D2.3 Report on implementation and validation of a standardized model for learning needs analysis and the provision of learning opportunities

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Author(s)  Jad Najjar (WUW - Editor), Simon Grant (JISC CETIS), Bernd Simon (WUW), Tomaž Klobučar (JSI)
Contributors  Franz Müller (WUW), Michael Totschnig (WUW), Evaldas Karazinas (KTU), Israel Gutiérrez (UC3M), Mikael Karlsson and Henning Eriksson (UMU), Martin Sillaots (TLU), Jacek Bubak (AGH-UST), Elisabetta Parodi (eXact learning), Roland Klemke (OUNL), Daniel Müller (IMC), Anh Vu Nguyen-Ngoc (ULE)

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Executive Summary

This deliverable reports on prototypical implementation and validation of standardized models for learning needs, learning outcomes and learning opportunities.

The report first (Section 2) introduces a study, analysis and discussion on learning needs in higher education institutions. A survey, with interviews, for understanding current practice of analysis of learning needs was developed. The aim of this work is to draw a picture on how learners think of their own learning needs, and how learning opportunity designers see themselves as providing for learners’ learning needs. Requirements for good practice on connecting learning needs and opportunities are discussed and the main requirement is that the overall process clearly needs to involve both the learner and the provider.

As a proof of concept for the adoption and added value of standards related to learning outcomes and learning opportunities in ICOPER project, Section 3 introduces prototypical applications that make use of learning outcomes and learning opportunities standards developed or adopted in this project. Applications covered the different phases of outcome-based online education, including defining and adding learning outcomes to a central repository for future reuse, linking learning opportunities and learning designs to learning opportunities, finding and publishing relevant learning opportunities, tracking learners achieved learning outcomes and sharing learners’ achievements. The evaluation of those prototypes revealed that target users appreciated the new added outcome-based functionalities.

Recommendations, for different stakeholders, in regard to learning outcomes and learning opportunities specifications, functions and adoption are provided in Section 4. Those recommendations are formulated based on the findings of the evaluation of user experience with developed prototypes.
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1 Introduction

Employers seek people matching particular qualifications and graduates seek jobs matching their qualifications. This market is currently managed primarily using paper certificates and heterogeneous university management systems that describe the intended learning outcomes (knowledge, skill and competence) of learning opportunities and track the achievements, and related evidence records, of learners after successful completion of learning opportunities. On the other hand, required learning outcomes and qualifications of a specific job are represented in corporate information systems. In the light of current trends towards increased student mobility, employability and lifelong learning, this situation is less than satisfactory (Lindgren R., Henfridsson, O., Schultze, U., 2004), (Paquette, G. (2007).

Following the European initiatives like European Qualification Framework (EQF, 2000), Europass (2010) and European Learner Mobility (EuroLM, 2009), the aim of Work Package 2 of ICOPER project is to introduce specifications that capture information on knowledge, skills and competences intended in learning opportunities and that are achieved by a person (a lifelong learner) in higher education and training institutions or in the workplace after completion of learning opportunities. Therefore in Deliverable D2.2, we proposed the Learning Outcome Definitions (LOD2) schema which allows describing and storing learning outcomes, in addition to linking them to relevant learning opportunities and learning designs. The Personal Achieved Learning Outcomes (PALO3) schema was also proposed and takes care of representing information about achieved learning outcomes of learners and relevant evidence and context data.

The purpose of this report is twofold:

- Draw a picture on (a) how learners think of their own learning needs, and (b) how learning opportunity designers see themselves as providing for learners' learning needs. In this context, see Section 2, a questionnaire was developed to gather information on ways learners identify their learning needs and ways universities address those needs in offered opportunities. The overall patterns visible in the responses suggested that there were two separate kinds of relevant learning opportunity, each with a different way of relating to differing learning needs. The first kind of learning is where a specific qualification is necessary in order for the learner to pursue his or her chosen career path. The second kind is where it is not a specific qualification, but a specific skill, competence, or set of skills that are perceived to be needed by the learner. In the first kind of learning, participants, made it explicit that the detailed learning outcomes were not significant, and did not play a part in the selection of the course. Rather, other published factors, such as the location and cost of the course, the hours required for attendance and coursework, the learning methods, were seen as important. For the second kind of learning, respondents were much more explicit about the reasons for selecting particular courses, and learners identified their own learning needs.

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2 LOD Schema http://www.icoper.org/schema/lodv1.0
3 PALO Schema http://www.icoper.org/schema/palov1.1
• Provide a pilot implementation and validation of the adoption of standards and specifications. For this purpose we developed several prototypes that take learning outcomes into consideration throughout the whole lifecycle of learning design and delivery. Prototypes of outcome based learning applications like widgets and modules of Learning Management Systems (LMS) have been developed, to produce and import data about achieved learning outcomes of learners in systems like Moodle (2010), Elgg (2010) and Clix (2010).

This paper is structured as follows: In Section 2, analysis of learners’ needs is presented and discussed. Section 3 introduces the adoption of standards and specifications related to learning outcomes and learning opportunities. This includes presenting implemented outcome based functionalities and prototypes. Recommendations on adoption and best practice outcome-based learning are presented in Section 4.

