International Journal of Learning and Teaching

Volume 08, Issue 1, (2016) 12-19

http://sproc.org/ojs/index.php/ijlt

Analysis of scientific contents of home products

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Suggested Citation:

Ezquerra, A., Fernandez-Sanchez, B. & Magaña, M. (2016). Analysis of scientific contents of house products. *International Journal of Learning and Teaching*. *8*(1), 12-19.

Received November 15, 2015; revised December 08, 2015; accepted January 18, 2016;
Selection and peer review under responsibility of Prof. Dr. Hafize Keser, Ankara University, Ankara, Turkey.

Abstract

The need for adequate scientific literacy is a fact. In addition, there is a lack of connection between the contents of what is dealt with in the science classroom and the daily-life issues of students. These circumstances make us to consider the need to analyse everyday situations in which individuals can come across scientific content. In this context, this paper presents a compendium of the results of previous studies about the scientific content found in different types of products used habitually in the home (food, electric and electronic devices, textiles and household cleaning products). The results collect the required data, which are classified in different categories: physical units, composition, procedures and security instructions. The conclusions suggest that there is a great deal of scientific contents in house products, and individuals should be able to deal with their labelling information. Therefore, the basic school curriculum should be adapted to these demands. Furthermore, teachers should take into account how to bring these contents into their classrooms.

Keywords: scientific literacy, individual consumer education, labelling, domestic science

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1. Introduction

Science and technology play an essential role in our society. This fact is so significant that the characteristics of our culture and its evolution greatly depend on the scientific-technical changes that this development has produced in our civilisation (Korotayev, Malkov & Khaltourina, 2006). It would be inconceivable to live without these scientific advances, from the wide range of telecommunications to the familiar carton of UHT milk everybody has in his fridge (including the fridge itself). In this regard, there are different agents who concern themselves with these issues, so there are different ways of highlighting the importance of these issues.

On the one hand, institutions have a certain interest concerning the acquisition of scientific literacy among the population. The term 'scientific literacy' is understood as the capacity for answering the many daily-life situations that involve science (DeBoer, 2000; Laugksch, 2000; Kolstø, 2006; Lewis & Leach, 2006; Bybee, 2015) related to personal, social and environment welfare (Harlen, 2001; Lemke, 2006). This concern can be observed in the large number of declarations and congresses put into place regarding this topic. To mention one example, the European Parliament approved the European Framework for Key Competences for Lifelong Learning. This Framework included scientific competences among the eight key competences for lifelong learning (EC, 2006).

On the other hand, 79% of Europeans declare themselves to *be interested* or *very interested* in science and technology. In particular, they are particularly interested in topics that are more proximate to their daily-life issues, such as health, food, consumption, the environment, etc. (EC, 2010; BBVA Foundation, 2012).

From the educational point of view, almost all European school curricula are designed from the science for everyone perspective, with the aim of achieving scientific literacy of citizens from the early educational stages (COSCE, 2011). However, students do not necessarily achieve an adequate level of scientific literacy (Osborne & Dillon, 2008; Bybee, McCrae & Laurie, 2009). One of the reasons for this problem in science education seems to be the lack of relationship between the topics worked on in science classes and the daily-life issues of students (Duggan & Gott, 2002; Swarat, Ortony & Revelle, 2012; Clegg & Kolodner, 2014).

This context makes us to consider the need for analyzing the everyday situations in which individuals come across scientific and technological content. The analysis of the relevant daily life situations in terms of scientific-technological content shows that there is a multitude of such circumstances (Ezquerra & Fernández-Sánchez, 2014):

- Scientific content in the media: advertising (Campanario, Moya & Otero, 2001; Pitrelli, Manzoli & Montolli, 2006; Belova, Chang & Eilks, 2015); TV programs (Dhingra, 2003; Ezquerra & Polo, 2010); high impact news stories (Oliveras, Márquez, & Sanmartí, 2013; Halkia & Mantzouridis, 2005; Jiménez-Liso, Hernández & Lapetina, 2010); information provided by weather reports (Ezquerra & Pro, 2006); the science sections of the press (Jarman & McClune, 2002; 2007); cartoons (Perales & Vílchez, 2002; Stephenson & Warwick, 2002), etc.

- Scientific content that is embedded in other sources such as social debate (Roth & Desautels, 2004; Levinson, 2010; Weiss, 2012; Ezquerra, Fernandez-Sanchez & Magaña, 2015; Hadzigeorgiou, 2015; Vesterinen, Tolppanen & Aksela, 2016).

- The buying process. In this context, it is possible to find different elements with scientific content such as claims on packaging (Arroyo, 2013), information on labels (Cowburn & Stockley, 2005; Besler, Buyuktuncer & Uyar, 2012; Sørensen, Clement & Gabrielsen, 2012), relations between shop assistants and customers, etc.

