



The flow of information in the creation of a microlearning on circular economy

Felipe Lopes Roberto

Information Manager, Universidade Federal do Paraná (UFPR), Curitiba, Paraná, Brazil.
Master program student in Information Management, Universidade Federal do Paraná,
(UFPR), Curitiba, Paraná, Brazil.

<https://lattes.cnpq.br/7307148430332267>



Maria do Carmo Duarte Freitas

Civil Engineer, Universidade Federal do Paraná, (UFPR), Curitiba, Paraná, Brazil.
Full Professor, Universidade Federal do Paraná, (UFPR), Curitiba, Paraná, Brazil.

<http://lattes.cnpq.br/1740734674821323>

Antonio Hélio Junqueira

Agricultural Engineer, Universidade Federal do Paraná, (UFPR), Curitiba, Paraná, Brazil.
Postdoctoral fellow, Universidade Federal do Paraná, (UFPR), Curitiba, Paraná, Brazil.

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ABSTRACT

Introduction: The area of education is important for a Circular Economy, as the transition to circular models requires individuals and organizations that learn to innovate and put into practice what they have learned in the real world. This area, from elementary school to graduate school, plays a vital role in ensuring that students of all ages are equipped with the key skills and knowledge to execute circular thinking in their careers. **Objective:** Map the information flow stages present in the MOOC production process on Circular Economy. **Methodology:** This research is characterized as exploratory in terms of its objectives and analyzes the flow of information in the process of creating an informational product with regard to procedures. **Results:** This research showed that an activity of an interdisciplinary nature, such as Information Management - which evolves over time, mainly due to technological innovations - contributed to mapping the stages of needs, obtaining, treatment, distribution, use, storage and disposal of information from the information flow within the process of developing an information product – in this case, the IEC MOOC. **Conclusion:** Associated with the concepts of information architecture, information design and information ergonomics, GI helped in the structuring, organization and presentation of educational information, optimizing the transmission of knowledge and user experience.

Keywords: information management; information architecture; informational product; microlearning; information flow.

INTRODUCTION

In a society marked by the strategic value of information and knowledge, issues related to Information Management (IM) in education become frequent. In this scenario, studies such as that of Roque and Costa (2006) highlight the value of IM for the organization of educational environments, in particular, by supporting the decision-making process, in the design of information products and in the implementation of innovation processes in multidisciplinary spaces (Roque; Costa, 2006).

The Ellen MacArthur Foundation is committed to the relevance of the education sector in disseminating topics such as Circular Economy, since the transition to circular production models requires individuals and organizations to learn to innovate and put into practice actions that aim to improve the future of the next generations. According to the Foundation, the educational segment, from primary to graduate school, plays a vital role in ensuring that students of all ages are prepared with key skills and knowledge to execute circular thinking in their careers (Ellen Macarthur Foundation, 2022).

The circular production model is presented as a proposal to protect the environment from pollution and promote sustainable development. Circular ideas drive the efficient use of resources and reduce waste production. Circular Economy seeks to maximize the use of resources and avoid the generation of waste, thus, environmental degradation is minimized with the advantage of not presenting social limitations, in addition to favoring economic growth and technological progress (Molina-Moreno *et al.*, 2017).

In contrast to the growth of the industrial production system and the continuous consumerism encouraged by society, it demonstrates a connection between the environment and its exploitation. Due to highly polluting habits and patterns, society inherits several environmental implications. The consequences of these ways of life and economic production include climate change, greenhouse effect, water scarcity, ocean pollution, natural disasters, among other phenomena that point to our descent into an unsustainable community (Sales *et al.*, 2019).

