LREC 2002. Workshop Proceedings. International Standards of Terminology and Language Resources Management. Las Palmas, Spain: ELRA. 2002. 61–68.

Where will the Standards for Intelligent Computer-Assisted Language Learning Come from?

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Abstract

Intelligent computer-assisted language learning—Intelligent CALL, or ICALL—can be defined in a number of ways, but one understanding of the term is that of CALL incorporating language technology (LT) for e.g. analyzing language learners' language production, in order to provide the learners with more flexible—indeed, more 'intelligent'—feedback and guidance in their language learning process. However, CALL, ICALL and LT have been three largely unrelated research areas, at least until recently. In the world of education, 'e-learning' and 'ICT-based learning' are the new buzzwords. Generally, what is meant is some kind of web-based setup, where course materials are delivered via the Internet or/and learners are collaborating using computer-mediated communication (CMC). An important trend in ICT-based learning is that of standardization for reusability. Standard formats for all aspects of so-called 'instructional management systems' are rapidly gaining acceptance in the e-learning industry. Thus, learning applications will need to support them in order to be commercially viable. This in turn means that the proposed standards should be general enough to support all conceivable kinds of educational content and learning systems. In this paper, we will discuss how ICALL applications can be related to the various standards proposals, basing our discussion on concrete experiences from a number of (I)CALL projects, where these standards are used or where their use has been contemplated.

1. Introduction

For some years, I have been actively involved in trying to combine computer-assisted language learning (CALL) with language technology (LT) (a.k.a. computational linguistics (CL), language engineering (LE), or natural language processing (NLP)) into what is often referred to as "Intelligent CALL" (ICALL), both as a teacher of CALL to LT students at the university, and as a researcher involved in a number of research efforts dealing with CALL/ICALL (see below), and also with neighboring areas, such as computer support for lesser used and lesser taught languages (Borin, 2000a; Allwood and Borin, 2001; Nilsson and Borin, 2002), and contrastive linguistic studies using computational methods (Borin, 1999; Borin, 2000b; Borin and Prütz, 2001; Borin and Prütz, 2002).

The present paper flows from a desire to make ICALL benefit from, as well as inform, ongoing standardization efforts in the computational linguistics and e-learning communities.

The rest of the paper is organized in the following way. First, I will try to sort out the relationships between CALL, LT, artificial intelligence (AI), and ICALL. Then I will describe briefly ongoing standardization work in the e-learning and CL communities, and some of the standards proposals that this work has produced. Following that, I will turn to a description of some (I)CALL projects in which I have been or am currently involved, where these standards are used or where their use has been contemplated, namely the SweLL Didax project, the LingoNet project, 'Corpus based language technology for computer-assisted learning of Nordic languages', the SVANTE learner corpus project, and 'IT-based collaborative learning in Grammar'. Finally, I will discuss the situation of ICALL with regard to this standardization work, in order to form an understanding of where we stand at the moment, but more importantly, of where we would like to go from here.

2. CALL, LT and ICALL

Intelligent computer-assisted language learning—Intelligent CALL, or ICALL—has been defined in a number of ways, but one understanding of the term relevant here is that of CALL incorporating LT techniques for e.g. analyzing language learners' language production or modeling their knowledge of a second/foreign language in order to provide them with more flexible—indeed, more 'intelligent'—feedback and guidance in their language learning process.

CALL, ICALL and LT have been three largely unrelated research areas, at least until recently:

1. The CALL 'killer apps' have been e-mail, chat and multimedia programs, developed and used by language teaching professionals with very little input from LT research (Pennington, 1996; Chapelle, 1997; Chapelle, 1999; Chapelle, 2001; Levy, 1997; Salaberry, 1999). The only kind of LT which has had any kind of impact on the CALL field is corpus linguistics, and even in this case it has been the Humanities Computing 'low-tech' kind of corpus linguistics,

rather than the kind pursued in LT (the latter is sometimes referred to as "empirical natural language processing").

2. ICALL has often been placed by its practitioners in the field of artificial intelligence (AI), rather than in LT (e.g. Swartz and Yazdani (1992); Holland et al. (1995)), more specifically in the subfield of AI known as *intelligent tutoring systems* (ITS) (e.g. Frasson et al. (1996); Goettl et al. (1998)). Partly for this reason, work on ICALL has proceeded, by and large, without feedback into the LT community.

