motivation level [35][36][37].

B. *Teaching Methods*

Dale's cone of experience presents how information is understood, processed, transferred, and maintained as knowledge within the learning process [38]. Fig. 4 shows what learners will be able to do at each level of the cone.

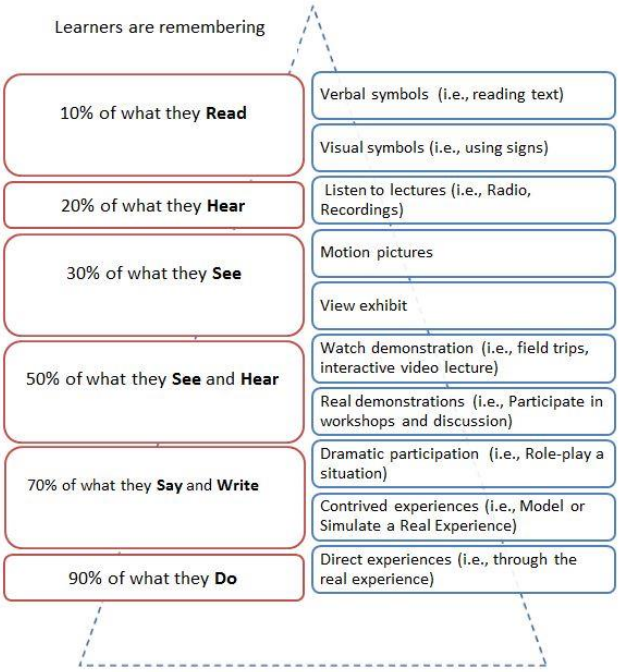

Fig. 4. Cone of experience.
Adapted from E. Dale, Audiovisual Methods in Teaching, 1969, NY: Dryden Press [38].

According to Dale's cone, the most effective methods stand at the bottom. These methods involve direct experience, practical and hands-on workshops, which compel learners to better remember their activities. Interactive videos belong to this category as they enable learners to interact with the video materials through annotations, discussions, and assessment. Educationists and scholars use a broad range of teaching methodologies in VBL environments in order to increase the value of interactive videos. In this literature review, collaborative learning is a key aspect which underlies most of the studies. Other methods involve micro teaching, video summarization, video assessment, hybrid learning, and student-centered learning.

1) Collaborative Learning: In video-based collaborative learning, which focuses on developing, discussing, exploring alternatives rather than directions, learners are able to share responsibilities for their learning [5][39][40]. Most of the reviewed studies validate the efficacy and usefulness of collaborative VBL, where learners can develop their problem-solving abilities via collaboration with others [12]. These studies reported various educational benefits for learners working cooperatively in teams such as shared goals, ideas, resources, activities, and supporting

each other [41][42][43][44]. For instance, Pea and Lindgren [45] investigated which collaboration design patterns are used by learners when they have access to a Web-based video collaboration platform. Five collaboration patterns were identified, namely collective interpretation, distributed design, performance feedback, distributed data coding, and video-based prompting. These patterns support teacher-centred learning by providing knowledge and allowing learners to discuss and find solutions.

2) Micro Teaching: The micro teaching method was used in some studies as a teaching practice with a smaller class size and time (e.g., four to nine learners in a class that is held for five to ten minutes). Educators are able to give learners some quick and easy feedback on their learning performance through video podcasts [46]. Finlay et al. [47] reported that learners' responses on micro teaching with video podcasts are very positive. The authors, however, noted that the video of 10 minutes length was too long for many learners and found that the shorter video podcasts (4-5 minutes) have the advantage of giving greater flexibility in micro teaching lessons. Woodruff [48] investigates video lectures with a small group of students with autism in a series of art lessons. The main result is the following: Students with autism spectrum develop their artistic skills and retain more art content knowledge with highest grades than through traditional teaching classes. Other studies showed that micro teaching provides a friendly and supportive learning environment [49][50].

3) Video Summarization: Video summarization technique extracts important information and provides short but informative summary of the lecture content [51][52]. Chang et al. [53] designed a keyword-based video summarization learning platform (KVSUM) which provides a keyword cloud as a textual surrogate to support learners to organize information of videos and enhance them to follow the videos and reducing the learning time.