2 Learning Needs Analysis and Provision of Learning Opportunities

This section introduces the process that starts with the identification of the learning needs of learners, going on to analyse these needs and turning them into desired learning outcomes. In theory at least, there is then a comparison of the desired outcomes to outcomes of university published learning opportunities, leading to the learner choosing to take an offered learning opportunity.

As there was no suitable material available about these initial processes, a small set of questions were asked of a total of 21 learners and 4 study programme managers. The points emerging from these responses are discussed, leading to some initial suggestions for good practice in this hitherto neglected area.

This section as a whole provides background and context for later sections. As motivation, we first describe a short example of learning needs analysis and learning opportunities provision in higher education.

University of Adriatic has decided on the basis of a survey of market needs to launch a new programme on education management. The main objectives of the programme have been identified in cooperation with professional educational association and some companies. Based on the identified objectives a special task force at university has prepared a list of learning outcomes every student of the programme should obtain at the end of the studies.

Emma is a teacher at UA, teaching around project management at undergraduate level. Within the new programme she is responsible to help the students learn how to manage educational projects. First, she refines university’s list of learning outcomes and prepares a more detailed list of the outcomes that students are expected to obtain after they successfully finish her course, selects appropriate teaching and assessment methods, and searches for relevant educational resources on the topic in an educational network. She integrates and modifies some of the found resources into her course, adds relevant metadata (about expected learning outcomes, etc.) to the content, and uploads it to the institutional Moodle system. As UA’s policy is to promote open educational content, Emma also offers her course as a learning opportunity to other users of the educational network.
Peter is a third year Bologna student of education at University of Mediterranean (UMe), currently on exchange at University of Adriatic. During his 9-month visit at UA he will attend a few courses and do some research studies for his final thesis. Peter’s obtained and required learning outcomes for getting a degree are stored in his learning outcome profile. As part of the enrolment process Peter uses university’s service to match his already obtained and expected learning outcomes to the learning outcomes of UA’s learning opportunities (courses) and selects the optimal list of courses. One of those courses is also Emma’s course on advanced project management. For the final assessment in the course he has to prepare a small project and lead a group of peer students who will help him implementing the project. After he successfully finishes the course obtained learning outcomes are added together with assessment records to his profile, so that Peter can prove them to his home University of Mediterranean.

2.1 Methodology

It has been recognised that in an ideal world, learning opportunities are provided to meet the actual learning needs of real people, rather than some theoretically based provision that does not connect with learners. However, the project did not have access to good examples of what learners' needs are, how they arise, and how they are connected with learning opportunity provision. In order to fill in this gap, it was decided to run an informal information gathering exercise, not to provide any definitive or quantitative analysis of learning needs, but to get first impressions of (a) how learners think of their own learning needs, and (b) how learning opportunity designers see themselves as providing for learners' learning needs.

As no quantitative analysis was required at this level, it was decided to use informal questionnaires, which could be completed in any way to suit partners who were helping with the gathering of this information. The questionnaires were intended to elicit information that could well be of interest to the partners themselves in ways beyond the ICOPER project, thus helping to motivate them. While the questionnaires could potentially be sent to people to fill in unaided, it was suggested that a more effective approach for the learners' questionnaires would be to deliver them as structured interviews, discussing the topics with the relevant learners.

As the small-scale nature of the investigation ruled out the possibility of significant distinctions being made for different groups of learners and managers, partners were free to find whoever they could to answer the questions, but were encouraged to find diverse respondents where possible, and not just focus on one kind. It was explicitly allowed to ask staff members about their past learning needs and experiences where this seemed relevant.

Taking the learner questionnaire first, this was drafted and revised several times in response to partner feedback. The final form was this, and it included some guidance notes in line.
Have you ever undertaken learning, or considered whether you might undertake learning, because you needed to learn something for a job — past, present or future? If so your feedback on following questions will be appreciated.

- In your own words, what was it that you need or needed to learn? *(This is the first substantive question. The answer may come in many different ways. The interview aim is to capture the answer in a way that reflects the respondent’s world view, and for this, some conversation may be needed.)*
- Of this needed learning, that you have done or considered, was it:
  - outside formal courses?
  - through formal courses?
- If your learning was through a formal course, did the (learning opportunity) provider publish their intended learning outcomes, objectives, or anything similar? If yes,
  - Was the information published by the provider useful for deciding what course to take?
  - How did you make the connection between your learning needs and what was published about the course? *(This is the second substantive question. The depth of reply will depend on the respondent’s level of self-awareness and reflectivity. Do not push too hard for a reply if none appears naturally.)*
  - What (other) information from the learning opportunity provider would really help you decide whether a course meets your needs, in terms of skills or competences? *(This is the third substantive question, and will depend on the respondent’s imaginative and analytic abilities to think through the situation in terms of making it better.)*
    - *(Point out, as part of the interview, that there are many different valid reasons why people choose courses, other than their explicit intended learning outcomes, or employment needs.)*

The questionnaire for the course designers was this.

- Can you describe how your institution typically proceeds when it comes to design a learning opportunity such as a new curriculum? Who are the main stakeholders of such a process? How do you involve them?
- Is there any difference between a re-design and new design with respect to this process?
- What kinds of learner needs are your courses designed to meet?
- How do you assure that a curriculum meets the needs of your learners and other important stakeholders?
- How do you ensure that the curriculum is described in an outcome-oriented way?
- What are your quality assurance processes in the various phases (design, delivery of the curriculum) with respect to satisfaction of previously identified learning needs?
Given the fact that there were no controls over the kind of participant, and no guarantees of representativeness of the learner population, the responses were gathered together in a manner intended simply to give an initial indication of the general range of possible responses, not to quantify different kind of response in any way.

