How Can Common Sense Support Instructors with Distance Education?

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Abstract. *This paper shows how a common sense knowledge base, collected from volunteers over the web, can be used by teachers to plan Learning Actions for preparing students to interact with the community where the common sense statements came from. Consequently, this knowledge base can help teachers to deal with some challenges they face when they adopt a DL approach.*

Keywords. *Common sense, knowledge base, distance learning, health care*

1. Introduction

For web-based distance learning (DL) to be effective, it is important to assist instructors during the design of instructional material, helping them model the lessons and the instructional material navigation, organization and layout. It is also important to consider pedagogical aspects that facilitate the learner's construction of knowledge.

In this context, instructors face challenges such as:

1. Off-campus student learning can demand more teacher time than traditional instructor controlled on-campus learning [Doube, 2000]. Here the instructional material design takes up most of the time;

2. How to get learners and instructors effectively motivated and engaged.

3. Institutional support is often missing. Most academics are familiar with the ad-hoc approach to e-learning where development of resources and support of students have more to do with individual heroics than good institutional planning [Marshell and Mitchell, 2004].

4. The need to bypass the misconceptions that some learners (and also some instructors) still have about the DL process.

5. How to get the best out of all the computer tools available and also how to use them to reach pedagogical goals.

6. How to evaluate the learners' performance and how to explicitly define the evaluation criteria.

This article focuses on the first two challenges, proposing the use of recent advances in Artificial Intelligence to model *common sense* knowledge in order to minimize these kinds of problems.

Many projects in curriculum development for distance learning or Intelligent Tutoring Systems have good models of the knowledge that is to be taught; few have very good models of what the student knows. The power of *common sense* knowledge is that it can serve as a generic model of what an ordinary person could be expected to know. Teaching can then be viewed as an activity that explains the expert knowledge by relating it to general knowledge. Often, good ways to do that are by making analogies from the expert knowledge to everyday life, or teaching by example, where the examples are chosen so that the student can relate to them. This idea has been already explored in an on-line help assistant that automatically searches for such analogies and examples [Lieberman and Kumar, 2005].

Here, it is considered that *common sense* can be used as a student knowledge model to guide a curriculum designer.

In this context, *common sense* can be defined as the knowledge that is shared by the vast majority of people who live in a particular culture [Anacleto et al., 2006; Liu and Singh, 2004]. For example, simple statements such as "ice is cold", knowledge about the world as "Brazil is in Latin America" and (possibly controversial) beliefs as "North Americans are the best soccer players in the world" are included. When it is said that some statement is *common sense* in a culture, it doesn't mean that it is scientifically true or even that it is also *common sense* in other cultures. For example the statement "North Americans are the best soccer players in the world" might be considered *common sense* in USA, but it is not possible to say that the same statement can be considered *common sense* in Brazil.

According to the *common sense* definition presented before, which considers as *common sense* the knowledge that most people agree with in a certain community at a certain period of time, the number of people in a culture who agree with the same statement is what defines whether the statement is *common sense* or not in the considered culture. So, as the number of people who agree with the same statement increases, the possibility of that statement being considered as a *common sense* also increases.

It is believed that *common sense* statements can be used to:
1. Support instructors preparing the subject matter to teach, and
2. Promote active learning by students.

This work focuses on the first case. Specifically, instructors can be helped by
a) Identifying topics of general interest to be taught;
b) Identifying student conceptions that are inadequate in a certain context;
c) Fitting the instructional material content to the previous learner's knowledge;
d) Providing a suitable language to be used in the instructional material and
e) Minimizing the time used to prepare it.

In order to show the potential of using *common sense* statements to help instructors in their work, it is being developed a case study in the context of the Brazilian Open Mind Commonsense Project [Brazilian OMCS, 2006], which has been developed by the Advanced Interaction Laboratory of the Computer Department of the Federal University of São Carlos (LIA-DC/UFSCar), in partnership with the Media

Laboratory of the Massachusetts Institute of Technology (MIT Media Lab), since August 2005.

In that case study, the project knowledge base is being used to support two professors of the Nursing Department of the same university (DEnf/UFSCar) to plan a learning action about home care education.