4) Video Assessment: A video assessment is short video that simulates real life activities and provides possible responses to the several daily problems. Learners are asked to select which of the responses they would take in these circumstances. Afterwards, teachers discuss each response and evaluate learner's responses [54][55].

5) Hybrid Learning: Hybrid learning has become one important TEL model, by integrating online learning and traditional face-to-face classroom together [56][57]. Pang [58] conducted a study by following a hybrid learning approach that uses video-based learning materials in a Physical Education course. In this course, the trainer can review the learner's actions video, pick out the wrong actions, and provide feedback. Then, students can reflect, find out mistakes. The experiment shows that 80.9% out of learners think that the video review indeed improved their physical skills.

In other studies, Shih [59] and Kırkgöz [60] investigated a hybrid learning approach supported by video lectures for an English speaking course. The study showed that the learners made noticeable improvement in their oral communication skills, and that they were satisfied with the blended learning model.

6) Student-Centred Learning: Most of the reviewed VBL studies followed a teacher-centred approach. Only 15% of studies have focused on student-centred learning [61][62]. These studies don't depend on teachers as content providers. They aimed at providing the space for students to be active participants in their learning environment, interact to build and construct knowledge, and get mutual support to make decisions using reflection and critical judgement.

C. Design

Several researchers in TEL have explored how to design effective VBL environments. Annotation and authoring tools are the most used design tools in the reviewed VBL literature.

1) Annotation Tools: Annotation means adding note, comment, explanation, and presentational mark-up attached to a document, image, or video [63]. In VBL, annotation refers to the additional notes added to the video without modifying the resource itself, which help in searching, highlighting, analysis, retrieval, and providing feedback [64]. Moreover, video annotation provides an easy way for indexing, discussion, reflection, and conclusion of content [65][66].

Colasante [3] examined the integration of a video annotation tool (MAT) into the learning and assessment activities of a third year class "Physical Education" course at RMIT University. This tool allowed learners to select and annotate parts of a video. These annotations are then used by students and teachers to discuss, receive feedback, reflect, and evaluate their learning and teaching practice. The results showed that MAT was effective for receiving feedback form teachers and peers. But, some issues regarding the quality of the collaborative input from peers were noted.

Moreover, feedback in VBL is recommended for several resons, it provides an easy way for discussion and reflection on the video content, provides scaffolds for learners to support self-reflection and self-assessment [3][29].

2) Authoring Tools: A number of studies have developed a wide range of authoring tools for VBL content. The primary function of these authoring tool is to increase the interactivity with the VBL environment, thus engaging learners in the learning processe [67]. The following tools were used in various VBL environments:

- Synchronize lecture note: The aim of this tool is to synchronize a video stream with the presentation slide by means of video clip timing [67].

- Content summarization tool: This tool is able to extract summary information from lecture videos and provide it to the learners automatically [68] [69].
- Digital Video Library: This tool uses indexing to enable content-based search for a particular information of a video lecture [70].
- Discussion forum: A space integrated in the VBL environment where learners can discuss and share common interests or goals on a learning topic [71][72].

As an illustration, the College of Engineering at the University of California, Berkeley has launched an online Master's program in integrated circuits. This project embeds VBL modules for library research methods. In this program, the library plays a significant role in providing the teaching resources and instruction to help learners succeed in their studies. The results manifested a positive impact on the university library and encouraged the development of facilities and services, such as using digital video library to enhance personalized interaction with learners [73].

D. Reflection

There is a general interest among researchers and educators in using VBL to support teachers' and students' reflection on their teaching and learning activities [14][74][75].

1) Teacher Reflection: Video recording of the classroom lessons enables teachers to reflect on their teaching [76]. Teachers can record their own teaching, watch what they did in the classroom, think about it, and reflect on the performance using both individual and collaborative reflection [77][78].

Studies examined both individual and collaborative reflection. 85% of the studies on reflection in VBL noted that teachers prefer to reflect on their teaching performance with colleagues [4][76][78]. Similarly, Calandra et al. [78] and Calandra et al. [79] stressed that the teacher's reflective process should be collaborative where groups of teachers provide comments or feedback to each other. Several reflection methods were used, e.g., daily reflection, weekly reflection, and end of semester reflection [80][81].