The linear economy production model will reach its limits, as it disregards the finitude of material and energy resources. This model accelerates environmental degradation, generated by the environmentally inappropriate disposal of waste, as well as increasing competition for *commodities*, raising prices and market instability (Gonçalves; Barroso, 2019). Topics such as the destruction of ecosystems and the unlimited use of natural resources are present in various discussions across different regions of the world. Excessive consumption and the search for meeting personal needs have taken precedence over imperatives such as environmental preservation and awareness, present in international treaties that aim to preserve life on the planet. Given these circumstances, a new point of view is presented, a proposal for changes in global production and consumption patterns: practices based on Circular Economy (CE) (Gonçalves *et al.*, 2021).

In its composition, Circular Economy (CE) consists of the processes of recycling and reusing products aimed at avoiding waste production. Based on the principles of reusing, repairing, reconditioning, remanufacturing and recycling, CE considers that products should undergo sub-processes and, therefore, be used again (Sales *et al.*, 2019).

Organizations and companies are gradually proving the possibilities that adopting Circular Economy provides, and moving forward in the initiation of sustainable practices. However, industry and technological innovation are incapable of driving fundamental systemic changes for today's economic model to achieve true transformation. Effective changes presume a paradigm shift from individual behaviors to cultural adoption of CE principles. This way, education plays an important role in instigating new perspectives for society and the economy, with regard to sustainability and environmentally-friendly growth (Ludwig, 2020).

Therefore, one of the strategies for attracting students and managers interested in more sustainable practices is developing Massive Open Online Courses (MOOCs) (Gonçalves; Gonçalves, 2014). MOOCs¹ emerge as an opportunity for the evolution and construction of knowledge, modifying teaching and learning environments, as they demand a different behavior from educational institutions and their professionals. On account of the number of students, MOOCs are characterized as a potential field of research for the study, creation of resources and more flexible and interactive teaching activities, as well as new evaluation methodologies (Artigas, 2016).

Given this context, an activity with interdisciplinary nature such as Information Management (IM), which evolves over time, mainly due to technological innovations, helps Circular Economy by means of the development of an informational product. IM acts as a set of processes for identifying informational needs and mapping formal information flows, also promoting an information sharing culture. It also encourages internal communication and the use of information and communication technologies in institutions, in addition to the technical processing of information, handling, analysis, organization, storage and sharing of necessary information (Valentim, 2008).

Considering the above, the research question of this paper is as follows: How does Information Management contribute to the dissemination of concepts and information related to the transition from linear to circular economy? In response to this question, the aim is to map the stages of the information flow present in the MOOCs production process on Circular Economy.

Information management and information flow

It all begins with understanding what Information Management is. Second term information must be understood, organized, processed and shared efficiently, in order to demonstrate to organizations how essential the use of internal and external indicators is, in order to measure their management and the challenges they face in the markets. Assimilating information as such helps ensure that the parts that make up an organization are constantly

1 Translation: Massive Open Online Courses.

aligned to overcome its challenges. Valentim (2002) explains that information is understood as a propagation path, that information technologies structure the storage, processing and access of this asset.

The definition of Information Management proposed by Detlor (2010) refers to the command or management of information and how it is constituted, gathered, established, grouped and shared with the aim of enabling access, chaining and using satisfactory and decisive information through people and organizations. In an organizational environment, Araújo Filho (2020) considers that Information Management plans what information the organization must gather, how it will be stored, the methods for its organization and instruments for disseminating the gathered information. The author explains that, in order to gather information, one must attribute meaning and relevance to the investigated data. Consequently, this information will modify the actors' thoughts and attitudes, while knowledge is related to the work and manipulation of information by means of experiences, values and other knowledge present in the mentality of subjects.

