Abstract

The communication through digital media has evolved at an exponential rate in recent years. Companies have used digital media to build their market strategies. At the same time, students in the management course need to know the technology involved in digital media to design strategies for companies. However, the traditional curriculum of business schools does not bring this content. One solution is to create a favorable environment for students so they can learn and develop products for digital media. An option of this favorable environment is the maker activity. The purpose of this article is to describe the maker activity for the development of digital media products for business school students. The method used is action research and descriptive approach. The maker activity was applied and the results were interesting multimedia products submitted by students.

Keywords: Digital media, Learning by action, Maker activities, Products

1. Experience Description

The maker activity was applied within the development interfaces for multimedia products research project. This is a movement that has grown into the world of technology to develop tools that enable the creation of products by people technical expertise. The idea is that more and more technology approaches to the market (Anderson, 2012). This project was proposed by a research group involving the course of business administration and systems and digital media. This multidisciplinary feature is a condition for the development of these products (Macias et al., 2014). The methodology used for this study are: action research, because the author is one of the project coordinators (Godoi et al., 2006) and the descriptive method that details the application process of the maker activity (Malhotra, 2011). The group used two models of development of products that alternated during the project execution. These models will be described separately for better understanding.
1.1 DESIGN THINKING

First, the group employed the approach of agile methodology that has the design thinking as one of its development models (Vianna et al., 2011). The original design model thinking was proposed and popularized by Ambrose and Harris (2010), which focused primarily on the creation of products for digital media. However, this original proposal has been the basis of many other creative possibilities for many application areas. The design thinking model used in this study was adapted by Vianna et al (2011), which has specific focus on generating innovative business. In this particular case of the design thinking methodology, the creation process is divided into four phases: immersion, analysis and synthesis, ideation and prototyping.

**Immersion**

The immersion phase aims the initial understanding of the problem, with its identification of needs and opportunities. In the case of this study, it was identified that the students have no motivation for the lectures of business administration course because they do not associate these with practical application in professional life (Silva, 2013). Such observations come mainly from the experience of the research group coordinator as teacher of this course. The maker activity brings the opportunity to encourage students to create digital media products offering practical experience (Derryberry, 2007). At this stage, they were carried out field research in companies or potential clients.

**Analysis and Synthesis**

After the immersion phase, the students identified a set of problems or issues that should be solved. They created personas that are fictitious persons featuring one set of problems. (Vianna et al., 2011). These personas are an important tool to test the products created. The personas are important to check the solutions as something fun, seeking also a pleasure in the experience for the consumer (Koster 2013).

**Ideation**

The documents generated by the analysis and synthesis fed the developers with information. These information was shared with the team of designers and developers during the Arduino workshops to discuss the best products for the solution of the problems. Surveys were conducted in companies for better contextualization of the products. Products should combine entertainment with the purpose of transmitting some content about the company (Prensky, 2013).

**Prototyping**

In the prototyping phase, the research group searched for materials to create products. In the design sector, positioning concepts were investigated to relate business and customers. In the area of programming, business administration students were assisted by students of systems and digital media as they don’t have the skills to elaborate algorithms. This part was easier because great part of the algorithms are available in the internet.
1.2. SPIRAL MODEL

In the preparation of prototypes, the research group took the spiral model of product development. The technology product development models are prescriptive. There are four types of prescriptive models: waterfall, incremental and evolutionary model (Medeiros, 2015). The waterfall model, characterized by its name, defines activities such as communication, planning, modeling, construction. Its application are in a sequential process to an upward movement of construction (Medeiros, 2015).

The incremental model is presented as a repeating waterfall model, meaning that it is iterative. This model delivers an operational product every time (Medeiros, 2015). The first increment has the most simple product with its basic parameters. The supplements will be added to this first product. From this first increment the customer already evaluates and provides feedback to the developer. After each increment the process is repeated. A practical example of this model is the e-mail service that initially provides only the sending and receiving messages, and each increment will receive new features such as file storage, voice and video calls (Medeiros, 2015). Evolutionary models characterized by delivering increasingly complete versions of the product.

The most common types of evolutionary models are: prototyping and spiral. Prototyping begins with communication between the client and the development team, setting goals and requirements. A prototyping iteration is planned quickly, focusing on the visible aspects of the product and the layout of the interface as the product interacts with the user (Medeiros, 2015).

The spiral model was proposed by Boehm (1986). It is an evolutionary iterative process and at the same time the product get better over time, and as development proceeds the specifications change. In a way, he is opposed to a “straight line” planning, present in the waterfall model (Boehm, 1986). Thus, a spiral model has several parallel activities to be performed by the development team and each of these activities is a segment of the spiral path, as shown in Figure 1.