Only 15% of studies examined self-reflection where teachers reflected individually on their teaching. Teachers used video-taped lesson analysis and wrote comments for self-reflection [82]. Likewise, Gainsburg, [61] implemented video annotation tools to scaffold, structure, and transform teacher reflection.

Recently, video reflection has been used for pre-service teacher education. Blomberg et al., [83] explored the use of two VBL courses, on to determine pre-service teachers' ability to reflect on classroom video. The study found that the video recording distinctly impacts on the pre-service teachers' reflection patterns. On the contrary, Cho and Huang [84] investigated the mutual relationships between pre-service teachers' beliefs and video-based reflection activities in wiki. The authors found that cognitive beliefs partially influenced reflective writing and questioning activities in wikis.

2) Learner Reflection: Recording classroom activities is also important for learners to reflect on their own learning experience, evaluate their performance, and get a clearer overview of their learning progress. Video recordings further help learners in revision prior to exams [75][85].

Dalgarno et al., [86] discussed three common methodologies in which learners are helped to reflect and make connections between their academic learning and their own practical learning. These methodologies are work-integrated learning programs, inquiry-based learning designs, and simulation. The authors recognized the role of rich media technologies such as videoconferencing, web conferencing and mobile videos in learners' self-reflecting and connect university classrooms to sites of professional practice.

V. FUTURE PERSPECTIVES

In this section, we present the future perspectives carried out from the critical analysis of the VBL literature. In the last few years, the expansion of new open VBL models, such as Massive Open Online Courses (MOOCs) and flipped classrooms has changed the TEL landscape by providing more opportunities for learners than ever before.

A. MOOCs

The term "openness" has received a great deal of attention from the higher education institutions, due to the growing demand for lifelong learning opportunities. Open Educational Resources (OER) represent a first implementation of openness in higher education. The concept of OER describes any educational materials that can be used and re-used in teaching and learning. These materials are openly available and free of charge [87]. They have been widely used by educators and students as rich and powerful learning resources. OER, however, have two main limitations: they lack human interaction and do not reach massive numbers of learners.

In 2001 the Massachusetts Institute of Technology (MIT) introduced the term of Open CourseWare (OCW) as a TEL platform in order to provide their curricula material for everyone at no cost. The key difference between OCW and OER is that OCW are more specific and structured as courses than the public OER library. OCW succeeded in assisting self-organized learners who do not meet the MIT admission requirement but are interested in an OCW course. [29][88]. The criticism against OCW mainly focuses on the customization necessary to match each institute curriculum requirements and the lack of direct feedback due to the one-way design of interaction.

In 2008, Massive Open Online Courses (MOOCs) have offered a whole new perspective for openness by providing unlimited learning opportunities for a large-scale

participation for free. MOOCs represent an evolution of the OER and OCW movements.

1) MOOC Definition: MOOCs are leading the new revolution of TEL by providing new opportunities to a massive number of learners to attend free online courses from anywhere all over the world [89]. Fig. 5 describes the characteristics of the four words included in the MOOC acronym.