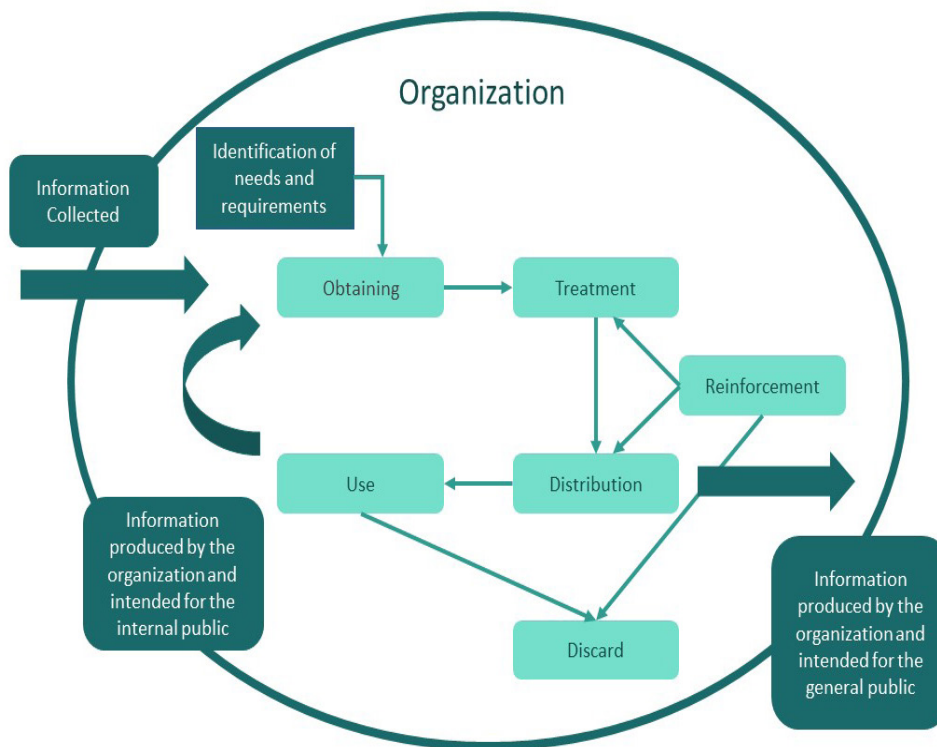
For Duarte *et al.*, (2020), Information Management aims to identify, select, prospect, organize, represent and disseminate information in different contexts, ranging from environments with lower complexities to more complex ones. On the other hand, he adds that knowledge management aims to encourage a culture of collaboration between people, intensifying the creation of a promising environment (physical or virtual) for sharing and generating knowledge in numerous organizational spheres, among other spaces.

Information Management requires the organization of systematized and structured procedures, steps or flows, correlated to the people responsible for their management, aiming to gather the desired results. Information flows provide the implementation of the stages of gathering, processing, storing, distributing, disseminating and using information at the organizational level (Vital; Floriani; Varvakis, 2010).

Araújo *et al.*, (2017) emphasize that information flows are present in the most varied contemporary social contexts and that information and communication technology (ICT), from its massification in these contexts, allowed the optimization of processes related to the production and dissemination of information in different arenas. Authors Porter and Millar (2009) add that ICT promotes informational changes: on the one hand, it can lead to the excessive production of information, but, on the other, it proves to be a tool for better practices and results in the processes of searching, selecting, processing, storing, disseminating and using information.

To analyze the flow of information in developing an information product (MOOC), Beal's (2008) information flow representation model was taken into account, which highlights it in a scenario gathering and producing information, as illustrated in **FIGURE 1**.

FIGURE 1 – Information flow representation model



Source: Beal (2008, p. 29).

In this model, information is initially seen from the perspective of information collection carried out externally, which means that this information is outside the organizational environment. In a second and third step, respectively, the information produced by the organization is shared with the internal and external public, aiming to meet their needs.

The first stage is related to the development of informational products, which is referred to as the *identification of the necessary requirements and needs* for using information and are specifically oriented towards each group and individuals that make up the organization (Beal, 2008).

In the second stage, the *acquisition* of information is evidenced and the activities of creating, receiving and gathering information are carried out, originating from external or internal sources, in any media or format (Beal, 2008).