3. But on the other hand, in LT in general, (human) language learning has not been seen as an application area worth pursuing. In the recent broad *State of the art of human language technology* overview edited by Cole et al. (1996), 'language learning' does not appear even once in the index, and there is no section on CALL. Certainly there are some exceptions to this general trend; there have been occasional COLING (*International Conference on Computational Linguistics*) papers on ICALL, although few and far between (e.g. Borissova (1988); Zock (1996); Schneider and McCoy (1998)), and there is a research group in Groningen which has been working very actively on LT-based CALL applications for quite some time (Nerbonne and Smit, 1996; Dokter, 1997; Dokter, 1998; Dokter and Nerbonne, 1997; Dokter et al., 1997; Jager et al., 1998). The situation has been changing somewhat only in the last few years, however, with dedicated workshops on language learning applications of CL being arranged in connection with LT conferences and the like (e.g. Olsen (1999); Schulze et al. (1999); Efthimiou (2000)).

3. Standardization in e-Learning and Language Technology

3.1. E-learning standardization efforts

In the world of education, 'e-learning' and 'ICT-based learning'[1] are the new buzzwords (see, e.g., European Commission (2000)). Generally, what is meant is some kind of web-based setup, where course materials are delivered via the Internet or/and learners are collaborating using computer-mediated communication (CMC) methods.

An important trend in ICT-based learning is that of standardization for reusability. Standard formats are defined for all aspects of so-called 'instructional management systems'. Thus, not only educational content formats are agreed upon, but also course structure formats, test formats, as well as how their interaction with recordkeeping systems used in education should take place. There is a number of organizations working on standards in the e-learning area, the most important ones being IMS (Instructional Management System Inc. `http://www.imsproject.org/`), IEEE's LTSC (Learning Technology Standards Committee; `http://ltsc.ieee.org/`), the American Department of Defence ADL (Advanced Distributed Learning; `http://www.adlnet.org/`) initiative, and the European ARIADNE project. Standards being developed by these and other bodies include educational metadata (Learning Objects Metadata – LOM; Anderson and Wason (2000)), test formats (IMS Question and Test Interoperability – QTI; Smythe and Shepherd (2000)), content packaging formats (IMS Content Packaging; Anderson (2000)), modular courseware (ADL SCORM; Dodds (2001)), and others (see, e.g. the IMS and LTSC websites referred to above). At least some of these standards are rapidly gaining acceptance in the e-learning industry. Thus, learning applications will need to support them in order to be commercially viable. This in turn means that the proposed standards should be general enough to support all conceivable kinds of educational content and learning systems.

The general idea is to create standards which are

> "pedagogically neutral, content-neutral, culturally neutral and platform-neutral"
> (Farance and Tonkel, 1999, 9),

and which support...

> "common, interoperable tools used for developing learning systems [...]
>
> a rich, searchable library of interoperable, "plug-compatible" learning content [...]
>
> common methods for locating, accessing and retrieving learning content"
> (Farance and Tonkel, 1999, 14)

One may certainly entertain doubts as to the general attainability of these goals, but one cannot afford to ignore the huge amount of time and labor invested in pursuit of their fulfillment by the organizations mentioned above and others. This being so, it is of course not unimportant if learning and teaching within a particular field—such as language learning—is adequately covered by the proposed standards or not.

3.2. Standardization in Language Technology/Computational Linguistics

In the LT world, too, standardization efforts are legion, and a recurring theme at the LREC (Language Resources and Evaluation Conference) series of conferences.

There is LT standardization work going on at least in the areas of

- resource storage and exchange: TIPSTER (Grishman et al., 1997), ATLAS (Bird et al., 2000), XCES (Ide et al., 2000);
- resource annotation: XCES (Ide et al., 2000), EAGLES (e.g., tagsets: see Monachini and Calzolari (1996));
- resource metadata: OLAC, ISLE (Wittenburg et al., 2000);
- resource presentation and manipulation, and software integration: THISTLE, GATE (Cunningham, 2001), KABA (Olsson, 2002).

[1] ICT is to be read out "Information and Communication Technologies".

To the best of my knowledge, however, the work within LT on resource markup and annotation has not been informed by language learning applications or by the work done on compiling and investigating so-called learner corpora by applied linguistics researchers (see, e.g., Granger (1998)).

4. (I)CALL Case Studies

In this section, we will look at some CALL research projects, where the issue of combining (I)CALL applications with e-learning standards has arisen in various ways.

4.1. Didax

Didax – the Digital Interactive Diagnostic Administering and Correction System, is a project in the framework of the *Swedish Learning Lab* (SweLL), a research effort funded by the Knut & Alice Wallenberg Foundation as part of the larger *Wallenberg Global Learning Network* endeavor, where a number of centers—or "nodes"—worldwide receive funding for exploring the use of ICT and other new technologies in higher education.