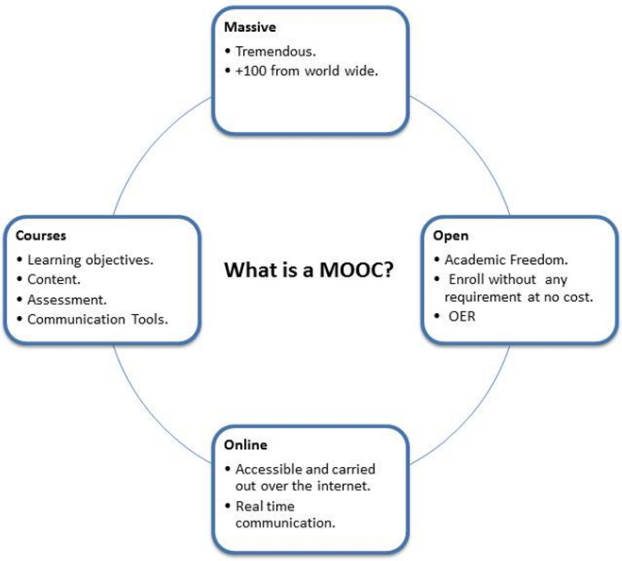

Fig. 5. MOOCs ideation

- **Massive** refers to the necessary size of course participants. But what is massive? Regarding to university campus courses 1000 learners is really a huge amount of participants. Many MOOCs have less than a hundred users, while some courses reached over 150,000 registrations. Basically, any online class that has a higher number of students than regular university courses (+100 participants) can be considered as a MOOC [34].
- **Open** refers to the academic freedom to expand access to participant regardless of their ideological, political, and cultural background [88]. Moreover, open is used in the sense of free reuse, revise, remix, and redistribute of the learning material e.g., learning objects, video lectures, quizzes, textbooks, any other tools [34], [89].
- **Online** requires the MOOC environment to be accessible and carried out over the internet. The hybrid MOOCs model (i.e., blended with face-to-face interaction and support) encourages participants to meet physically and work together on their studying projects [34].
- **Courses** are related to the structure and organization of the learning curriculum. A MOOC includes OER, learning objectives, collaboration tools, assessments, and learning analytics features [34].

Due to the nature of MOOCs environment, we strongly believe that the original definition of MOOCs will change as a result of the various challenges and rapid developments in this field.

2) MOOC Categories

Different forms of MOOCs have been introduced in the MOOC literature. Siemens [90] characterize MOOCs into cMOOCs based on the theory of connectivism, and xMOOCs by virtue of behaviorism and cognitivist theories with some social constructivism aspects as more institutional model, e.g., Coursera, edX, and Udacity. Hills offers a diagram of the evolution of MOOCs over the last few years [91].

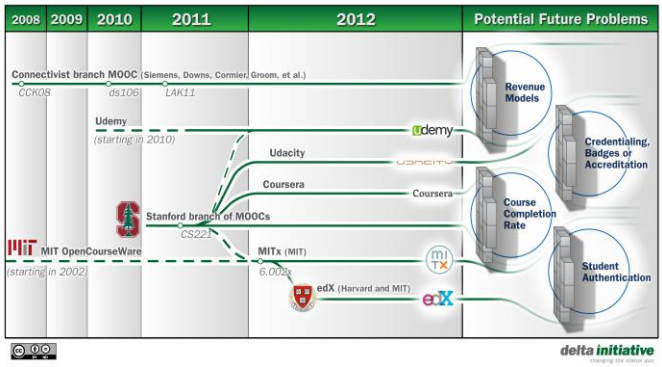

Fig. 6. The evolution of MOOCs [91]

The first design of cMOOCs was established in 2008, based on the connnectivist pedagogy approach. That enables learners to build their own networks via blogs, wikis, Google groups, Twitter, Facebook, and other social networking tools outside the learning platform without any restrictions from the teacher [92]. In xMOOCs, by contrast, learning objectives are pre-defined by teachers who impart their knowledge through short video lectures, often followed by simple e-assessment tasks (e.g., quiz, eTest) [93]. Recently, new forms of MOOCs have emerged. These include smOOCs as open online courses with a relatively small number of participants and blended MOOCs (bMOOCs) as hybrid MOOCs including in-class and online video-based learning activities [34]. The key characteristics of MOOC forms are summarized in Table I [34][94].

The majority of existing MOOCs that have been delivered at higher education institutions are xMOOCs. These university style platforms were developed by different elite institutions and usually delivered via a third party platform provider. For example, Coursera has been developed by Stanford University and currently partnered with top universities and organizations worldwide. In addition, edX was founded by the MIT and Harvard University in May 2012. There are more than 40 high ranked universities co-operated and offered courses on the edX platform [94].

Table I. Characteristics of MOOCs

Compare Item		cMOOCs	xMOOCs	bMOOCs	smOOCs
Learning theory	Connectivism	√	-	-	-
	Behaviorism	-	√	-	-
	Cognitivist	-	√	-	-
	Social constructivism	-	(√)	√	√
Structure	Pre-determined	-	√	√	√
	weekly sequences structure	-	√	(√)	√
	Self-organized	√	-	(√)	-
	Short video lectures	(√)	√	√	(√)
	Fluid structure	√	-	-	-
Teacher role	Teacher-Based	-	√	-	√
	Facilitator	√	-	(√)	-
	Co-organizer with course participants	√	-	√	(√)
Interaction	Open network via social tools e.g., Blogs, forums, live chat, social media	√	(√)	√	-
	Face-to-Face	-	-	√	-
	Daily or weekly meeting	-	-	-	√
	Limited interaction among participants and course teacher	-	√	-	-
Assessment	E-Assessment i.e., automatically grading	-	√	√	√
	Self-Assessment i.e., short quizzes to help participants formatively assess their own learning	-	√	√	-
	Peer-Assessment	√	(√)	√	(√)
	Open Assessment	√	-	-	-