This work, partially supported by TIDIA-Ae FAPESP project, proc no. 03/08276-3, and Programa Novas Fronteiras, proc no. 06/52412-7 and CAPES, presents some previous results of the case study. This paper is structured as follows: section 2 presents the approach adopted by the Brazilian OMCS project to collect and use *common sense* knowledge in computer application; section 3 explains how *common sense* statements can be used to help instructors plan learning material; section 4 presents an analysis of the *common sense* statements obtained from the Brazilian OMCS knowledge base that are related to health care domain; finally, section 5 points to some conclusions and future work.

2. The Brazilian OMCS Project

The Brazilian version of the OMCS project has the same architecture that the American version. This architecture works on three fronts to make machines capable of *common sense* reasoning, as it is represented in Figure 1. In the following, each work front is approached in details.
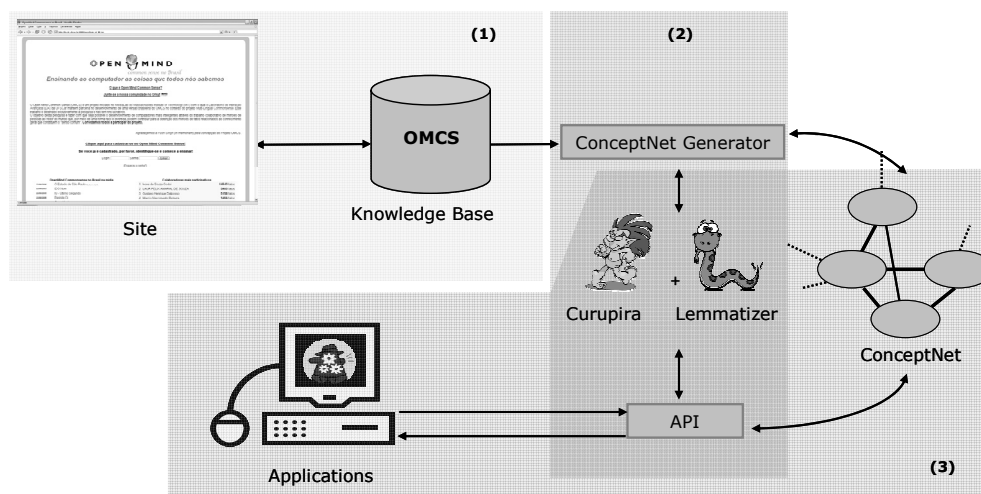

Figure 1. Open Mind Commonsense Project Architecture

2.1. *Common Sense* Knowledge Collection

The first work front of Brazilian OMCS project is related to the collection of *common sense* knowledge. Since every ordinary person has the *common sense* that computers lack, everyone can contribute to build the knowledge base that is necessary to give computers what they need to be able of *common sense* reasoning.

This is only possible because of web technologies, since lots of people can be reached through the web. It would be very expensive, time consuming and less efficient to try to approach the number of people that has access to web through other ways.

Taking this into account, it was developed a web site (www.sensocomum.ufscar.br) where everybody can contribute to build the project's knowledge base, making his contribution filling out in natural language the *templates* presented by the site activities, telling about his everyday life.

Using natural language was chosen intending to avoid making the contributors to learn a specific language in order to give their contributions. In this way, everyone that knows the language adopted in the project version – Portuguese, in the Brazilian version – can easily contribute with the project.

The templates presented in the site are semi-static, what means that part of it changes each time it is presented and part does not. They are generated dynamically and the dynamic part is filled out through a feedback schema, which makes use of the contributions stored in the project knowledge base to compose the template presented to the user. This explains the bidirectional arrow connecting the *site* and the *knowledge base* in Figure1.

It is valid to point out that, in OMCS projects the set of contributions gotten on the sites can be downloaded for free in the site project to be used to research purposes.

2.2. Knowledge Preparation

In order to be used in computer applications, *common sense* knowledge should be represented in a way that it can be manipulated by inference procedures [Liu and Singh, 2004].

As OMCS projects adopt a natural language approach to populate their knowledge base, it was decided in the original project to pre-process the contributions stored in the knowledge base so that they could be easier to manipulate.