Figure 1. Illustrating the spiral model. Source: (Galeote, 2015)
In general, it begins by the center of the spiral and continue in the clockwise direction. At every turn the risks are assessed. The first activity is always to define the product specifications. Then the developing prototypes goes from the most simple to the most complex. The cost and schedule are adjusted every meeting with the client. The spiral model differs from other models mentioned above because the desired product can be adjusted for each delivery, adjusting the particular demands during the construction process. Deliveries are alternated with workshops that are held to be more interactive between the development team and customers (Galeote, 2015). In the case of this project, it was carried out one turn of the spiral process. Initial prototypes of the project were presented to the customer with a first feedback.

2. **MAKER ACTIVITY**

The maker activity has enabled students to develop skills not related to the initial areas of interest. In this case, students had the opportunity to develop technical skills as programming and electricity by the method of learning by doing (Martinez, Stager, 2013). These activities allow students to integrate other areas such as product design and engineering (Honey, Kanter, 2013).

2.1. **ARDUINO**

The creation of digital media applied to the development was the Arduino workshop. Arduino is a platform that allows people to capture and control the physical world. It is an open platform based on a simple micro controller board and a development environment for programming (www.arduino.cc, 2015).

Arduino can be used to develop interactive objects, capturing pulses of a variety of sensors and control lights, motors, and other physical objects. (Alves et al., 2012). Arduino projects can run alone or with software on your computer. (Flash and Max / MSP – Max Signal Processing). The Arduino is the most used tool by the maker movement.

3. **DEVELOPMENT OF THE MAKER ACTIVITY**

Two experiments were carried out in the course of administration. The first experiment had no connection with any industry or company. Students were free to create products that elapsed from field research. To enable students to develop products using Arduino workshops were prepared into the following steps: First, there was a meeting between the teachers involved courses: Business Management and Systems and Digital Media. A list of topics was drafted based on marketing concepts, main objective of business administration discipline. The topics originally proposed were: history of Arduino creation, types of boards, physical computing, micro controllers, difference between digital and analogic signal, electricity and programming. The topics would be divided into four classes, and at the end students should submit product projects. The topics were simplified for a better understanding of business administration students. The explanation of the different types of boards and electricity were removed and part of the physical computing and microcontrollers has been simplified. This simplification was made
to the students understand the basic principles of the Arduino, enough to propose projects. It was not necessary a deep theory that are designed for students of systems and digital media. The workshop was held for a group of twenty five students of the discipline of Marketing and Technology. Students were divided into five groups of students.

Each class of the workshop was divided into three parts; presentation of a video with examples of practical applications, presentation of the concepts on the functioning of Arduino and a practical exercise using Arduino board.
After the workshops, the students had a month to develop their projects. Students were divided into five groups of four students.

<table>
<thead>
<tr>
<th></th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Close phone – mobile device loss; beep alert after a five meters distance</td>
</tr>
<tr>
<td>2</td>
<td>Smart bottle – milk temperature device bottle for baby</td>
</tr>
<tr>
<td>3</td>
<td>Energy saving button for switches</td>
</tr>
<tr>
<td>4</td>
<td>Quizz game machine for English schools</td>
</tr>
<tr>
<td>5</td>
<td>Home automation devices</td>
</tr>
</tbody>
</table>

The second experiment, carried out in the following semester was held with the same methodological procedure. Arduino workshops were divided into four classes. However, this time the project coordinator established that the products have to be developed for supermarkets. He contacted a local supermarket marketing manager to make the experiment in one of the stores of the chain. Students were divided into eight groups.

A field survey was conducted in order to identify potential problems to be solved. The groups visited the supermarket, interviewed clientes, suppliers, employees, managers in order to identify potential problems. Some problems were detected: product replacement, validity, refrigeration, identification and pricing, signaling, product location, flow in the checkouts, customer service, communication between the checkout operator and management.

The problems have been identified and associated with what might be called persona. Persona is a fiction character associated to a given problem.
1. Replacement Product
PERSONA - CLIENT - The client cannot find the product because of bad replacement.

2. Arrangement of sectors
PERSONA - MANAGER - The manager has a cost problem related to energy expense by the location of different temperature conditioning products in the same place.
3. Lack of Organization
PERSONA - CLIENT - The client has a bad impression of the store because disorganized and dirty stock sector is exposed as well as cleaning supplies are in the middle of the store.

![Figure 7. Lack of organization - Source: Research](image1)

4. Communication
PERSONA - CLIENT / STAFF / MANAGER - Customer, employee and manager does not identify the organizational culture of the company by the lack of information about the founder, mission and values.

![Figure 8. Communication - Source: Research](image2)
5. Maintenance
PERSONA - CUSTOMER - Customer has a bad impression and lack of security when sees the wiring and hole exposed on the air conditioner spot

![Image of maintenance issue](image9)

6. Cooling
PERSONA - CLIENT - The client does not have information about the temperature of the products in refrigerators. After identifying the problems, students groups proposed various product possibilities for the solution of problems. The group chose the project of these possibilities that would be more feasible for implementation. This decision was made together with the group of programmers and designers.

![Image of interaction with sensors and mobile](image10)
The product designs sought to analyze the interaction Arduino board possibilities for other possible types of interaction as mobiles and sensors.