The responses were gathered by various means, and gathered together in various formats. 21 interviews with learners were reported, of which 3 were reported by audio file, the rest with documentation. Four responses were received from managers.

The responses were examined in order to list and categorise the different answers given to the questions. In view of the fact that there could not be any valid quantitative results, numbers of responses in different categories were not recorded, as these might have been misleading.

2.1.1 Results

2.1.1.1 Learners

The overall patterns visible in the responses suggested that there were two separate kinds of relevant learning opportunity, each with a different way of relating to differing learning needs.

The first kind of learning is where a specific qualification is necessary in order for the learner to pursue his or her chosen career path. The second kind is where it is not a specific qualification, but a specific skill, competence, or set of skills that are perceived to be needed by the learner.

Respondents mentioning the first kind of learning sometimes made it explicit that the detailed learning outcomes were not significant, and did not play a part in the selection of the course. Rather, other published factors, such as the location and cost of the course, the hours required for attendance and coursework, the learning methods, were seen as important.

For the second kind of learning, respondents were much more explicit about the reasons for selecting particular courses, and it is worth considering the responses to the questions in more detail for this kind of learning. The paragraphs immediately below follow the questionnaire themes.

Learning needs.

A commonly mentioned need was specific ICT-related skills, such as a specific programming language, or editing photos with Photoshop. Then there were language learning needs, and other specific skills such as statistics and academic writing. Some learners were aware of what they had needed to learn in longer courses, but this awareness could have been retrospective, as they were not explicitly asked whether they were fully aware of their needs at the time.

Formality of courses.

Most of the learning experiences reported were formal courses. Some formal courses are not assessed.

Publication of intended learning outcomes etc.

This varied considerably. Some learning experiences were of courses that did publish these, others that did not. Often, a syllabus was published, but other things may not have been, and this will be returned to below.

Was the published information useful for deciding on the course to take?
Learner experience here was very varied, ranging from a clear yes to a clear no, and many points in between. One interesting point noted by some respondents was that what was most helpful was examples spelled out of what the learner could do after completing the course. One learner, in particular, was looking to learn how to manipulate files in PhotoShop to create smaller files that loaded more quickly on web sites. A very similar example was explicitly published for the course, so it was easy for that learner to know that the course was suitable. Some other learners were still positive, but in more general and muted terms.

**Connecting learning needs with what was published.**

Again, learner experience here was very varied.

- One learner took part in a highly structured career management programme within a company. This provided all the support needed.
- For some technical skills, matching the offer to the need is very straightforward, based only on the syllabus. This is sometimes matched against tasks at work.
- Learners often take into account the methods of learning, where these are published, as some methods may be more suitable than others in terms either of timing or of learning style.
- One learner reported looking at the required course reading, scanning this in a library, and from that gaining an enriched understanding of what the course was covering.
- One learner mentioned consulting with a supervisor to help the decision.

**What other information would help?**

The learners responding gave many ideas, which indicates a wide range of potential improvements by those providing learning opportunities, in the many cases where this information is not provided already. The responses are so varied that they are difficult to group other than in a simple list. (This list is in no particular order.)

- Financial assistance available.
- Teaching and learning methods. (Preferred learning styles and modes are varied.)
- Clear listing of what can be done after completion of the course.
- Clearer connection to the needs of work situations.
- Testimonials from, or career paths of, former course attendees.
- Feedback on teaching quality.
- Compulsory and recommended texts.
- Background and connections of teaching staff.

Presumably, there is a trade-off in providing this detailed information. If only a few people want it, it may be more cost-effective to have an enquiry service answering specific questions, than to assemble and publish the information for everyone. However, having this information only available by personal enquiry would greatly limit the accuracy and usefulness of any automatic advisory systems attempting to match learners' needs with opportunity provision.
2.1.1.2 Managers

How the institution designs learning opportunities.

Even this small sample revealed mixed methods in the design of learning opportunities. The old-fashioned approach to base what is offered on staff expertise still seems to play a significant role. Another current approach is to involve several stakeholders in the curriculum design process. Here, relevance to employment is attempted through involvement of employers in the process. Feedback is gathered from students who have taken the course. Professional bodies may also help to define what is needed. A third approach is to rely on market forces: courses can be set up and offered, and the numbers of students enrolling determines whether they run or continue.

Differences between re-design and new design.

Everyone answered that re-design involves less extensive changes than new design. Re-design tends to be more internal. One respondent wrote that the “bigger community is not involved”.

What kinds of learner needs are courses designed to meet?

One respondent pointed out that, at least at bachelor's level, learners “don't think about needs and outcomes”. In any institution where this appears to be true, the learning needs will be assumed during the course design process. This was illustrated by the report that in one course, a module needed to be made mandatory before students understood its importance. Overall, this question was not answered convincingly, suggesting that not many course designers have a detailed model of learners' needs.

Assuring that a curriculum meets needs.