At present, there are three nodes in the WGLN: (1) SweLL, with three participating institutions of higher education, (1a) the Royal Institute of Technology and (1b) Karolinska Institutet in Stockholm, and (1c) Uppsala University, (2) the Stanford Learning Lab (SLL), at Stanford University, California, USA, and (3) Learning Lab Lower Saxony (L3S), at the University of Hannover, Germany. SweLL research is currently organized into a multi-tiered structure, with two top-level 'projects' subdivided into a number of 'experiments´. Each experiment is further subdivided into 'tracks', where each track in turn typically is made up of several research teams cooperating on related research issues. Our work on Didax is thus carried out in the *Digital Resources in the Humanities* (DRHum) track of the *Archives – Portfolios – Environments* (APE) experiment of the SweLL project *New meeting places for learning – New learning environments*.

The Didax research team currently consists of three computational linguists and one SLA researcher, but we also cooperate closely with the other DRHum research teams, drawing on the other kinds of competence found there, especially the teams working with digital archives for humanities teaching, as well as with the Uppsala Learning Lab e-folio project group.

The end result of the Didax project is supposed to be a web-based language testing environment, which will provide both students and teachers with a more flexible format for taking, marking, constructing and setting diagnostic language tests in higher education. In Figure 1, the overall architecture of Didax is shown. The three Didax clients (*teacher – setting test*, *teacher – marking test*, and *student*) run in ordinary web browsers. There is nothing out of the ordinary to be seen in any of the client interfaces. This is quite deliberate. Most of the innovation is hidden under the surface, and the interface is a familiar one from many web applications. Didax is described in more detail by Borin et al. (2001).

4.2. LingoNet

LingoNet is a one-year R&D project funded by the Swedish Agency for Distance Education. The project is a cooperation between the Divison of IT Services and the Department of Humanities, Mid Sweden University, and the Department of Linguistics, Uppsala University (see `http://www.mitt.mh.se/lingonet/`).

The aim of the LingoNet project is to build a 'language lab on the Internet', i.e. a web site with a collection of language training resources to be used in higher education, both locally and in distance education. Even though the point of departure for the LingoNet project is the traditional language lab, we actually envision a more general language training resource than this, i.e. a 'computer language lab', rather than a 'computerized version of the tape recorder-based language lab', as the idea is not only to transfer older techniques into this new technology, but also to exploit the additional possibilities offered by the new technology itself, including the incorporation of LT-based language learning resources in the LingoNet lab.

Specifically, in the LingoNet project, we make systematic use of quality control and metadata. It is a well-known fact that the information to be found on the web on any topic is, not only abundant in almost all cases, but also—to put it mildly—of extremely varying quality. At the same time, web search engines are still fairly primitive, so that finding educational resources, appropriate as to their content and level—regardless of their quality—in itself takes some work (Howard Chen, 1999, 24f.). It is only after they have been found that the real work begins, however, when the chaff—resources which are of low quality or of the wrong kind—is to be separated from the wheat—the resources which we can use for our educational purpose, i.e. educational web resources which are quality controlled and classified as to their content and level. In the LingoNet project, the quality control and metadata markup are done by academic language teachers. For more details about the LingoNet project, see Borin and Gustavsson (2000).

4.3. Corpus based language technology for computer-assisted learning of Nordic languages

'Corpus based language technology for computer-assisted learning of Nordic languages', or in short, the Squirrel project, is funded by the Nordic Council of Ministers, and represents a collaboration between the University of Helsinki in Finland, the research foundation SINTEF in Norway, and Stockholm University in Sweden (see `http://www.informatics.sintef.no/projects/CbLTCallNordicLang/squirrel.html`).

One of the aims of the Squirrel project has been to build a prototype web browser for students and teachers of Nordic languages as a second language, which will help them to find practice texts on the web according to the three parameters *language*, *topic*, and *text difficulty* (Nilsson and Borin, 2002). For more details about the Squirrel project, see Borin et al. (2002)