√Completely (√) Partly - Not supported

3) MOOC Goals

The question is how and why are higher education institutions engaging with MOOCs. Through interviews with administrators, faculty members and researchers from 29 different institutions that were already offering or using MOOCs, Hollands and Tirthali [94] identified six major goals for MOOC initiatives:

- Massiveness: to extend the reach and access of education to a wider audience.
- Building and maintaining brand.
- Improving economics by reducing the costs of education or using MOOCs as a potential source of revenue i.e., business models.
- Improving learning outcomes.
- Innovation in teaching and learning.
- Research purpose i.e., conducting studies on MOOC design and methodologies.

4) MOOC challenges

Much has been written on MOOCs about their design, effectiveness, case studies, and the ability to provide opportunities for exploring new pedagogical stategies and business models in higher education [34][89]. MOOCs are still in a pilot form till now. A variety of concerns and criticisms in the use of MOOCs have been raised [29][94]. In this part we discuss several pedagogical and technological crucial challenges that should be considered in the development of the future MOOC environments.

a) Free against business models: The original idea of MOOCs is to offer learning content to a massive number of participants for free. In reality, however, some providers view MOOCs as a potential source of revenue and offer certificates and teaching assistance for additional fees [29][34].

b) Openness against licensing: Although MOOCs are open for massive number of participants without any entry requirements, they are not open from a copyright perspective. For instance, Coursera does not permit users to reproduce, retransmit, distribute, or publish any material from its platform[1].

c) Massiveness against drop-out rates: MOOCs have reached thousands of learners at a time. However, only few of them have completed the courses [33]. A possible reason for high drop-out rates is the lack of academic guidance for participants to select courses which are suitable for their interest as well as their knowledge level [95].

d) Lack of human interaction: The lack of human interaction is a critical issue in MOOCs, both for learners and professors. In MOOCs, It is not easy to provide direct feedback to a massive number of participants [95]. Moreover, learners in these open courses come from all over the world. They speak English in different levels and have different cultural believes. To address this challenge, integrating social media tools to increase the interaction among MOOC participants can be helpful [96].

[1] https://www.coursera.org/about/terms

e) Certificates: Another important challenge is how to assess the learners and certify their activities. In fact, many learners enrolling in MOOCs are looking for certification to promote their career or complete post-graduate studies. Some MOOC providers already provide certification possibilities, e.g., through test centres.

f) Plagiarism: Scientific integrity is an important factor for the success of online learning, especially MOOCs. The main challenge is how to validate participants' original work and prevent plagiarism? A technical solution can be a plagiarism-detection software but this can be expensive and time-consuming. Peer-reviews can be an option to solve this problem but still quality criteria and indicators are needed to ensure the effectiveness of the peer-review [29][34].

In general, the future of higher education and the potential role of MOOCs require key stakeholders to address these challenges, including questions about the lack of human interaction, plagiarism, certification, completion rates, and innovation beyond traditional learning models. These challenges need to be addressed as the understanding of the technical and pedagogical issues surrounding MOOCs evolve.

B. *Flipped Classrooms*

The flipped classroom is an instance of the VBL model that enables teachers to spend more time in discussing only difficulties, problems, and practical aspects of the learning course [35][97]. In flipped classrooms, learners watch video lectures as homework. Each video lecture comes with a short online quiz as a formative feedback. The class is then an active learning session where the teacher use case studies, labs, games, simulations, or experiments to discuss the concepts presented in the video lecture [6].

Bishop and Verleger [98] define the flipped classroom as interactive learning technique that includes: a) Group learning activities inside the classroom time and b) computer-based learning outside the classroom, as presented in Fig. 7.