In the third stage, the *processing* of information is characterized by making information more accessible to users through its processing via the organization, formatting, structuring, classification, analysis, synthesis and presentation, according to Beal (2008).

The fourth stage is associated with the distribution of information in relation to user needs, being it shared with the internal and external users of the organization. Regarding internal distribution, Beal (2008) reports that depending on the size of the organization's communication network, the internal distribution of information process will become more efficient, increasing the possibility of its usability in processes and decisions.

Beal (2008) explains that the fifth stage of the information flow is the *use* of information. In this stage, the combinations of information and the emergence of new knowledge are essential, which promote the feeding back of the corporate information cycle, in a continuous process of learning and growth.

The next stage of the information flow is the *storage* of information, which Beal (2008) considers a process of conserving data and information, allowing its use and reuse by users inside and outside the organization.

The information disposal stage allows the organization to eliminate unusable information, contributing to providing space and agility for the information in use. This process helps to improve Information Management (Beal, 2008).

The next section will describe the characteristics of informational product.

Informational product

In order to understand what constitutes an informational and information product, it is essential to reflect on these two components – product and information (as previously explained). The concept of product is diverse, but it generally includes goods and services. The most important attributes of a product are tangibility, the ability to be stored, production not simultaneous to consumption, low level of contact with the consumer, transportability and evidence of quality (Silva; Santos; Freitas, 2008).

According to Silva, Santos and Freitas (2008), information product is the tangible result of the stages of Information Management, that is, the collection, analysis, processing, dissemination and storage that result in advantages by means of its use, aiming to meet the investigated demands. Informational product is characterized as the content introduced into the information product, exposing a tangible or intangible good. In other words, it is what is most central, the most important characteristic of an information product.

Castells (1999) lists the particularities of a successful informative product in the information society:

- a) it adds value by including innovation in the process and product;
- b) innovation is only concrete when it results from investments in research and application in certain context needs;
- c) it adds automated tasks, resulting in more efficient execution, granting human time for adaptation tasks, generating feedback in the system;
- d) Product content makes the decision-making process more flexible and provides the aggregation of all components of the production process.

Galvão (1999) explains that informational products contain different attributes than those of the production of traditional goods and services. Among the aspects listed are:

- a) Unlike traditional goods, an informational product is not composed of tangible properties, in addition to being entirely disassociated in a unique, particular way;

- b) unlike traditional services, the provision of these products eliminates interaction between supplier and consumer;
- c) for consumers, the value of informational products is not associated with their tangible qualities, but rather with their informational, educational, cultural or entertainment content;
- d) unlike traditional goods and services, cultural and informational products are easily replicated and at a reasonably low value;
- e) an informational product is not used in the same way as a traditional product or service. Software or audiovisual products are used several times without losing their original value;
- f) the intangible particularities of informational or cultural products make the modes of production and distribution different from those related to the production and distribution of traditional goods and services. The holders of property rights over those works are the only ones allowed to legally transact them. Costs related to the acquisition of rights are generally significant, and expenses related to their distribution are incidental; and,
- g) distributors of informational products are able to add value to the distribution procedure.

Silva, Santos and Freitas (2008) consider information products to be highly valued due to the knowledge embedded in them, which originates from the information collected and stored, or information regarding each customer's needs and desires. Both types of information are applied to adapt the characteristics of a product to the observed preferences. When classifying information products, Silva, Santos and Freitas (2008) noted that products arise as a result of services, in the same way that services give rise to other products, and that the main distinction between products and services is the participation of customers in the service development stages.

The purpose is understanding the process of structuring an information product as a Massive Open Online Course, highlighting that its delivery and use will be associated with a service – learning platform. In this case, more sustainable strategies, techniques and technologies on Circular Economy will be presented; the next section will bring concepts about MOOC.