From this pre-processing it is generated a semantic network is in which the knowledge is represented as binary relations. Those relations are used by the inference procedures, which are being developed in the OMCS project context, to be used by computer applications which will be capable of *common sense* reasoning. This semantic network is called in OMCS projects as *ConceptNet* [Liu and Sing, 2004].

To automate the generation of *ConceptNet*, it was developed a Python module to process the sentences and build the relations. This module receives a text file with the sentences stored in the knowledge base, uses a group of extraction rules and generates binary relations. Those sentences that do not match to any extraction rule are submitted to a natural language parser that works on each one, identifying language structures, such as noun phrase, verbal phrases, adjective phrase, etc. The structures identified by the natural language parser return to the *ConceptNet's* generator that uses a set of inference heuristics to compose the relations.

In Brazil the natural language parser adopted is the Curupira [Martins et al., 2003]. The terms identified by it is normalized by the *Normalizer* module, depicted in Figure 1, which was developed by LIA. The normalization process is performed in order to increase the network connectivity.

There is another moment in which data should be processed so that they can be used by inference processes. It is when data come in natural language from computer applications, which use *common sense* reasoning. In that moment the text should be

manipulated in order to allow *common sense* inferences over the *ConceptNet*. This is explained with more details in the following sub-section.

2.3 Applications with *Common Sense* Reasoning

Once the semantic network is built, it is necessary the development of procedures capable of manipulate it so that *common sense* reasoning can be achieved.

The procedures developed in the context of the OMCS project are integrated in the project's Application Program Interface (API). Nowadays there are five basic procedures that try to simulate some kinds of human reasoning ability. They are related to *context, projections, analogy making, topic gisting* and *affective sensing*. The logic behind each of these procedures is described in [Liu and Singh, 2004].

Having those procedures developed, it is possible to build applications that make use of them. The current prototypes developed in the project context are text-based. Some of them are presented in [Lieberman et al., 2004].

In those applications, users usually type a text that is sent to the proper API's procedure that implements a process which will be helpful in the application context. So, the text which comes from the application should be parsed in order to have embodied language structures identified so that inferences can be performed over the semantic network. This configures the overlap between the second and third OMCS project's work fronts, as it is represented in Figure 1.

3. Using *Common Sense* to Aid the Learning Process

As previously mentioned, it is believed that *common sense* can be used to help learners and instructors in the learning process. Here it is explained some of the specific roles that *common sense* can play.

The first point is identifying topics of general interest to be taught. Considering that *common sense* consists of statements that most people agree with, the instructor can identify the students' needs, and prepare a class with topics of general interest taking *common sense* statements into account. For example, if it is found the statement "*To take care of sick people at home is cheaper than at a hospital*" in OMCS knowledge base, the instructor can decide to prepare a class explaining the cost-effectiveness of taking care of sick people at home.

Second, statements that are inadequate or incorrect can be identified in order to correct students' misconceptions. Continuing with the previous example, if it turns out that there are studies which prove that taking care of sick people at home is not cheaper than paying for a hospital treatment in certain cases, instructors can prepare instructional material pointing to these studies. It is important to point out that acting in this way the instructor is promoting active learning, since learners are supposed to be able to change incorrect or incomplete assumptions they may have. This is, according to Liebman (1998), one of the main characteristics of active learning.

The third point is related to using *common sense* knowledge to fit instructional material to the learner's previous knowledge, so that instructors do not waste time rehashing material already known by the students. For example, if the instructor identifies procedures that a person who is taking care of a sick person should perform

before administering medication, there is no need of spending a lot of time talking about it again. Filtering *common sense* by geographic location, age, educational level, etc. of the contributors, it is possible to customize presentations to the needs of specific kinds of students.

Now, about the fourth point, instructors can use the OMCS corpus to provide a suitable vocabulary in the instructional material. *Common sense* statements help instructors know using what terms the general public uses to think about and deal with the theme. Thus, instructors can compose the instructional material using a vocabulary known by most people, and also take examples from the OMCS corpus to facilitate understanding of the stuff that is being taught.

Finally, the fifth point is a consequence of the ones presented previously. It is believed that using *common sense* to guide the themes to be taught, examples, and language will improve the efficiency of production of educational material as well as its accuracy.