Respondents described a feedback process, intended to ensure that a course meets the needs at least of the learners who take the course. There was, however, no discussion of two particular issues. Firstly, feedback from existing students cannot take into account the needs of people who did not come on the course at all. Secondly, feedback at the end of a course will capture needs as perceived on the course, but not needs of which the learner only becomes aware at some later point. Even where a good consideration of needs has taken place, one respondent admitted that “there are subjects that are needed for achieving the outcome but never provided in our university” – i.e. it is sometimes simply impractical to assure that a curriculum meets even those needs that have been identified.

Describing the curriculum in an outcome-oriented way.

It seems that where regulations insist in it, curriculum does come to be designed in an outcome-oriented way. However, having outcomes in itself is no guarantee that those outcomes are compatible with the outcomes needed for employment. Rather, it has been observed elsewhere that academic formulation of outcomes has a different style of language to outcomes formulated by employers.

Quality assurance process with respect to satisfaction of previously identified learning needs.

This is another way of looking at questions similar to those asked above. This particular question was not answered in sufficient depth to give insights distinct from those of the other questions.
2.1.2 Summary

Overall, it seems useful to start by classifying the learning opportunity into ones (typically degree courses) necessary for entry into a profession, and ones (typically shorter) aimed at developing particular skills or competence. The first kind can be changed only through professional and regulatory bodies, as it is not a free market. However, it may be that a wider deployment of transparency instruments such as Europass would help to promote a freer and more open environment in which progress could more easily be made.

The second, shorter kind of learning opportunity is more the proper subject of ICOPER. There are a few general conclusions that appear to be supported by the survey that was undertaken.

- Learners clearly do sometimes perceive themselves as having learning needs, at least in the context of the second, shorter kind of learning opportunity.
- These learning needs very often arise in the context of the learner's occupation, whether that be ordinary employment, or higher study.
- Learners mention several kinds of information, that would help them assess whether a learning opportunity meets their perceived needs, that are rarely if ever made public by providers. Thus there is considerable scope for improvement in the amount and quality of information given by learning opportunity providers.
- On the other hand, there are situations where learners are not aware of their own learning needs, in any more detail than the need or desire to attain a qualification. Thus there is a need for supporting this awareness.
- Providers generally believe they are addressing some learners’ learning needs in their course or curriculum design processes. More “reality checking” and a more open-minded attitude might help towards providers' understanding more of learners' real learning needs.
- Describing the curriculum in what appears to providers to be an outcome-oriented way is no guarantee of addressing actual learners' learning needs. A more reliable approach would ensure not only that learning outcomes are used, but also that outcomes are formulated in a way that is better matched to, for example, the way that employers describe needed skills.
- There is little or no evidence that providers consult either learners who decide not to take the courses they offer, or graduates from their courses several years after graduation, when they could be expected to have the most realistic perception of learning needs they may not have recognised at the time.
- There appear to be some learning needs that providers often do not meet. Exactly which needs tend not to be met, and how frequent this is, are not clear from this very small survey.

2.2 Good Practice

The above summary is consistent with the common experience that there is no current “best practice” in the analysis of learning needs. Thus, ICOPER has no recommendations as such for best practice learning needs analysis. Instead, here are agenda and requirements for good practice. To connect learning needs and opportunities, the overall process clearly needs to involve both the learner and the provider. It might be useful to envisage such an overall process...
as can explain and put in context the observations from the brief survey. This is, no doubt, not the only such model, but some model based on this could be very useful as a starting point for improving practice in this area.

### 2.2.1 Learners recognising their needs

In cases where learners do not recognise their needs, there is no option but to adopt the approach reported in some cases, of assembling learning opportunities based on some combined ideas of learning needs. Who is to judge whether learning opportunities devised in this way do actually meet learners’ needs? There is little more to say from the current perspective.

In order to put good practice on a firm foundation, it is essential that learners do indeed recognise their learning needs. This is implicit in the concept of personal development planning (PDP) defined by the UK’s Higher Education Academy as “a structured and supported process undertaken by an individual to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development”.

Facilitating PDP in general is the subject of much writing elsewhere. Particular stress is laid within the PDP community on the word “supported” within the definition. It is common practice that, to be effective, such processes do need support. It is generally recognised as hard for the average individual learner to do PDP unaided, to the level that would be useful here.

In principle, the process could be seen as involving the learner in:

- recognising that s/he will have to make some decisions or take some action to get a job
- taking the decision to invest time and effort considering future occupation
- talking with other people, investigating possible occupations
- deciding on occupational / career goals.

Beyond this point, what needs to be done depends on the level at which learning needs are formulated. If the process stops there, the need would still be vague and undefined: to study to achieve the selected career goals. The next step could be seen as:

- researching the connection between occupational goals and competencies.

This should enable the formulation of learning needs as competencies. However, when learning opportunities do not formulate their learning outcomes directly as competencies, a further step is needed:

- linking competencies required with learning outcomes offered by learning opportunities.

It is possible to envisage institutions supporting learners at each stage of this process.

### 2.2.2 The role of the supporting institution

To be effective in practice, learners need to do their own learning needs analysis before selecting a course. This may mean that an earlier educational institution needs to support appropriate PDP.

In any case, the receiving institution itself will need to ensure that learners applying for courses have indeed gone through this process. Clearly, from the responses received, institutions tend not

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[^4]: http://www.heacademy.ac.uk/ourwork/teachingandlearning/pdp
to do this. No such formal practice within higher education institutions is known to the present writers.