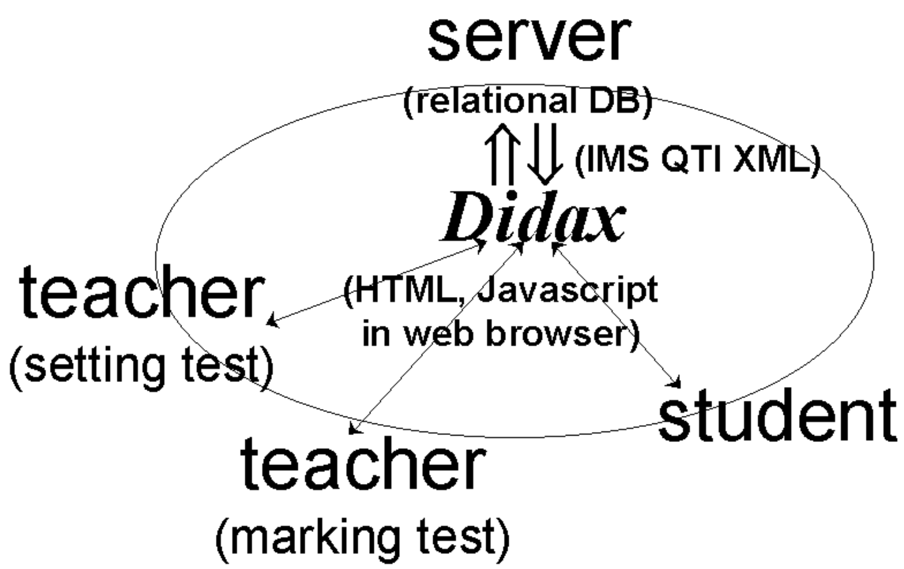

Figure 1: The anatomy of Didax

4.4. SVANTE

SVANTE (SVenska ANdraspråksTexter – Swedish Second Language Texts) is a loose collaboration between linguists, computational linguists, and teachers of Swedish as a second language, with the aim of creating a versatile learner corpus of written Swedish, to complement the learner corpora of spoken Swedish that already exist (see `http://www.ling.uu.se/lars/SVANTE/`). The SVANTE project is partly funded by VINNOVA within the CrossCheck second language Swedish grammar checking project (see `http://www.nada.kth.se/theory/projects/xcheck/`).

4.5. IT-based collaborative learning in Grammar

'IT-based collaborative learning in Grammar' is a collaborative project, funded by the Swedish Agency for Distance Education, with partners in the Linguistics Departments at the universities in Uppsala and Stockholm, and the IT Department and two language departments at Uppsala University. This project revolves around two fundamental assumptions:

1. The use of web-based communication and collaboration technologies will help us make make basic grammar courses better and more effective for students and teachers alike;

2. Language resources originally developed in a research setting, such as tagged and parsed corpora (of Swedish in our case) and grammar writing workbenches, can be (re)used in the context of teaching grammar (Borin and Dahllöf, 1999).

Perhaps I should clarify at this point that this is not primarily an application intended for *language* students, but rather for students of Linguistics and Computational Linguistics, although we believe that it will be useful also as a component in language courses (Saxena and Borin, 2002).

4.6. Relation to e-learning standards and to ICALL

These projects are variously related to ICALL on the one hand and to e-learning standards on the other:

- Didax is not an ICALL project *per se*, but creates an infrastructure which can be used for ICALL applications, and thus must be able to accomodate them. It uses the IMS QTI, and the IEEE, IMS, ARIADNE LOM emerging standards.

- LingoNet is not an ICALL project either, but it goes without saying that among the more exciting possibilities for a web-based language lab are language training applications built on LT methods and resources; hence, we must take this into consideration in designing the underlying language lab format. Like Didax, LingoNet can be considered as an infrastructure project which should be able to accomodate ICALL applications. The standards involved are IMS Content Packaging, and IEEE, IMS, ARIADNE LOM.

- Squirrel is an ICALL project, which does not (yet) utilize any of the proposed e-learning standards, but we see how e.g. the LOM could be used to mark up the located text resources, e.g. for inclusion in something like the LingoNet database.

- SVANTE forms an integral part of an ICALL project, namely the CrossCheck second language grammar checking project, but SVANTE itself is more in the way of a linguistic resource project, where LT standards for basic markup and linguistic annotation of the texts are important.

- 'IT-based collaborative learning in Grammar' is very much an ICALL project. At this initial stage of the project (it started in January 2002), there are still a number of implementational details left to be decided.

However, we would certainly like to make our learning resources as widely useful as possible, meaning, i.a.,

1. that they should be—wholly or in part—easy to integrate into other e-learning environments, but also
2. that it should be easy to use corpus resources for other languages than Swedish in our application.

The first requirement implies the existence and use of general standards for e-learning applications, while the fulfillment of the second requirement certainly would be facilitated by standardization of language resources.

5. So, where will the Standards for ICALL Come from?

Summing up the foregoing, we may say that there are three communities which would benefit from closer interaction, because of a considerable overlap in their goals, but which thus far have pursued these goals separately:

1. The 'ordinary' CALL community—including those researchers working with learner corpora—has extremely tenuous links to LT (see e.g. Chapelle (2001, 32ff.)), and, as far as I have been able to acertain, none at all to the ongoing e-learning standardization work mentioned in section 3.1. above.