- Scientific and technological questions related to concerns such as medicine and health emerge as scientific literacy improves our decision making when it comes to choosing medical treatment

(Maienschein, 1998; Allchin, 2011). Thus, it is important that we, as patients, understand what the doctor tells us, identify which medicines to buy, and know how to follow a course of medical treatment. In the same way, it is important to possess critical thinking to avoid being cheated with pseudo-medicine or alternative treatments. This knowledge and the commitment of individuals to medicine have been studied by Coulter, Askham & Parsons (2008).

We are aware of the wide spread of everyday contexts, the great diversity of elements that form these contexts, and the huge number of contents that appear there. For this reason, in this paper we focus on the analysis of the contents of one context – science in the home -, and on one element – household products -, and one type of content – the information on labels and packages relating to these products. Specifically, the purposes of this paper are:

- Detecting and categorizing the scientific content that appears on the labels of different types of home products (food, electrical and electronic equipment, household cleaning products and clothes).
- Analyze the knowledge that consumers need to deal with the scientific content appearing on the labels of these home products.

2. Methodology

This work is based on a compendium of previous studies in which we analysed the scientific contents of packaging and labels of different products: food (F), electric and electronic devices (E), textiles (T) and household cleaning products (H). The methodology is based on a qualitative method approach. The first step consisted of collecting the units of information found on labels and packaging. Next, we established different categories based on these units of information and their linkage to scientific and technical aspects.

The categories common to all the products are *physical units, composition, procedures* and *security instructions*, so these are the categories we have selected for this compendium.

3. Results and discussion

Before presenting the results we have to highlight two aspects: firstly, these categories are not exclusive. For instance, an information unit such as “contains gluten” could be both in the composition details and in the security instructions. Secondly, the contents shown in the tables are only a small sample of all the examples we have found for each category and type of product.

3.1. Information referring to physical units

This information presents objective information about the characteristics of the product. In the analysis of each type, we appreciated that these units could be divided into different groups: *pre-defined physical units* (both *universal* and *specific*) and *units of convenience* (Table 1).

Predefined physical units are those that have already been established. They measure both universal characteristics of all the products (e.g. mass, volume), and the specific characteristics of each one (e.g. conductivity, frequency). The presence of these contents in labels and on packaging demands the need to identify the symbols for the units, of knowing the magnitude that is being measured, of estimating the quantity that each represents, of comparing different measures, etc.

On the other hand, *units of convenience* are those that have been created to measure a specific property of the product by a unit created in an ad hoc manner. Their origin seems to be the need for simplifying the communication between the manufacturer and the user (e.g. to show the capacity of a dishwasher in terms of the number of pieces of cutlery that fits in it). Furthermore, we have observed that these units of convenience try to overcome conceptual difficulties. Some of these units seem to be highly established (e.g. daily values in food), while there exist others that are more whimsical (e.g. servings per container with regard to food, or caps in detergents to measure the quantity of the product to be used).

Table 1. Physical units present in home products' labelling

Sub-category	Some examples [units] (Type of products)
Pre-defined universal magnitudes	Dimension [cm; m; inch] (E, T, F, H)
	Volume [litre; ml; fl; oz; pint; cm^3] (F, H, E, T)
	Mass [Kg; g; mg; µg; oz] (F, H, T, E)
	Energy [kJ; kcal; cal] (F, E)
	Voltage [V] (E)
	Time [s; min; h; days] (F, H, E, T)
	Temperature [ºC; ºF] (F, H, E, T)
Pre-defined specific magnitudes	Concentration [%; ml/L; g/100 g; mg/L] (F, H)
	Power [W] (F, E)
	Acidity [%] (F, H)
	pH [dimensionless] (F, H)
	Daily values [%; traffic light] (F)
Units of convenience	Quantity [teaspoon; drop; glass; box; piece; servings per container] (F)
	Quantity [cap; washes; tablet; bucket; washing] (H)
	Capacity [cutlery] (E)
	Printing speed [Pages per minute (ppm)] (E)
	Talk time [hours] (E)

3.1. Information referring to the composition of the products

In food, this information refers to the ingredients (whether they are foodstuffs themselves, chemical elements, chemical compounds or additives) and to the biomolecules in terms of nutritional composition; in electric and electrical devices and textiles, it refers to the materials these products are made of; in household cleaning products, to the chemical compounds (Table 2).

These contents can be also by classified according their origin into natural (both animal or vegetal) and synthetic. We have to highlight that despite the natural origin of the materials, all of them have been processed in one way or another, and individuals have to take this aspect into account. In

addition, these contents demand the need for, first of all, identifying these compounds, and secondly, connecting their presence to specific characteristics of the product.