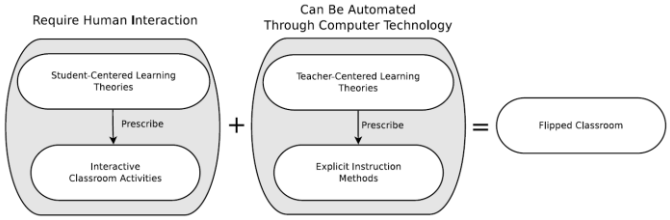

Fig. 7. The Flipped Classroom [98]

We define the flipped classroom as a pedagogical strategy which encompasses several teaching and learning practices split into homework and on-campus activities. Some practices, such as watching video lectures, fall into the home activities. On campus, learners are supposed to conduct their collaborative project or laboratory work and engage in discussions with their peers and teaching staff. On the other hand, teachers plan learning activities, give feedback, and evaluate learners' work. Fig. 8 illustrates the activities in the flipped classroom in more detail.

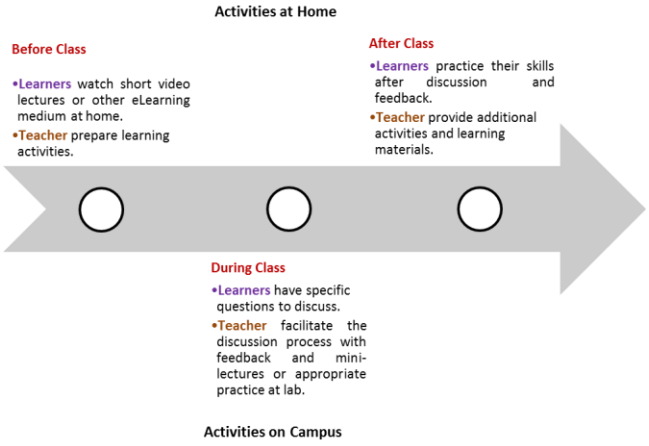

Fig. 8. Flipped classroom activities

1) *The flipped classroom in action*

The flipped classroom model has been successfully applied in the higher education context. This section outlines two case studies that investigated the impact of flipped classrooms on student achievement and engagement.

a) The University of Western Sydney: The flipped classroom has been examined in the first year management accounting unit at the University of Western Sydney in autumn semester 2013. It consists of two main parts: individual instruction outside of the classroom by assigning learners weekly reading of selected chapters (*offline*) and a variety of online activities which are developed to assist students in better understanding the learning topic (*online learning*). The in-class time was devoted to in-depth discussions, problem solving, demonstration, tutorials, and mastering the material through collaborative learning exercises and direct feedback (*face-to-face*). This course had 259 formal learners who were enrolled and have completed the learning course. The most interesting finding was that the majority of learners reported that they have received sufficient instructions and feedback. In addition, they appreciated the quality of the learning material, flexibility, time saving and online activities with the formative feedback. However, the unexpected finding was that some learners did not like the course design because it required learners to complete too many assignments, which was time-consuming [99]. This study, however, did not report on the impact of flipped classroom on learning outcomes.

b) Capital University: Wilson [100] investigated the potential of the flipped classroom model for enhancing learning outcomes in an undergraduate statistics course for social science majors at Capital University in Ohio. The author designed a flipped classroom environment, in which the majority of learning materials were moved out of the classroom and lectures focusing on real-world practices of statistics were given during in-class time. Quizzes were used to measure the learning outcome.

- The quizzes accounted 10% of a learner's overall grade.
- In-class assessments constituted 15% of a learner's grade and were conducted daily.
- Collaborative learning in form of group homework to be completed outside the class accounted 20% of the final grade.
- Final exam accounted 55% of a learner's overall grade.

Learners were asked to evaluate the learning activities that are most helpful for their learning objectives. The students' evaluations of these activities fell into the "somewhat helpful" to "very helpful" categories and resulted in 48% for reading quizzes, 96% for in-class activities, and 91% for group homework. Moreover, the study showed that learners' performance was better in the flipped classroom compared to the traditional class from the previous year. Furthermore, the participants had a higher level of satisfaction with the flipped classroom approach [100]. The limitation of this experiment is that, the number of course participants was only 25 learners.