4. *Common Sense* and Home Care Nursing Education – A Case Study

In order to show the potential use of *common sense* to support instructors in their tasks, a previous analysis of the data stored in the Brazilian Open Mind Commonsense knowledge base (http://www.sensocumum.ufscar.br), related to the health care domain, was performed.

The educational situation of interest is the one where instructors are preparing material for teaching nursing students how to advise home caregivers in taking care of patients. Thus there are three actors in this situation – an instructor who is preparing educational material to be used in distance learning; a student who is studying to be a professional nurse; and a caregiver who is a friend or family member of the patient, and who will care directly for the patient. It is important that the instructor take into account the state of knowledge of both the nursing students *and* the probable state of knowledge of the caregiver with whom the nurse will interact.

In this study it is defended that if instructors have a notion of what *common sense* is for caregivers when they talk about home care, they will be able to teach their students how to orient caregivers in home care more effectively.

It is important to point out that in the Brazilian Open Mind Commonsense website there is an activity related to health with templates that are used to get statements about the procedures of home care of a sick person. Those templates were defined specifically for this domain, according to a health care expert, in order to make fast the collection of data about the home care theme. They have some specific words of the health domain and lacunas which should be filled out by contributors so that a *common sense* statement might be composed. Figure 2 shows a screen shot from the Brazilian OMCS site's with a template about health.

To this work, it was selected the statements from the Brazilian OMCS knowledge base, entered through the templates mentioned before. It was considered only one statement of each contributor, removing repetitions from the same contributor, following the health care expert advice for this analysis, because the number of different people talking about the same thing is more important than the statement repetition by the same contributor. Then the statements were grouped according to the expert criteria.
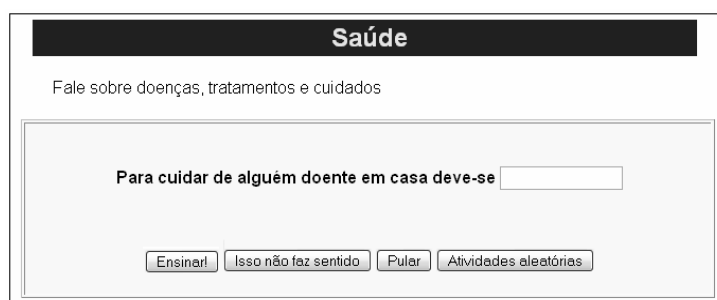
Figure 2. Screen shot of a health template of the Brazilian OMCS site

For example, considering the template presented in Figure 2 – "*In order to take care of a sick person it is necessary to _____*" – it was found some statements like "*to know a little bit about health care*", "*to know how to administer medicines*", and others to compose the first category presented in Table 1: "*Having basic knowledge about home care of sick people*".

In the following, some tables are presented, each one related to one template of the Brazilian Open Mind Commonsense Health theme. It is shown three categories for which it was obtained good responses from contributors.

Table 1 expresses the collected in the Brazilian OMCS knowledge base about what is necessary to home care of a sick person.

Table 1. Template: "In order to home care of a sick person it is necessary _____"

Category	Percentage of related contributions
Having basic knowledge of home care of sick people	57.7%
Paying attention to the sick person	7.7%
Keeping the environment clear for people with restricted mobility	7.7%
Others	26.9%

The Brazilian OMCS statements collected through that template point out caregivers want to know about health care procedures, medication procedures, and also about the diseases they are dealing with. It is also interesting to note that the contributors commented that they want to know how to care for a sick person in an emergency.

Table 2 expresses the Brazilian OMCS statements about the prerequisites for home care of a sick person.

Table 2. Template: "Before starting home care of a sick person it is necessary to _____"

Category	Percentage of related contributions
Learn about how to take care of sick people	20.0%
Clean and arrange the environment	16.4%
Contact a doctor	14.5%
Others	49.1%

The difference between this template and the template presented in Table 1 is that here, the template focuses on what is necessary *before* care, e.g., *"it is necessary to wash your hands before any home care procedure"*.