In the ideation phase, methods as the storyboard (story in comic form) were used to describe the use of products.

![Figure 11. Storyboard - Source: Search](image)

Drawings were performed to describe the products in the store. This method allows the developer to view the product in a tangibilization process.

![Figure 12. Drawing - Source: Search](image)
Eight product designs have been proposed.

<table>
<thead>
<tr>
<th>group</th>
<th>product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Product film video at the shelf</td>
</tr>
<tr>
<td>2</td>
<td>Product replacement beep</td>
</tr>
<tr>
<td>3</td>
<td>Handcap assistance</td>
</tr>
<tr>
<td>4</td>
<td>Automatic promotion display</td>
</tr>
<tr>
<td>5</td>
<td>Temperature and humidity meter</td>
</tr>
<tr>
<td>6</td>
<td>Product validity display beep</td>
</tr>
<tr>
<td>7</td>
<td>Checkout operator request device</td>
</tr>
<tr>
<td>8</td>
<td>Checkout line sensor</td>
</tr>
</tbody>
</table>

1. **Product film video at the shelf.** This product will be developed in partnership with suppliers of the supermarket. A ten inches LCD (liquid Crystal) display is the fixed at the shelf. When the customer approaches the product on the shelf, a promotional video is aired on the LCD screen.

2. **Product replacement beep.** The product replacement beep will allow better product turnover. A sensor is installed on the shelf. The sensor captures the amount of product. When this amount reaches a minimum, a message is sent to the replenishing people’s mobile.

3. **Uncapped Project.** A button is installed in each section of the supermarket for handcap assistance. When they need a product that is out of their reach, they activate a button that sends a message to the store manager’s mobile.

4. **Automatic display promotion.** A LED display is installed at the shelf where the product is on sale. When the customer approaches the product to LED screen is on, warning the customer about the discount.

5. **Temperature and humidity meter.** A LED display is installed in the horizontal freezer indicating temperature and humidity. When there is a change in these indicators, a message is sent to the store manager.

6. **Product validity display beep.** A LED display is installed on the shelves with the validity date of the products. Upon reaching maturity, the display illuminates to warn the auxiliary store and a message is sent to the store manager’s mobile.

7. **Checkout operator request device.** A device is installed in each checkout with request options as change, misclassification, product’s cancellation. When the operator turns on the device, the store manager receives the respective request on the mobile.

8. **Checkout line sensor.** A presence sensor is installed at a point of the line of the fast checkout. When the queue reaches this point, a message is sent to the manager’s mobile to open a new checkout.
The developed products used Arduino controller board, LED, motion, temperature and humidity sensors, LED and LCD displays.

Design thinking an Spiral Model were applied in the development of the products.

These products were presented to the customer following a script, starting with the product description, whom the product is intended to and what problem it solves.

The supermarket marketing assistant attended the presentation of the projects and made a critical assessment of the products. Some projects would be outside the scope of the company’s positioning because they are against the value of a better consumer shopping experience at the store. However, he considered that the checkout products have a good potential because they could improve the store management.
4. Final Thoughts

The purpose of the article was to describe the maker activity within the administration course. This experience allowed students to develop projects to some sectors in the first experiment and supermarket in the second experiment. These experiences involved teachers and students from different areas and contains a particular characteristic, demanding an emotional involvement (Giannakos et al., 2014) and an engagement by the team to create the product (Lilly et al., 2013). One of the intangible gains of the project was learning by creating, cited by (Gupta et al., 2012) as a result of the technological product development.

The results were quite satisfactory. First, despite being from outside of the technology area, all the teams carried out the projects proposed in the workshops. Some students were so interested that have intention to buy Arduino boards. In addition, the workshop allowed the students to suggest projects that were beyond expectations, acquiring some engineering and programming skills. This process allowed the teacher to develop action learning (Tell, 2015), meaning learning by doing, important skill for decision making for the students, especially in the business administration course.
REFERENCES


Ambrose, G., Harris, P. (2010), *Design Thinking. Basics*, Lausanne, Switzerland, AVA Publishing


Arduino (2015), www.arduino.cc

http://dl.acm.org/citation.cfm?id=12948


Galeote Sidney (2015), *Modelos Prescritivos para desenvolvimento de software*, “Qualidade de software limitada”
http://www.galeote.com.br/blog/2012/06/modelos-prescritivos-para-o-desenvolvimento-de-software/


Koster Raph (2013), *Theory of fun for game design*, California, Reilly Media


Medeiros Higor (2015), *Introdução aos processos de software e o modelo incremental e evolucionário*, Devmedia.com


Silva Marco Antonio (2013), *Laboratório de gestão: Jogo de empresas com pesquisa para a formação crítica em administração*. (Doutorado), Universidade de São Paulo, Brazil

Tell Joakim (2015), *Organizing principles of learning networks in Hei-Based management training*. Paper presented at the International Association for Management of Technology, Capetown, South Africa