But higher education institutions are potentially well-placed to bring together the information required for this kind of process. Already, many institutions recognise the range of stakeholders with an interest in courses and their graduates, attempting to involve them in course design, and it is not too difficult to imagine bringing them together to collaborate also in this process of support for learners. What is more challenging is to devise a way of doing this in a cost-effective manner.

In the ideal case, where learners have already identified their own learning needs, it should be a relatively quick and cheap process, perhaps involving e-portfolio tools, for the learners to document those needs.

It is only after learners’ learning needs have been properly investigated and analysed that it makes good sense to write learning outcomes, and to design curricula in courses to achieve those learning outcomes. Similar procedures to the ones currently in operation could work much better at addressing learners’ needs if based on established, rather than hypothetical, learners’ needs. To do this thoroughly, it is important to include investigation of the needs of those learners who might have come on the course, but did not, and also graduates, not immediately after graduation, but some time later, when the recognition of what would have useful is at its highest point.

Educational institutions could well take note of best practice within human resources management / talent management in companies, where one learner respondent was highly satisfied with the way that learning needs were identified and then provided for. Perhaps, though, this should be part of a more general raising of awareness within academia of thinking and practice in the “real” world, and this is notoriously hard to address within currently established ways of doing things.

3 Adaption of Schemas and Specifications for Learning Outcomes and Opportunities

The importance of recording and managing data about life-long learners’ knowledge, skills and competences has been stated by several national/international initiatives and standardisation bodies. The European Qualification Framework (EQF, 2000) was proposed as an instrument to make learning outcomes, related to learning opportunities and qualifications more transparent and comparable across Europe. This is an important step towards outcome-based learning and mobility. This section, first, discusses the current practice and adoption of specifications related to learning outcomes in existing projects across different sectors. Afterwards, the ICOPER proposed solution for the use, adoption and integration of specifications is presented with prototypical implementation as proof of concept. Evaluation of ICOPER approach to the adoption of specifications is also provided.

3.1 Current Practice

3.1.1 IEEE Reusable Competency Definitions (RCD)

In order to enable the management, finding, sharing and reused of learning outcomes and learning needs, metadata about key characteristics of learning outcomes should be recorded.
IEEE Reusable Competency Definitions (RCD) standard (IEEE RCD, 2007), defines a conceptual base schema for describing and sharing learning outcome definitions. The data model provides a way to describe a learning outcome, independently of its use in any particular context or target group (persons), to enable storage, findability and exchange of learning outcomes across learning systems that deal with learning outcomes data.

However, IEEE RCD does not collect data on the type (knowledge, skill or competence) of a learning outcome. Data about learning outcome type is important to be distinguished in the education domain during the course design or publishing of learning opportunities; flowing the definitions of the European Qualification Framework (EQF, 2000).

IEEE RCD is widely accepted, by experts, for describing characteristics of learning outcomes and competencies but its adoption is not so high. All existing developments has been in research projects or by communities participated in the design of this specification.

The e-Access2Learn project developed tools and services to facilitate the development and sharing of accessible eTraining objects and courses that bare the potential to be inter-exchanged between eTraining Platforms and Programmes (Sampson, 2009). The e-Training Activities and Courses stored to the e-Access2Learn Repository have been tagged with educational metadata following the proposed IEEE LOM (2002) Competence-related Application Profile, to enable searching relevant e-Training courses using competence related searching criteria.

In the Calibrate project, Van Assche (2007), with a focus on linking metadata records of learning resources to curricula via competencies, the intended competences of courses were expressed as part of classification information of LOM metadata record of learning objects.

Both Van Assche (2007) and Sampson (2009) extended the IEEE Learning Object Metadata (LOM; IEEE, 2002) records with some attributes that capture generic characteristics of an intended competence, like title, type, description, proficiency level and context. These implementations are good steps towards adding competence data to learning objects metadata records but embedding competence metadata into a specific LOM metadata record of an object reduces the reusability of a learning outcome across courses.

The other relevant specification for describing learning outcomes and competencies is HR-XML (2008). HR-XML is a specification that includes the possibility of formalization and ranking of competences, supported by HR-XML Consortium. The specification is, among other things, used to capture information about evidence used to substantiate a competence, their ratings and weights and reusable data typed for referencing competences. Because HR-XML collects data about learning outcomes as part of a large schema that cover a wide range of evidence and other job related properties, it becomes so complex to used this schema for describing learning outcomes outside their context of use. Currently, HR-XML is working on integrating main metadata elements of IEEE RCD into their schema to increase exchange of data between systems that conform to IEEE RCD and those conform to HR-XML schemas.
### 3.1.2 CEN Metadata for Learning Opportunities (MLO)

Following the definition of (MLO 2008), a learning opportunity is a chance to participate in education or training. Metadata about learning opportunities provide information to an interested learner about the offered (advertised) learning opportunities at an institution. This information enables the learner to find out whether the offered opportunity is of her interest by providing information about the location, cost, places, engagement, duration, language of instruction and intended learning outcomes (objectives), to name a few. Learners who want to obtain a specific skill or competence required to perform a new job or task search for learning opportunities with intended learning outcomes similar to the ones they plan to obtain. It is important to track and link learning outcomes to learning opportunities to help learners follow the learning opportunities that really match and help them achieve their desired learning outcomes and goals.