Table 2. Composition present in home products' labelling

Sub-category	Some examples (products)
Ingredients	Eggs; milk; olive oil; corn; beans (F)
Chemical elements	Calcium; sodium; potassium (F) aluminium; lithium-ion battery (E)
Chemical compounds	NaCl; bicarbonates; nitrates (F) sodium hypochlorite; sodium or potassium hydroxide; anionic surfactants; non-ionic surfactants; amphoteric surfactants (H)
Additives	Colours (E100-E190); preservatives (E200-E299); sweeteners and glazing agents (E900-E999) (F)
Biomolecules	Carbohydrates; fats; proteins; vitamins (F)
Natural origin	Wool; leather; silk; cotton; linen (T)
Synthetic materials	Carbon fibre; polystyrene; nylon; neoprene; silicone (T) teflon; stainless steel (E)

3.2. Information referring to procedures

These contents refer to the procedures associated with the product itself. They can be divided in two groups: treatment procedures and instructions (Table 3).

The first one – treatment procedures - consists of a broad variety of procedures that indicate how the product has been treated. The understanding of these procedures, which appears more often in food, is associated with several characteristics of the product such as flavor, composition, shelf life, etc. (in the case of food). Furthermore, these contents can also refer to the supposed quality of the product.

On the other hand, we have found a wide ranging group of instructions. These contents involve the implementation of a series of simple actions conducted in a certain manner, but with no explanation. Even though these instructions seem to be clear and simple, they involve the need for the consumer to understand specific concepts needed for their appropriate implementation.

Table 3. Procedures present in home products' labelling

Sub-category	Some examples (products)
Treatment procedures	Fermented; pasteurized; not treated with rbST; vacuum packed; mechanical means (F) Handmade (T) Made with natural products; homemade (H, F)
Instructions	For best before date: [date]; Heat product in microwave (1000 W) for xx seconds (F) Iron to xx ºC; wash to xx ºF; dry to xx ºC; do (not) use perchloroethylene (T) Dilute first; pour at least one third (100ml) of the bottle down the plughole (H) Device designed to work with 220-240 V; 50 HZ alternating current (E)

3.4. Information referring to security instructions

This information could be equally considered as *procedures*. However, due to the relevance for the health of the individual, we decided to create a different category entitled *security instructions*, which can be divided into two different groups: preventive instructions and palliative instructions (Table 4).

In food and household cleaning products, this information is so important that there exists a regulation for them: Regulation (EU) No 1169/2011 for food and Regulation (EC) No 1272/2008 for household cleaning products. On the other hand, we have not found this category in textile products due to the fact that, in principle, the use of these products does not entail considerable risks. As it occurs with the *information referred to procedures*, these contents present an indication of the need to carry out some protocol, but with no justification.

Table 4. Security instructions present in home products' labelling

Sub-category	Some examples (products)
Preventive instructions	Avoid using if inflammable gases are available; ensure socket can withstand the maximum power load of the machine; avoid conductive material contact with battery terminals (E)
	Conservation between xx ºC and xx ºC; this product has not been pasteurized and may contain harmful bacteria; contains eggs/ soya/ fish/ nuts / gluten (F)
	Contact with acids may liberate toxic gas; do not use together with other products, may release dangerous gases (chlorine) (H)
Palliative instructions	If product gets into eyes rinse thoroughly with water; wash skin thoroughly after handing; ventilate the room after use (H)

4. Conclusions

As occurs in every context of our lives, there are many scientific contents with regard to home products - from food technology, to synthetic materials, through to the surfactants in detergents. These contents imply that individuals should be able to deal with the labelling information they contain. According to this, the two first categories - physical units and composition - demand a conceptual knowledge, while procedures and security instructions demand more action and specific activities.

In this context, it is necessary to understand the whole gamut of information present in labelling in order to use the product in a correct way, and take full advantage of the benefits it offers. This is connected with our capacity to decide, and therefore with our choice capacity as consumers. Our duty as citizens is not only to demand laws that compel manufacturers to specify the characteristics and instructions with regard to their products, but also to claim an education that satisfies our demands as consumers.

In this regard, related to formal education, most of the contents analysed in this study do appear in the science curriculum. However, they are presented as a set of concepts and procedures with no contextualization in terms of familiar situations for students. Consequently, we think that the proper development of scientific literacy among students depends on the personal work of each teacher. Since this labour is already complex, it is necessary to facilitate the teachers' work by giving examples of the contexts that are connected to students' daily lives. One of these contextualized examples could be the scientific content of labelling and packaging with regard to home products, as we have done in this work. However, there exist many other aspects which have to be taken into account. The analysis of all these contexts, contents and elements would provide an excellent way, not only to introduce the

appropriate curricular scientific content, but also to show their significance, because of their applicability and closeness, to everyday life of the individual.

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