About Web Learning and E-Commerce: The MOV Approach to Online Tutoring

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Abstract

The paper focuses on a synchronous, one-to-one tutoring service supplied by the web learning portal "Matematica On Video" (www.matematicaonvideo.it) and on its most interesting functional and technological solutions. Among others, we could mention: the implementation of WebRTC standard, that allows real time, intra-browser, plugin-free audio/video communication, ensuring high quality and low latency video flows; the application of the Canvas API and HTML5/WebSockets technology to realise a shared interactive whiteboard enabling tutor and student simultaneous, real time handwriting; the realisation of an online lesson reservation system, inspired both by tools for the remote management of laboratories and libraries and by procedures for the access to videoconference sessions; the implementation of e-commerce features, based on virtual money, to support an easy and efficient execution of the transactions induced by interactions among tutor, student and service manager (such features can avoid commission costs and fulfilment times; they can also drastically reduce the transfer of real money among the agents, improve promotion and facilitate the customisation of commercial offer). These and other solutions, suitably extended and generalised, will be embedded in a new web services suite named ELWA, which could be of interest to remote education and consulting companies and institutions. At the end of the paper, we will illustrate the main principles inspiring this new project.

1. Introduction

The paper describes the **Tutor online** service offered by the web portal **MOV** ("Matematica On Video"). Although basic web learning principles were used in its realisation [4], the portal has relatively uncommon functions and technological features. In particular, the Tutor online is endowed with avant-garde solutions concerning the audio/video communication technology, the shared interactive whiteboard, the lesson reservation system and the e-commerce in virtual currency. These and other characteristics are fully discussed.

A web services suite will stem from the portal so that the latter could be regarded as a customised version of the former. Temporarily named **ELWA** ("E-Learning Web Application"), the suite will satisfy various needs of remote online education and consultancy. It will be supplied at competitive prices to small and medium companies and institutions interested in offering web based, user friendly and low cost e-learning services.

2. MOV project

MOV is an **On Video**'s project launched in 2012, partially financed by public funds. Its object is to develop innovative web learning services in Maths and other scientific subjects for university students, who can choose from a number of didactic tools, at accessible costs or free, for separate usage or integrated in a learning plan to be defined with a consultant.

The operative phase involved the simultaneous realisation of the teaching materials and the portal, followed by the educational staff selection. Concept, functional requirements and navigation flows were the first steps of the portal development; the mock-up was repeatedly refined based on the results of user tests. In June 2014, it entrusted **Zaki Design** with the feasibility analysis, the graphic design and the coding. A first release was put online (www.matematicaonvideo.it) in May 2015; since then, it has been continuously improved and integrated based on feedbacks from teachers and students.

In the first 10 months, about 300 university students used MOV, mostly enrolled in Departments of Economics, Engineering and Natural Science. Currently the MOV's Tutor online concerns Maths, Statistics, Physics and Chemistry; about 60 students have used the service, giving enthusiastic feedback.

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3. Tutor online service

Synchronous one-to-one tutoring was projected taking into account the best practices internationally applied in private e-tutoring [2]. The student has to register on the site to access the service; he can manage it by his personal page, named **Study Plan**.

3.1 Operational features

Lesson reservation system is similar to the ones used by remote laboratories and libraries [3]. Each tutor has a **Digital Diary** including a web calendar where he publishes the time slots available for lessons in his subjects. The student selects a subject, a tutor and then chooses one or more available time slots; the appointments are noted both on his Study Plan and in the tutor's Digital Diary. The minimum booking notification is 15 minutes but the tutor can extend this lapse up to 24 hours. The student can cancel an appointment but in doing so in less than 24 hours before the lesson, he will not be reimbursed for any eventual reservation costs. Instead, if the tutor cancels an appointment, the student is always refunded and the lesson is replaced using the "invitation tool". Such tool is inspired by procedures to access videoconference sessions: actually, an invitation is nothing but a digital ticket that the tutor sends to the student's Study Plan; if the student accepts the invitation, it becomes an appointment.

The lesson takes place in a web environment called **Tutoring Room**, whose technological features are explained in section 3.2. It is enabled 15 minutes before the lesson and shut down 15 minutes after its scheduled ending; it is possible to enable any number of Tutoring Room simultaneously. The tutor enters from his Digital Diary while the student from his Study Plan; once inside, they can use the audio/video channel and the text chat in the typical way of videoconference platforms. They can also use a shared interactive whiteboard with an arbitrary number of digital sheets and many functions, including a "pen" which simulates the mouse movements on the sheet; so the mouse allows them to handwrite any kind of notes, which are instantaneously transferred to the counterparty. Tutor and student can write at the same time on the same sheet or on different sheets and all notes can be saved in their shared cloud file. The whiteboard makes it also possible to upload pdf or jpg files which then can be modified like any handwritten note.