CEN Metadata for Learning Opportunity (MLO, 2008) is a European specification that covers a wide range of information about learning opportunities including intended objectives (learning outcomes); to some extent. Nevertheless, MLO records information about intended learning outcomes of an opportunity in free text format, this limits the interoperability and reuse of common learning outcome definitions across courses and curricula. Hence that some learning outcomes maybe shared between several courses of same program or across universities. Learning outcomes should be managed independently of learning opportunity metadata be linked using a semantic web services; e.g, using a URI.

To our knowledge there is no other European or globally proposed schema for describing properties of learning opportunities. Taking into account that MLO is a European model and vocabulary that represents the common subset of several existing specifications used for advertising courses. This includes XCRI from the UK, CDM from Norway, CDM-FR from France, EMIL from Sweden, and PAS1068 from Germany; see more details in (MLO, 2008). The common subset consists of four classes and 13 properties that are common to all or most of these existing specifications.

### 3.1.3 Missing Specifications

To our knowledge, there is no common specification for recording data about learner’s needs or her achieved learning outcomes. Nevertheless, several projects and initiatives have shown some interest in creating such a specifications and related application profiles in the near future.

IEEE Competency Profile Standard, draft submitted to IEEE LTSC Competence WG 20, is a first draft of proposal towards an information model for describing, referencing and exchanging data about the relationships between competences in a competence profile. That is in addition to recording other competence related information like competence qualifiers (like proficiency level, weight, ageing and importance), context where competence is acquired and evidence data. The proposed specification is needed because there is very little agreement on how a set of related competences (belongs to one person or task) can be described, grouped and exchanged, to support machine-readability. This specification should allow the representation of relationships between competences or complementary aspects of a competence, such as they have often been
captured in competence models. The term competence is used here in the broadest sense, including skills, knowledge and attitude.

A collaboration between experts that represent several projects including ICOPER, have submitted a proposal to CEN Workshop in Learning Technologies - WSLT (CEN, 2010) to develop the first European specification for representing data about personal achieved learning outcomes and competences.

3.1.4 Other Related Specifications

3.1.4.1 IEEE LOM
IEEE Learning Object Metadata (IEEE, 2002) represents data about characteristics of a learning resource. Learning outcome definitions are linked to metadata of learning resources to enable finding relevant resources based on intended learning outcomes attached to them. Once a learning resource is successfully followed, for example as part of course, by a learner its attached intended learning outcomes are represented in the learner achieved learning outcome profile with other relevant data about context where a knowledge, skill or competence was achieved, proficiency level and assessment records.

3.1.4.2 LEAP2A ePortfolio Specification
LEAP2A is an outcome of the JISC CETIS - (JISC Innovation Support Centre - Centre for Educational Technology & Interoperability Standards) project called Portfolio InterOperability Project (LEAP2A, 2008). It sets up the framework for the e-portfolio data interoperability. The purpose of this specification is to represent e-portfolio information collected by the individual (learner) and not the information stored by the others (teachers) about this individual. This information can be digital artefacts and users reflection to some kind of information. Though LEAP2A specification focuses on capturing all types of ePortfolio information of a person, this specification can be used as one of the supported export format of learner learning outcomes and other learning assessment and evidences records; in case learners want to import data on their achieved learning outcomes into their ePortfolio.

3.2 ICOPER Practice
This section presents pilot implementation and adoption of learning outcomes and learning opportunities data models. The aim of this section is to demonstrate the added value of data models of learning outcomes and learning opportunities designed in D2.2 in facilitating the outcome based education; Figure 1 shows the outcome based learning round trip and relevant data models.
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The emphases were put on building software prototypes, services and modules that integrate learning outcomes and learning opportunities specifications:

- Learning Outcome Definitions (LOD) schema is used to describe, store and reference the characteristics of learning outcomes.
- CEN MLO, an application profile of it, is used to describe university advertised courses.
- PALO model is used to describe, store and exchange learners personal achieved learning outcome data between systems.

The prototypes use the Open ICOPER Content Space – OICS (Totschnig, et al., 2009) as an open repository containing a set of repositories for learning outcome definitions, learner achieved learning outcome profiles, learning opportunities and metadata of different kinds of educational resources collected from distributed providers, ranging from small-scale assets like pictures and documents to complete learning designs. There are two types of prototype being developed:

1. design-time applications that enable users to plan and design outcome-based learning, including finding and reusing learning outcomes and attaching them to relevant learning opportunities and learning designs, and
2. run-time applications that enable implementing and running those learning designs and tracking and publishing of learners achievements.

As far as learning outcomes and learning opportunities are concerned, the LOD and MLO schemas are used during design-time of learning opportunities and learning designs while the PALO model is primarily targeted towards run-time applications: the idea is that the applications use and update the PALO profile of a learner, e.g. when evidence or context for the achievement of an intended learning outcome is available. Therefore, applications that use PALO are dependent on learning designs and learning opportunities that have their intended learning outcomes (LODs) explicitly stated. This is where the design-time applications come into play. The design-time prototypes being developed enable learning designers to enrich learning designs with definitions of intended learning outcomes; in addition to assessment resources, learning resources, and so forth.