Massive Open Online Courses

Massive Open Online Courses are free online courses, which have interactive participation, in a broad manner and with free access via the web (Santos, 2017). The main characteristics of MOOCs are related to their open access, the possibility of gradually increasing the number of students, as well as monitoring their performance by means of activities that seek to verify the level of learning and asynchronous participation, that is, the period in which

the course is offered. MOOCs are delivered by means of structured platforms with the aim of encouraging excessive simultaneous access, standardizing how activities, the verification of learning, as well as the presentation of content and forums are conducted (Santos, 2017).

In **TABLE 1**, we have Clark’s taxonomy (2013) with 8 types of MOOCs: *TransferMOOCs*, *MadeMOOCs*, *SynchMOOCs*, *AsynchMOOCs*, *AdaptativeMOOCs*, *GroupMOOCs*, *ConectivistMOOCs* and *MiniMOOCs*. MOOCs are divided into two categories: x- MOOCs and c- MOOCs. X-MOOCs are similar to in-person classes, in which the teacher plays a central role in teaching. While in c-MOOCs, students develop the activities themselves, posting reflections on blogs and platforms, and sharing them with other class members (Hayes, 2015).

TABLE 1 – Types of moocs and their characteristics

Type of MOOC	Characteristics
TransferMOOCs	TransferMOOCs collect existing courses and allocate them to a MOOC platform, under the pedagogical assumption that they are coordinated by the teachers, and many are dependent on an institution’s name to attract students.
MadeMOOCs	MadeMOOCs seek to be more innovative and sophisticated. They use more formal and quality-focused methods to develop more complex and challenging materials and activities: problem solving and different levels of interactive experiences based on sophisticated software. Peer assignments and evaluation also characterize this type of MOOC.
SynchMOOCs	Synchronous MOOCs have pre-established start and end dates and course evaluations. Consequently, they are based on the academic calendar defined by the institution.
AsynchMOOCs	Unlike the synchronous ones, asynchronous MOOCs are flexible in terms of beginning, end and evaluation – they tend not to set dates or deadlines activity delivery. The possibility of carrying out tasks within the period defined by the student is one of the pedagogical advantages of asynchronous MOOCs, as they visibly work better in different time zones.
Adaptatives MOOCs	Adaptive MOOCs use adaptive algorithms aimed at delivering personalized learning experiences, based on dynamic evaluation and course data collection. These MOOCs have prerequisite networks and help students through diverse and personalized content.
GroupMOOCs	They are aimed at the collaboration between small groups.
Connectivist MOOCs	They are characterized by the spirit of collaboration. They use content that is available free of charge on the web, and part of the material is produced, remixed and made available by its participants throughout the course by means of activities such as posts, blogs or discussion forums, visual aids, audios and videos.
MiniMOOCs	Associated with more traditional universities, they are short in duration and amount of work, ranging from one day to one week

Source: Clark (2013)

There are structural limitations in MOOCs for the application of revolutionary learning, with fundamental knowledge and skills for the digital age. Due to the recent use of MOOCs, their strengths and weaknesses are notable, however, practices are becoming innovative and gaining relevant space in higher education (Bates, 2019). The MOOC strengths are listed below:

- a) They provide free-of-charge quality materials validated by universities around the world to anyone who has a computer and internet connection;
 - b) They provide access to high-quality materials, especially in developing countries. However, in order to carry out MOOCs satisfactorily, adaptation and substantial investment in local support and partnerships are essential;
 - c) They are important for the prosperity of basic conceptual learning, as well as the generation of online communities with similar objectives or the same practice;
 - d) They are a differential training and continuing education method;
 - e) They drive conventional Higher Education Institutions (HEIs) to re-evaluate their methods for open and online learning;
 - f) They expand the brand and status of institutions, paving the way for public experience in some academic areas;
 - g) They eliminate, through automation and/or peer communication, the cost and variables linked to offering support and quality evaluation for higher education students.
- Bates (2019) also adds the weaknesses (W) and challenges (C):
- a) it is difficult to visualize how public HEIs are able to create sustainable business models for MOOCs (W);
 - b) they awaken the interest of people with a high level of education, instead of expanding access (C);
 - c) they have limited competence to enhance high-level academic learning, or high-level intellectual capabilities essential in a knowledge-based society (C);
 - d) evaluation of the highest levels of continuous learning, given that a large proportion of MOOC providers do not accept their own MOOCs for credit (W);
 - e) Copyright and temporality restrictions limit the reuse of materials as Open Educational Resources for MOOCs (W).