2) Flipped classroom pros and cons

The flipped classroom approach involves a range of advantages for learners including:

- Flexibility: The flipped classroom helps learners to meet a diverse range of their needs by doing several activities outside the classroom [100][101].
- Student-centred learning: This learning model provides a variety of opportunities for learners to be self-organized and self-independent [8]. Teachers are no longer the only source of knowledge.
- Scaffolding: In flipped classrooms, learning occurs in small learning groups. The teacher's role has been shifting towards facilitating the learning experience by supporting learners in discovering the tools that they need for learning and providing them with the needed guidance and feedback [98][101].

The flipped classroom model, however, suffers from several limitations. These include:

- Lack of motivation: Learners with low motivation or bad learning habits do not pay full attention to out-class activities, such as watching videos, reading materials, or completing assignments at home [102]. As a solution, educators recommended assigning a pre-class quiz on the video material in order to increase the learners' motivation.
- Class structure: Most of the studies that examined flipped classrooms mentioned that the separation between in-class and out-of-class activities is not clearly understood by the learners. Bishop and Verleger [98] recommended that the various learning activities in a flipped classroom should be clearly described at the beginning of the learning process.
- Assessment and feedback: The flipped classroom model emphasizes the role of problem-based learning and project-based learning. This requires creative assessment methods beyond traditional multiple-choice examinations in order to effectively gauge the learner's performance in both individual tasks and group projects [98][100].

VI. CONCLUSION

In the past few years, there has been an increasing interest in video-based learning (VBL) as a result of popular forms of online education, such as Massive Open Online Courses (MOOCs) and flipped classrooms. VBL is a rich and powerful model used in TEL to improve learning outcomes as well as learner satisfaction. In this paper, we analysed the research on VBL published in 2003-2014. 76 peer reviewed papers were selected in this review. A cognitive mapping approach was used to map the conducted research on VBL into four main dimensions namely, effectiveness, teaching methods, design, and reflection. Most of the reviewed VBL studies still follow a conventional learning approach where the teacher is as the centre of the learning process. Moreover, there is a focus on traditional assessment methods, such as eTests and quizzes.

The following is a summary of the main findings in our study as well as aspects of VBL that need further research, according to each dimension.

A. Effectivness

The analysis of the VBL research showed mixed results in terms of learning outcomes in VBL environments. There is, however, a tendency that users of VBL environments rate interaction and learner satisfaction significantly higher than in traditional classroom environments. Despite these possible advantages, several aspects concerning effectiveness in VBL need further investigation: (1) What are the positive and negative attitudes towards using video lectures? (2) How can VBL motivate learners? (3) How can a MOOC as VBL environment personalize the learning experience for learners? This would enable learners to select the educational resources and the learning style that meet

their characteristics best, thus increasing the effectiveness of the learning experience.

B. Teaching Methods

Educators use a broad range of teaching methodologies in VBL environments. These include collaborative learning, micro teaching, video summarization, video assessment, hybrid learning, and student-centered learning. Most of VBL implementations so far still follow a top-down, controlled, teacher-centered, and centralized learning model. Only, 15% of the reviewed research papers describe attempts to implement bottom-up, student-cantered approaches. Additional research is needed to investigate the benefits of new ways of VBL based on new learning concepts such as personal learning environments [103] and network learning [104].

C. Design

Several tools were used in VBL to increase interactivity, collaboration, and learners' satisfaction with the VBL environment. Annotation tools are utilized in searching, highlighting, analysis, retrieval, and providing feedback. To increase interactivity a number of authoring tools were used. These include lecture note synchronization and content summarization tools as well as video libraries and forums. Future research needs to find out how to design more open models of VBL such as MOOCs and flipped classrooms.

D. Reflection

VBL facilitates teachers' as well as learners' reflection. Our study showed that teachers prefer to reflect on their teaching performance with colleagues rather than individually. And, learners think that videos have the potential to be used as a reflection tool. Future research is needed to investigate how learning analytics can help to better understand and improve reflection and awareness in VBL environments, such as MOOCs.

MOOCs and flipped classrooms represent promising implementations of the VBL model. Further work is still needed to investigate how to personalize the learning activities in these environments [103]. Learners are learning at different paces and have different aptitudes. Thus, curriculum, pedagogy, and assessment should be customized in order to fit each learner needs and perspectives [104].

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