To have access to as many existing users as possible, the plan was to enable the design and delivery of outcome based learning by extending functionality of existing systems that are...
already used by teachers and learners. To illustrate this approach of implementing LOD, MLO and PALO specifications, this section presents a set of extensions to existing learning management systems and social applications that cover:

- OpenGLM Instructional Design Authoring Tool – Open Source
- Moodle Learning Management System - Open Source
- Clix Learning Management System - Product of IMC AG
- 2Know2 - Product of Knowledge Market
- Elgg Social Networking Platform - Open Source
- dotLRN Platform - Open Source
- Facebook Social Network - Product of Facebook Inc.
- Learn eXact LCMS – Product of eXact Learning solutions

In the coming sub-sections, the use and integration of specifications in prototypes is demonstrated. The sub-sections are structured around the processes involved in outcome based learning setting.

In Section Storage and Interoperability of Learning Outcomes, the LOD specification is used to describe learning outcome definitions and enable their storage and reference in the OICS. Section Enriching Learning Opportunities and Learning Designs with Learning Outcomes discusses the linkage of stored learning outcomes to relevant learning opportunities and learning designs at design time. Once learning opportunities are enriched with metadata about their intended learning outcomes, this metadata can be used to advertise them to interested future learners. MLO specification and its use to describe metadata of learning opportunities is presented in section Publishing Learning Opportunities. The outcome based finding of relevant learning opportunities and learning designs, based on their intended learning outcomes attached at design time, is presented in Section Outcome-based finding of Learning Opportunities and Learning Designs. In Section Tracking Personal Achieved Learning Outcomes, PALO specification is used to represent data collected about learner achievements and relevant context and evidence data. Recommendation of relevant opportunities, learning designs and peers for teachers and learners is illustrated in Section Recommendation of Learning Opportunities and Peers Based on Learning Outcomes. The process of sharing information about learner achieved learning outcomes in social applications, using PALO specification, is presented in Section Sharing Learner Achieved Learning Outcomes. Open ICOPER Space (OICS) services that support interoperability of learning outcome data is presented in Section 3.3

### 3.2.1 Storage and Interoperability of Learning Outcomes

Learning outcomes can be common within the same course, taught by several teachers and for different groups of students, and across universities and domains. Instead of describing learning outcomes from scratch every time a new course is created, teachers should be provided with a list of relevant learning outcome definitions that they can link to their courses. In order to enable finding and reusing learning outcomes across courses and universities, their descriptions should be stored into a centralized repository accessible via outcome based finding and publishing services.
In ICOPER, learning outcome instances are collected from different providers and stored in a specialized repository of the Open ICOPER Content Space; see Figure 2. Instances stored in this repository are valid against the ICOPER Learning Outcome Definitions (LOD) data model. LOD schema provides a way to capture the key characteristics (identifier, title, description and type) of a learning outcome, see Figure 3, independently of its use in any particular context or target group (persons).

This specification extends IEEE RCD (IEEE, 2007) with one metadata element defining the type of the learning outcome and its associated value domain to capture whether a learning outcome refers to knowledge, skill or competence following the definitions of the European Qualification Framework (EQF, 2000). It is important to note that the LOD schema is an application profile of IEEE RCD customized for ICOPER purposes, and is not a new specification or standard. Instances that conform to the LOD specification should also conform to the IEEE RCD standard, for more information see D2.2.
Learning outcome definitions populated the learning outcome repository of OICS were collected as follows:

- **IEEE/ACM Computer Science Curricula**: The ACM/IEEE Computer Science Curricula review task force have defined the list of learning outcomes (objectives), as part of course descriptions, for all computer science courses published in 2008 in a PDF file. Learning outcomes of those courses were extracted into HTML format that was afterwards transformed into ICOPER valid LOD XML instances stored, with unique identifiers, into the OICS learning outcome repository. In this way, different universities use common learning outcome terms for describing what students would achieve when finishing a particular course.

```xml
<learningOutcome xmlns="http://www.icoper.org/schema/lodv1.0">
    <identifier xmlns="http://www.icoper.org/schema/lodv1.0">
        <catalog>ICOPER</catalog>
        <entry>12768626-f7ad-4903-6a4c-64bf3db4901d</entry>
    </identifier>
    <title><string language="en-US">human centered design</string></title>
    <description>
        <string language="en-US">Explain the characteristics of human-centered design methods</string>
    </description>
    <type>
        <source>EQF</source>
        <value>knowledge</value>
    </type>
</learningOutcome>
```

- **OpenLearn of the Open University UK**: Most learning opportunities of the OpenLearn (OU) UK have learning outcomes associated to their metadata records, represented in a local XML format and recently as part of IEEE LOM application profiles of OU. All individual learning outcome definitions were extracted and described in LOD schema into the OICS learning

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outcomes repository. In this way, those metadata instances were made available to learning systems of all ICOPER partners to be reused during creation and update of learning designs and learning opportunities.

- European Computer Driving License (ECDL\textsuperscript{6}): all learning outcome definitions about knowledge and skills trained are stored into ICOPER repository. Those outcomes were transformed from sources files from excel sheets into LOD XML format.
- WU Vienna: for the study programme Business Education at the Vienna University of Economics and Business, 52 learning outcomes were defined at the level of the curriculum. These learning outcomes should describe the competences a student should have achieved after successfully completing the whole programme. The learning outcomes were exported from Learn@WU and stored in ICOPER valid LOD XML instances. Afterwards, the LODs were tagged with unique identifiers and stored into the OICS learning outcome repository.