The next section will describe the methods applied for this research.

METHODS

This is an exploratory research in terms of its objectives and it analyzes the flow of information in the process of creating an informational product with regard to procedures. Exploratory research is conducted faced with a problem or question, which are usually subjects with a low number of previous studies in that area. To this end, it is not limited to testing or confirming a specific hypothesis; in reality, new discoveries occur. Exploratory

research determines which existing theories or concepts are invested in a given problem or whether theories need to be updated and concepts need to be created (Collins; Hussey, 2005; Gil, 1999).

The literature review technique was employed as a way of gathering information regarding Circular Economy metrics, guidelines and good practices, as well as means to evaluate the success of MOOCs with actions provided for in Educational Marketing. These analyzes will lead to the achievement of the proposed general objective, with a strategy to guide the development of an informational product.

To this end, a questionnaire was applied and helped to gather information regarding the creativity and clarity criteria of the proposal; innovation, social contribution and sustainable development; methodological quality; coherence of the proposal and formal aspects of microlearning. The questionnaire included the participation of teachers and students of areas such as Information Management and others related to circular economy. The results found are important for capturing positive and negative aspects about the course structure, and for demonstrating the experts' perspective regarding the knowledge acquired by students.

Tool ATLAS.ti was used, which is considered a form of processing, organizing, classifying, analyzing and presenting, for analyzing information related to the opinions of experts who participated in the questionnaire.

RESULT ANALYSIS AND DISCUSSION

The Information Management perspective is detailed in the search to identify the information flow stages – about the process of creating microlearning about Circular Economy. This study will present the stages of information needs, gathering, processing, distribution, use, storage and disposal – in the same way as Beal's (2008) information flow representation model, from information gathering to production.

a) Need for information

The first stage presented was the identification of the necessary needs and requirements for using information, which aims to identify information needs to then develop informational products specifically oriented to each group and individuals that make up the organization. At this stage, it was defined that the target audience would be Information Management students and professionals, as well as the general community who were interested in more sustainable strategies, techniques and technologies applied to the business environment. Therefore, to meet the informational needs of these audiences, it was determined that Circular Economy concepts should be presented, relating them to different social spheres; the environmental impacts associated with waste dumping into the environment; the different strategies and

technologies for reusing waste, the incorporation of Circular Economy in professional, academic and citizen practice; and current linear economic models, from the perspective of related environmental impacts.