By means of e-commerce virtual currency features, the service can be managed in a flexible, fast and economic way. A lot of literature has described the need to manage the various steps of a business relationship within an e-commerce framework [8]. Actually, the Tutor online could generate many interactions among the agents and just as many transactions; if the agents are charged in Euro (or another legal tender) through an online shop, they would have to pay fees and commissions, fulfilment times would be required and many useless money transfers would occur: for example, the tutor needn't be paid lesson by lesson and the student doesn't have to be refunded in Euro for a cancelled appointment or lesson (he is just interested in his right to schedule another one). Instead, if transactions are priced in virtual currency and carried out through internal e-commerce features, fees, commissions and fulfilment times are almost reset to zero and money transfers drastically decreased (in the MOV case, the ratio is 8 to 1).

MOV services are priced in **credits**; the student has to buy a refill to be charged for credit payments. The exchange rate between credit and Euro is set at 1 but discounts can be obtained on the refill according to its value. The refill can be purchased by the Banca Sella e-commerce service; the usual means of online payments are available.

Both the reservation and the lesson can be priced and prices are for 30 minute lessons. The MOV business model makes the cost of an appointment the same for all the tutors while the cost of a lesson (which determines the tutor revenue) could change across tutors. The payment procedures are very simple: the student pays the credits for the lesson by clicking a button on his Study Plan, MOV charges for the amount on the student's refill and transfers the credits to the tutor's virtual wallet on his Digital Diary. Payment has to be done within 25 minutes from the Tutoring Room launch, otherwise the lesson is cancelled, unless the "Debit tutoring" has been required. In the latter case, the student formally asks the tutor to postpone the payment for the lesson; if the tutor accepts the request, the lesson takes place and the student will pay later on from his Study Plan.

The internal e-commerce system can also be used for promotional and commercial purposes. For example, coupons can be created and provided to the student for some free services, including the tutoring one. Each coupon is identified by an alphanumeric code that once entered in the appropriate box, activates the coupon. Since the activation can be free or have a cost, the coupon can be used both to promote the services and to tailor a commercial proposal to individual student needs, even by packaging the offer.

For each student, the website administrator can monitor refills data and value, discounts applied, reserved, taken and cancelled lessons, credit payments made or still owed, coupons activated and free services used.

3.2 Technological features

The portal is based on the CMS WordPress, strongly customised by plugins. The server-side language is PHP, the relational database is MySQL, the web pages are coded in HTML5/CSS3, design is fully responsive. The portal runs on a dedicated Linux cloud server; in January 2016, an SSL certificate was installed on the server so MOV now uses the HTTPS protocol, thus retaining the compatibility of the Chrome browser with the **WebRTC**.

This open source technology (www.webrtc.org), supported by W3C, Google, Mozilla and Opera, allows for real time, intra-browser audio/video communication. It is regarded as the new era of this kind of communication; it ensures a high quality, low latency video flow and can be naturally integrated in HTML5; it is already internationally widespread to support services similar to MOV (e.g. www.chegg.com) and is arousing increased interest in Italy too (e.g. www.fluentify.com/it_IT). WebRTC is natively supported by Chrome, Firefox and Opera on desktop devices and by Chrome on Android mobile devices. The Tutoring Room exploits this technology through the OpenTok platform (www.tokbox.com) that enabling peer-to-peer connections in the absence of technical obstacles (firewall, NAT, other infrastructural network barriers) and connections via dedicated servers when such obstacles occur. The platform also supplies plugins to make WebRTC supported by other recent browsers (e.g. IE 10 and 11) on desktop devices, while an ad hoc MOV app was developed for iOS mobile devices.

The shared interactive whiteboard was set up through the **Canvas** API, an HTML5 extension that allows for design and graphic manipulation by Javascript. Hardware acceleration was used in browsers that natively supported it to obtain the best possible performance and user experience [1]. With the same purpose, the Union platform (www.unionplatform.com) is used to set up the real time data exchange between clients through the WSS protocol (WebSockets over SSL/TLS). It is well known that this technology performs better than polling and long polling solutions [7]. The tutor/student chat and other basic functions of the whiteboard, such as the user status system and the system of synchronising the canvas among connected users, are also based on this technology.

4. Conclusions and future developments

Due to lack of space, neither further features of the site (video courses, tests, formularies, notes, didactic events notifications, etc.) nor some functions which will be added soon (shared desktop, online tutoring recording, internal email system, additional promotional functions) can be illustrated here. However, as mentioned in the introduction, the ELWA web services suite will be realised by generalising and extending just the MOV portal features, in order to satisfy the various needs of remote education and consultancy. Although the e-learning platform market is very competitive [6], it is felt that there is space for a tool that combines the features partially described here with a remarkable ease of use on both front and back end, on desktop and mobile devices. Moreover, the ELWA interface will be completely customisable as opposed to other platforms which allow for logo insertion, few graphic themes variations and nothing more.

The technological choices about the audio/video communication and the whiteboard will be fully confirmed in ELWA. The WebRTC will take advantage from a progressive expansion of cross-browser compatibility (for instance, the native extension to Edge, the Microsoft browser released in Windows 10, is under study) and allow to endow ELWA with new functions. On the other hand, Canvas and WebSockets will expand the graphic manipulation functions to any number of users. The combinations of these extensions will be the basis for a marked increase in the teaching collaboration among students, which is now the main shortcoming of both the MOV portal and the new ELWA.

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