

INFORMATION LITERACY APPLIED TO ENGINEERING

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Abstract

The Information literacy is defined as the competence, aptitude and knowledge to access, to use, to administrate and to communicate properly the information within the aim of study, research or even for the professional exercise.

In our current information society to get and to understand correctly the information and to deal with it is a guarantee for successful outcomes.

That is the reason why University, as an education institution must guarantee the acquisition of the whole set of competences that allow students to search, assess and analyze the information needed related to any knowledge area. It is important to highlight that this becomes essential in a digital world as the one we have. For that, communication and information technology (C&IT) become necessary to allow students to access to a wide range of information resource. It is not only a matter of finding out the information, but to analyze and apply the information to generate new knowledge.

Engineering schools must develop clear strategies to address the acquisition and application of this competence using these technologies. This research is focused on the application process to acquire the information literacy competence for civil engineering students related to environmental impact. For that purpose, different stage in the information literacy process has been defined and deeply analyze. The most difficulties founded by students are discussed and some methodologies to enhance the process are proposed.

Keywords: information literacy, engineering, environment, competences.

1 INTRODUCTION

The concept of information literacy has been defined in different ways since the early 1970s when it was first considered [1]. Nowadays, information literacy is defined as the competence, aptitude and knowledge to access, to use, to administrate and to communicate properly the information within the aim of studying, research or even for the professional exercise.

During the last decade, the world has developed to a hiperconnected one. In fact, it is well-known that we currently live in the "information society" where everyone uses information not only as a learner but as a worker, citizen, etc. This has set off (triggered) information as a business today in most societies.

The way this information comes to us (citizen, workers, students...etc) are diverse and include libraries, special organization, media and Internet mainly. It is important to highlight that most of these information sources provides unfiltered formats and inaccuracy details through texts, databases, graphics and images. Moreover, in some specific knowledge area, this amount of information is changing very quickly and becoming obsolete in a short period of time. All these facts contribute to the complexity of the society and demand people to be able to face with abundant and sometimes uncertain information.

For that, information literacy as a set of skills required to identify information sources, access information, evaluate it, and use it effectively, efficiently, and ethically [2] becomes a core competence for all graduates.

The higher education institutions as University, has within its missions to promote lifelong learner to the challenges of modern and changing societies. Thus, information literacy is a key component of and contributor to lifelong learning since it is the basis for learning in all common disciplines and through all education levels. Nevertheless, some studies reveal that university student's cannot retrieve and evaluate the information that is required for problem-solving and decision-making in the workplace and in society generally [3]. However, as university students know how to access to information (which is easily available and free from the internet) it is wrongly assumed by the academic community that they also know how to select, organize, interpret and use it. Furthermore, as

it is said by Alexius Smith [4] the confidence so many students demonstrate in using technology often creates a barrier between what they really know and what they could learn to sharpen their skills.

The Universitat Politècnica de València (UPV) expects to promote the acquisition of both, the academic-professional competences and the transversal competences for its grades. The latter is considered by employers of a great interest and necessary for success in real life, and thanks to the Bologna process [5] these competences have been rescued and giving a more important role. In fact, the UPV is currently implementing a training model on transversal skills. Deeper analyses of the 13 transversal competences list highlight the information literacy ability underlying most of these competences skills.

For all mentioned above information literacy seems to be an educational goal that cannot be ignored but, rather need to be fostered from the university through all disciplines.

In some scientific disciplines, information literacy is seen as relevant and necessary. For that incorporation of information literacy into science and engineering education curriculum is linked to a greater success in the future. The ability to select appropriate sources of information, understand the purpose of the sources of information and be able to critical thinking, are fundamental to personal and professional life.

In environmental science disciplines, it is of high importance (great relevance) to deal with so many sources of information related to the natural ecosystems (soil, atmosphere, water, flora and fauna) as well as to the social cultural information. However, the skills demonstrated by the students to search for the environmental information are weak and inconsistent. For that, the aim of this study is to provide information literacy skills in the environmental science disciplines since there has been identified a gap between the importance of information literacy skills for success in a professional life and the current skills that students reveal.

1.1 Students and subject context

We conducted our study in 2016-17 academic years with a 4th-year student's group of Civil Engineers from UPV (Spain). The objective has been applied to "Science and Environmental Impact of Civil Engineering" subject, which is a four-month and mandatory of 6 ECTS credits with a student number range from 25 to 30.