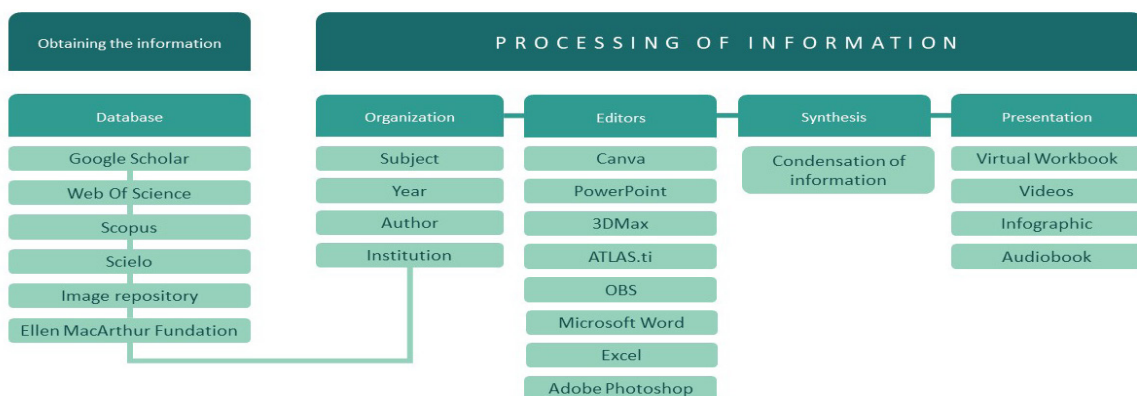
b) Gathering information

In the information gathering stage, queries in databases Google Scholar, Web of Science, Scopus, Scielo were necessary, among other databases available in CAPES journals to gather information related to the course subjects. It was also defined that term search would be conducted in English and Portuguese, within the period between 2008 and 2022. Another means of gathering information employed by the author was a questionnaire to validate the MOOC. This stage also involved the analysis and disposal of information, in order to select the most relevant documents for the target audience.

c) Processing information

In the third stage – processing – the tools that would enable the organization, formatting, structuring and presentation of this information were defined. Aiming to achieve the best results, the author applied Information Architecture and Information Design principles during the material development process. In order to format text and data, record videos and build material layout, several tools were used to assist the researcher in the creation process.

FIGURE 2 – Tools for processing course information



Source: Systematized by the author (2022).

Tools Microsoft Word and Excel were used to format text and data. For video recording and editing, Open Broadcaster Software (OBS) was employed. With Microsoft PowerPoint it was possible to organize and build video layout. In developing the layout and booklet

illustrations, tools Canva, 3DMax and Photoshop were used. Course materials were prepared in PDF, PNG, JPGE, MP4 and MP3 formats. Content classification and organization followed the order of the subjects to be covered in the produced course.

For course validation, ATLAS.ti tool was adopted, which is considered a form of processing, organizing, classifying, analyzing and presenting information related to expert opinions regarding the ICE course. With this tool, it was possible to identify course strengths and weaknesses based on the analysis of the opinions of experts who participated in the MOOC evaluation.