The most cited category related to this template reveals that caregivers are often unsure whether they have sufficient knowledge to care for the patient, alerting the instructor to make sure that students know where to find information and that they know how to determine if their knowledge is sufficient. This information goes towards what is mentioned by Zarit (1997), who states the necessity of identifying the cargivers' characteristics to promote programs that can help mitigate any negative impact that home care procedures can generate and can help to identify factors that can assist caregivers in their tasks.

The second most cited category shows that people are concerned about the importance of arrange the environment. However, the specialist has missed information about how people usually arrange the environment when they are going to home care a patient. Considering that, the specialist has mentioned that it is important for the instructor to emphasize to students that they have to tell caregivers relevant information about how to arrange things in an environment, so that it will be adequate for receiving a patient. Home care patients often have restricted mobility, so measures like removing rugs that present a hazard of slipping, and making sure furniture does not block paths through the home are often required.

Table 3 illustrates some aspects that are not always given sufficient consideration, e.g., questions related to quality of life for the caregiver. To become a caregiver is a process that occurs gradually or immediately, depending on the pathology of the dependent and, generally, factors as kinship, gender, physical and affective proximities determine who gives care, the most common situations being caring for your spouse, and parents caring for children [Mendes, 1995]. *Common sense* shows that successful home care of a sick person requires love, affection, skill, devotion, patience, etc. This must be considered when education in health is developed, in academic as well as clinical settings.

Table 3. Template: "In order to home care of a sick person someone has to have _____ "

Category	Percentage of related contributions
Affection and patience	42.85%
Medications at home	24.7%
Knowledge about how to home care of sick people	9.0%
Others	23.45%

It is interesting to point out that the analysis was done considering about 3000 statements which were gathered through the health activity templates of the Brazilian OMCS site. Those statements were supplied by more than 70 different users of which 70% are male. It is good to point out that all the contributors previously mentioned are *older than 12* years – 65% are between 18-29 years old and 20% are between 30-45 years old. Another statistical data related to the users is that *more than 70%* of them are from the *São Paulo* State, the most economically developed State of Brazil, about 4% of users are from the State of Santa Catarina and other 4% from the State of Minas Gerais,

all States placed on the most economically developed region in Brazil. It is also interesting to point out that the majority of those users (21%) are interested in the *computers area*, followed by 6% interested in the *health care and education areas* and 3% interested in *arts*.

5. Conclusions and Future Works

As commented before, it is believed that *common sense* statements can be used to support (1) instructors, and (2) learners, in order to promote active learning.

The focus here is on the first case, and it is believed that *common sense* knowledge can be used to help instructors to (a) identify topics of general interest to be taught, (b) identify facts that are inadequate in order to fill in gaps in knowledge, (c) fit the instructional material content to the learner's previous knowledge, (d) provide a suitable vocabulary to be used in the instructional material and also (e) minimize the time used to prepare lessons.

This work has discussed the possibility of using the *common sense* knowledge stored in the Brazilian Open Mind Commonsense knowledge base to help instructors in the design of instructional material for DL. Here it was presented the first analysis with the OMCS statements in the health care domain.

With this preliminary analysis it was possible to realize that there is a potential for using the Brazilian OMCS knowledge base to support learning, considering the domain that was chosen.

It is important to point out that the health professionals that analyzed this data have commented that the use of these statements can really help in the development of instructional material for undergraduate nursing students. It is believed that this type of procedure of using OMCS statements can be useful for general instructors and applied in other knowledge domains.

As future work, it is proposed to finish planning the learning action and to execute it. It is also intended to make available this support that *common sense* can give to instructors in Cognitor, an authoring tool, based on the e-Learning Pattern Language Cog-Learn [Talarico Neto, 2005], whose main objective is to support the instructor during the design and editing of the instructional material to be delivered electronically to the students on networks, CD/DVD, and the Web.

It will be also explored the possibility of using *common sense* statements to allow *common sense* reasoning in applications developed to support learners in the learning process so that those applications can (a) support the learner in the search for information related to a given theme; and (b) select kinds of material suited to the learner's profile.

It is also intended to develop other case studies and explore different domains and also to develop OMCS based tools to support health professionals and teachers in the task of updating knowledge.

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