The academic program of the subject is divided into three didactic units focused on the environmental impacts of civil engineering works such as dams, channels, roads, bridges, etc. The course aims to provide the tools to analyse properly the natural environment where the different work-steps are going to be developed in order to identify the main impacts. Once the impacts are identified, they have to be evaluated and mitigated. This knowledge is programmed including both, theory classroom and practical informatics and lab lessons.

2 ANALYZING THE PROBLEM

As it can be deduced, a good environmental impact assessment (EIA) strongly demands a high level of knowledge of the ecological and the socio-cultural environment. As it is said in the Directive 2014/52/EU [6] the environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors: (a) population and human health; (b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC; (c) land, soil, water, air and climate; (d) material assets, cultural heritage and the landscape; (e) the interaction between the factors referred to in points (a) to (d) (6. Directive 2014/52/EU of the European Parliament and the Council of 16 April 2014).

For that, in order to carry out an EIA of a civil work properly, it is important to handle correctly a great variety of environmental resources. However, the students in its 4th year of Civil Engineering (although they how to access to information) are not mature enough to seek environmental information and interpret it by themselves. Furthermore, it is important to highlight that the subjects been taught in the previous year are related to the engineering field (maths, physics, structure, etc) meanwhile the one we are working with is closer to ecology field. For that, even the basic concepts might be difficult for them.

All these mentioned above hamper to learn some basic concepts of this discipline and hinder the critical thinking skill. Moreover, the students sometimes are lost in a huge amount of environmental

information that is not even able to understand; neither discriminates nor incorporates to its knowledge.

2.1 How can we foster information literacy? An application example

The learning and teaching methods applied to environment areas should encourage reflection and critical thinking rather than memoristic. For that, it is necessary to engage students in more advanced information literacy.

During this subject in the practical session's students are asked to compose an "environmental inventory document" of a real EIA from an actual civil engineering project that they have previously chosen by small groups of 3-4 students. The purpose is to use real-life projects to meet real-life information needs. The reason why students chose by their own the project to work with is, the more local and closer (to the student) the civil project, the more relevant it will be in the student experience.

The main goal of the practical exercise is to make the students learn how to use the acquired theoretical knowledge in class. In fact, is in this part of the programme where some guidelines to improve information literacy skills are taught. So that, the teaching strategy adopted engages students to:

- a) Recognize the need of information: the first questions they formulate is: How do I achieve this? This formulated question is the based on the information needs. They recognize the need of ecological and socio-cultural information in order to carry on the task. Moreover, this information may accomplish to be specific of a determined area, for that there is a need to seek for both an accurate and precise information. Although this step is mainly based on questions formulated to the student group, the information retrieval process is initiated even before the environmental information required is really identified.
- b) Identifies potential sources of information: During the theoretical classroom each teaching unit has its own references, which constitute potential sources of information indeed. However, in the informatics lessons they are encourage to search and browse in the Internet developing successful search strategies and survey technique. In this step the student creates the need to learn about information resources and this should be taken up by the teacher to introduce information literacy skills. One of them is the use of keywords and specific vocabulary properly to obtain positive results in the seeking process.
- c) Evaluate information: This might be the critical point since the student has to assess the information found and how this information fit its requirement. They have to be aware of the amount of information non precise on the internet and the subtle intention of the resource. It is also important to fully understand what they are reading and being able to summarize and identify the main ideas in order to develop new knowledge. They are taught to search information in the official State and European web pages and database related to environment like government reports and data, e-encyclopaedias, scholarly journal articles, full-text online.
- d) Organizes information for practical application: Once the information is achieved and selected it has to be arranged for its application. There is a wide range of environmental information linked to air, soil and water quality, noise, vibration, sociocultural etc. For that, it is important that the students as a member of a group keep the information organized.
- e) Integrates new information into an existing body of knowledge. This may be the most arduous step since the student has to completely understand what he/she has found and composes new information melting its own prior knowledge with the current and already found. However, this task may be greatly eased if the professor provides sufficient background about the environmental inventory.
- f) Use information in critical thinking and problem solving. The final purpose of the previous steps is to enable student to use the information in critical thinking, not only for environmental but rather as a citizen. Students at this level are expected to developed environmental awareness both for the professional and the civil life.

All these steps summarize the acquisition of information literacy skills developed by the students (Figure 1).