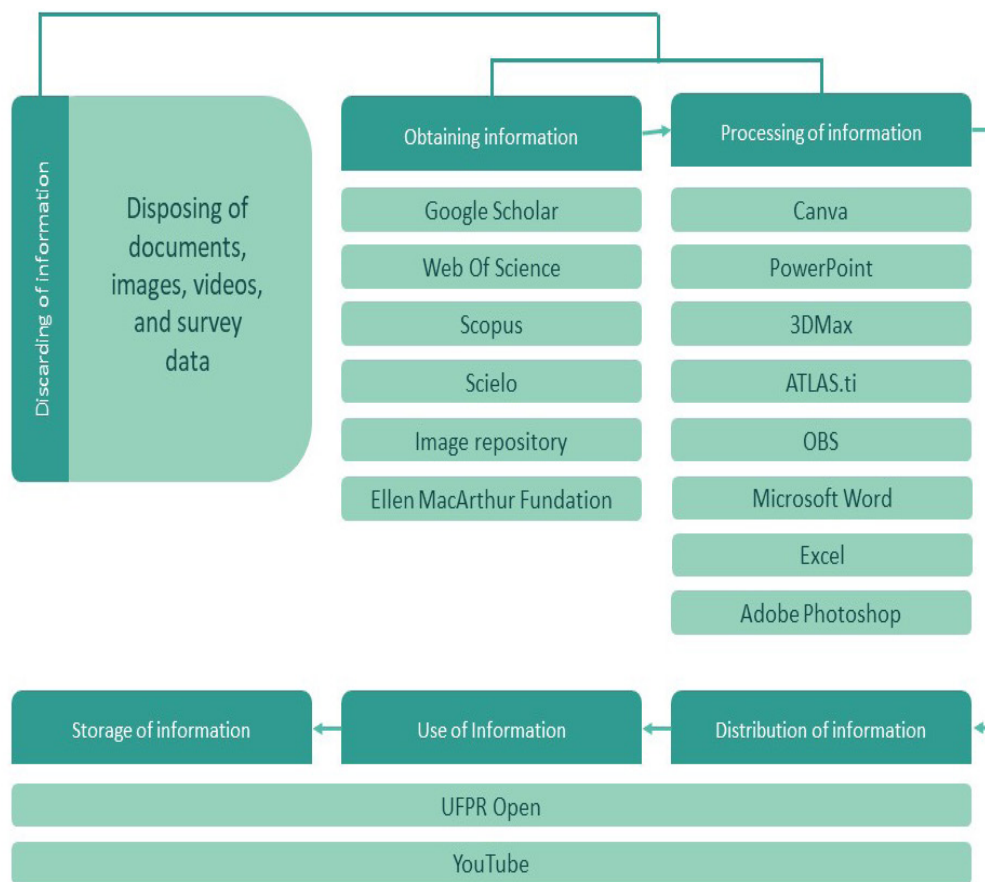
d) Distributing information

Information distribution takes place from the moment the course is available on the university's Open platform for society as a whole. For the distribution of information to happen effectively, defining strategies assisted by Information and Communication Technologies are necessary to publicize Massive Open Online Course Introduction to Circular Economy on different social media, in order to prospect professionals interested in techniques and methodologies that promote sustainability in organizations. After launching the course, ensuring that the target audience has access to information regarding Circular Economy, these participants would have interactive classes on the selected topics, with available and easily accessible bibliography, as well as complementary material to optimize the understanding of the exposed content. After course completion, it is believed that students are able to apply the concepts of Circular Economy in different work environments.

e) Storing information

In the information storage stage, it was necessary to make a request to the Coordination for the Integration of Distance Education Policies (CIPEAD) to store the course. After approval, the MOOC will be stored on website <https://ufpraberta.ufpr.br/> along with the other courses offered by the institution. Throughout the conception of the MOOC, information was mainly disposed in the first stages of development. From the moment the appropriate documents were selected for preparing the material, an assessment was carried out regarding the content of these files and, after analysis, documents that were not relevant to this project were excluded. To this end, it was determined that, at first, the title of the document would be read, then the summary analyzed and, finally, the documents read in full, with the purpose of selecting the most important parts to be used in the materials.

FIGURE 3 – Technologies and information flow in creating the mooc



Source: Systematized by the author (2022).

In the results analysis stage, the information was also disposed of, as some respondents confused the ICE course proposal with a subject that was being offered during the same period of questionnaire application.

CONCLUSIONS

This research showed that an interdisciplinary activity, such as Information Management – which evolves over time, mainly due to technological innovations – contributed to mapping the stages of needs, gathering, processing, distributing, using, storing and disposing of information from the informational flow within the process of developing an informational product – in this case, MOOC ICE. Associated with the concepts of information architecture and information design, IM helped in the structuring, organization and presentation of educational information, optimizing the transmission of knowledge and user experience.

This research brings contributions in the academic-scientific scope by sharing the methods, strategies and educational practices applied in microlearning. It offers a conceptual basis for discussions related to Circular Economy (CE) within the Information Management (IM)

research community, based on the analysis of the information flow stages in the process of developing a course aiming to present solutions in production processes and environmentally-sustainable consumption.

It makes a social contribution since the information product, validated by experts and approved by CIPEAD, will be available to the entire society via UFPR Aberta – a platform for free open courses.

For the business environment, this research contributes as knowledge for applying Circular Economy principles can be applied to organizations, promoting innovation and the creation of more sustainable strategies, techniques and technologies for reusing waste.

It is also expected that future work will contribute to the dissemination of Circular Economy principles. The importance of actions that promote the democratization of scientific information is highlighted in this research, especially for studies that suggest practices for sustainable development.

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