2. Nor is the e-learning community working on any standardization for *language learning* (as opposed to *learning* in general). For example, the IMS Question and Test Interoperability (QTI) proposal specifies five test question response types, which can be rendered in up to three different formats (Smythe and Shepherd, 2000, 17). However, for the 'IT-based collaborative learning in Grammar' application, as well as for many other of the corpus-based CALL applications found in the literature, a response type "select (portion/s of) a text" would certainly be good to have.[2]

3. The LT community is not involved in any standardization effort for *language learning* information (as opposed to *language* information in general). The kinds of standards that come to mind first are those involving linguistic annotation schemes, with regard to both their content and their form:

   So-called *learner interlanguage* is characterized by a number of linguistic features absent from the native-speaker version of the target language (and sometimes absent from the learner's native language as well (Richards and Sampson, 1974, 6)). Interlanguage goes through a number of stages, terminating in a final (hopefully close) approximation of the target language. This has some implications for linguistic annotations of learner language production, whether in learner corpora (longer texts) or in analyzers of free learner language production in ICALL language exercises. Thus, part-of-speech (POS) tagging or parsing of learners' interlanguage may have to deal with categories absent from the canonical target language grammar as reflected in an LT standard, etc., but which can be related either to categories in the learner's native language, to universally unmarked categories, to a conflation of target categories, to the pedagogy used, to some combination of these, etc. (Cook, 1993, 18f.). The status of a given linguistic element can change from one language learning stage to another, e.g. the unmarked form in a morphological paradigm becoming functionally more and more specified, as the learner acquires the marked forms and their functions.[3]

   Hence, multiple linguistic annotations of the kind proposed for XCES (Ide et al., 2000) and ATLAS (Bird et al., 2000; Cotton and Bird, 2002) are a necessity for language learning applications of e.g. language corpora.[4] In addition to providing multiple annotations of the same linguistic object (a word, phrase, etc.), the annotations should also be relatable to each other, making it possible to relate an analysis of a form in learner production to the (inferred) intended interpretation of this form, for providing appropriate feedback to the learner. The linguistic categories provided by annotation standards would need to be different from the ones used by native speaker experts (which is arguably most often the kind of annotation aimed for now) if they are to be used for formulating feedback to language learners. They would also have to be different for different kinds of learners, depending on their level, background, native language, etc.

   Standardization of (formats for) *error typologies* would also be desirable. Again, this desideratum is not exclusive to language learning applications; work on grammar and style checkers for native speakers would also benefit from standardized formats for error typologies.

   In the same way as the learner's language progresses through successively more advanced stages, the authentic language that the learner is exposed to as part of her learning process should be successively more complex, in a linguistic sense. This is the main motivation for the Squirrel web search application described above (Nilsson and Borin, 2002). Here, there is consequently a need for a classification and concomitant annotation scheme which relates linguistic complexity to language learning stages, for applications where corpora are used for e.g. generating lan-

[2]In the QTI specification, there is actually a sixth response type `response-extension`, intended for proprietary response types, but the predefined types will always determine the 'path of least resistance', at least for many users.

[3]Here I have in mind cases such as when e.g. learners of English initially use the infinitive (or sometimes gerund) as their only—and hence extremely polyfunctional—verb form, and then gradually start using other forms (tensed forms in finite clauses, etc.), which then usurp, as it were, some of the functions of the initial forms.

[4]Multiple annotations actually seem necessary for other reasons as well, see e.g. Sampson (2000).

guage learning exercises.

In language learning applications, the need to cater for *bilingual* and *multilingual* text materials is evident, which raises the issues of how to handle multiple writing systems in a standardized way, e.g. left-to-right and right-to-left writing in the same text corpus (the latter issue is raised by Cotton and Bird (2002) as still not having been determined for ATLAS).

Hopefully, the state of affairs depicted here is really due more to lack of interaction than anything else, and if the present paper can be instrumental in bringing about this interaction, it will have served its purpose.

6. Acknowledgements

The work reported herein was carried out partly within the project 'Corpus based language technology for computer-assisted learning of Nordic languages', in the framework of the Nordic Language Technology Research Program 2000–2004 (Holmboe, 2002), funded by the Nordic Council of Ministers through Nordisk Forskerud-dannelsesakademi (NorFA), partly within the project 'Digital resources in the humanities', funded by the Knut & Alice Wallenberg Foundation, as part of the Wallenberg Global Learning Network, and partly within the Cross-Check/SVANTE project, funded by VINNOVA within the Language Technology Program.

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