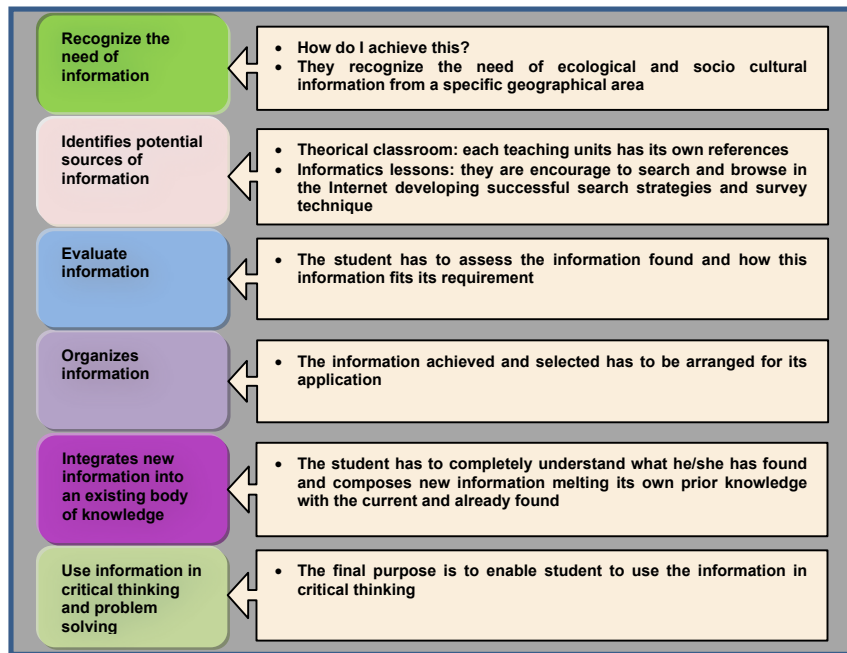


Figure 1: Information literacy applied to an environmental area.

Although the process has been split into six different steps sorted from the general to the particular when this is applied to the student this might not occur in such a well-defined way. The key is to find out a strategy to be able to apply this skill in any scenario related to the environmental science.

2.2 Evaluating information literacy

It is important to highlight that the information literacy cannot be the outcome of any one subject rather a way to success in professional life (8). For that, when information literacy competence is integrated into the curriculum, it is evaluated along with other aspects of the subject concerned.

In the case of study the “environmental inventory” is evaluated as a part of the practical work performed by the student. However, in order to evaluate the information literacy skills acquired and the student perception of the process, a questionnaire was delivered to each student related to both, the prior knowledge of information literacy and the skills learned after the task.

Some basic question such as: How do you search new environmental information?; Do you check the accuracy of the new environmental information found? If yes, how do you do it?; Do you handle numerical and graphical information?; Have you got any specific process to search new information?

The results indicate that most of the students did not search any kind of real environmental information before the subject, although most of them taught environment related subjects in the high school period. And, in those cases where the student searched for the information it was never numerical or graphical data. In fact, the students reveal that dealing with this kind of information provided by graphics; clusters, box-plot etc. became difficult.

Another relevant aspect was that the students did not discriminate between official/non-official resources, assuming as true all the information provided through the world wide webs. Thus, they did not even ask about the veracity of the source. This is a weak point and need to be addressed properly since the goal is to promote the critical thinking in the students

None of the students had a specific way of searching information before the task was carried out although in their personal life all of them uses internet such a browser for a wide grade of information.

Nevertheless the most challenging step of the student to accomplish through the task was to organize and combine the new information with the one already known to draft the document. This process of incorporating new knowledge into the one is a dynamic, internally, cognitive and effective process defined as a learning process.

There are two significant aspects to be considered at this point; the first one is the need of using their own words when incorporating new information into the existing knowledge, since this indicates a

meaningful learned process. And the second one is the need of incorporating new values to the individuals' personal ethics system.

Finally, the analysis of the students' responds to the questionnaire also indicated encouraging results. All the students agreed in the acquisition and improvement of the information literacy skills after the task. Moreover, they admitted the usefulness of what they had learnt and the easy implementation to other subjects taught in the course.

3 CONCLUSION

This society demands grades with information literacy skills due to the need of search, applied, update etc. new information in all disciplines. Furthermore, this enables the lifelong learner process which is also of great value and one of the goals of the university. In the other hand, the environmental professional life requires dealing with a huge amount of information which is diverse and quickly modified. For that the student is trained from the very first academic-years of the University to acquire these skills that will assure the success in the future.

The task proposed engage students in active development of the information literacy ability. Through the different class sessions the student realized the need of information and developed a personal strategy to achieve it. The strategy adopted by the student may be used in other fields of engineering or sciences.

Moreover, during the process some questions about the veracity of the information found and the subtle intention of the source come out and debated between the students. This fosters the maturity of the process and the critical thinking.

Therefore, this activity program became the starting point of working out these skills in the environmental area and must be extended to other subjects from different disciplines in the following degree courses.

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