For more details on number of instances and technical transformation of learning outcome instances into LOD XML format, see ICOPER WP1 D1.2.

### 3.2.2 Enriching Learning Opportunities and Learning Designs with Learning Outcomes

Data about learning outcomes is attached to metadata records of learning opportunities and learning designs to enable finding those resources based on their intended learning outcomes. Two prototypes where learning outcomes are added to learning opportunities and learning designs developed in ICOPER project are introduced below.

#### 3.2.2.1 Linking Learning Outcomes to Learning Opportunities

Data about learning outcomes is attached to metadata records of learning opportunities or a learning design to enable finding those resources based on their intended learning outcomes. Two prototypes where learning outcomes are added to learning opportunities and learning designs developed in ICOPER project are introduced below.

#### 3.2.2.2 Linking Learning Outcomes to Learning Opportunities

The prototypical implementation in the eLearning .LRN platform Learn@WU aims at supporting WU Vienna in its effort to better align learning opportunity (course) delivery with what has been promised in the curriculum. Currently, one part of the general course information relates to learning outcomes. However, editing support of this part of the course information is very limited.

To overcome this drawback this prototype makes it possible for instructors to re-use learning outcomes from a curriculum-specific pool, described using the ICOPER Learning Outcome Definitions (LOD) schema, and to assign those learning outcomes to a course, see Figure 4.

\textsuperscript{6} ECDL definitions http://www.ecdl.org/programmes/media/ECDL_ICDL_Syllabus_Version_51.pdf.
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After assigning learning outcomes to a course the instructor has the possibility to change its title, description or type to make the learning outcome more suitable for her course.

In case instructors do not find relevant learning outcomes to their courses in the OICS learning outcome repository, they can create additional learning outcomes for each course, see Figure 5. The possible types of learning outcomes were aligned with the current WU internal notation.

Figure 4: List of learning outcomes in a study program

Figure 5: Adding a new learning outcome to the course
Once the instructor has finished these tasks she can select the relevant learning outcomes and publish them to the course description, Figure 6. Afterwards the learning outcomes become visible for learners (students) in the learning opportunity (course) catalogue.

3.2.2.3 Linking Learning Outcomes to Learning Designs

Learning outcomes are linked to learning design during design time of a course by an instructional designer who creates a new, or updates an existing, learning design (LD) for the program. Using an authoring tool like OpenGLM, the instructional designer retrieves the relevant learning outcomes mentioned in the curriculum from the LOD repository, via a search module implemented in OpenGLM; see Error! Reference source not found.
After the instructional designer finds here relevant learning outcome she imports it into her authoring environment and adds other relevant data on resources, teaching methods (TM), learner assessments and LOD context and levels retrieved from the OICS; see Figure 8.

![Figure 8: Adding learning outcomes to learning design](image)

An instructional designer can reuse existing LODs and link them to learning designs but she may also introduce new learning outcomes using OpenGLM if needed, Figure 9. The new added LODs can be accessed and reused by other instructional designers and teachers to link them to other learning designs or learning opportunities. Additional links to LODs and TMs can be added by program management. The created/updated learning designs are then made available in the learning design repository.
In the above prototypes, LOD schema was used to describe learning outcome definitions and link them to metadata records of learning opportunities and learning designs. As an example, the LOM XML instance below shows how a metadata record of a learning design is linked to learning outcomes (LODs) in the educational category. The global unique identifier (URI) of the learning outcome is used to link a particular learning outcome to a learning design metadata record; and not embedding the full description of a LOD in LOM. In this way, the LOM instance of a learning design is linked to up-to-date information about a learning outcome. In this way also, learning outcomes maybe hosted and maintained in a different repository or provider than the learning designs.

```xml
<lom xmlns="http://ltsc.ieee.org/xsd/LOM">
    <general>
        ....
        <identifier xmlns="http://ltsc.ieee.org/xsd/LOM">
            <catalog>ICOPER</catalog><entry>232c3a4a-9936-4a83-7667-5952ef03a45f</entry>
        </identifier>
        <title><string language="en-US">Journal writing about soccer</string></title>
        ....
    </general>
    ....
    <eductional>
        ....
        <learningOutcome xmlns="http://www.icoper.org/schema/loDv1.0">
            <identifier xmlns="http://www.icoper.org/schema/loDv1.0">
                <catalog>ICOPER</catalog>
                <entry>456411e6-b349-40c7-53fd-c256d2dd0537</entry>
            </identifier>
        </learningOutcome>
        ....
    </eductional>
</lom>
```
3.2.3 Publishing Learning Opportunities

In order to give potential learners access to information on a learning opportunity that enables them to achieve specific learning outcomes, metadata about learning opportunities and their intended learning outcomes should be published. Knowledge Markets (KM) implemented a prototype on top of its 2know2 platform that allows course designers to announce learning opportunities that are linked to learning outcomes and teaching methods. Figure 10 shows the edit screen of a sample course which addresses two learning outcomes and in which one teaching method is applied.

![Figure 10: Linking learning outcomes and teaching methods to courses](image)

The learning outcomes, described using the ICOPER LOD schema, and teaching methods are directly stored in and retrieved from the OICS; see Figure 11.
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Once the creation/editing of learning opportunities is done, learning opportunities could be announced at the 2know2 platform with a news article and an RSS feed, see Figure 12.
In addition to the possibilities to announce a course at the 2know2 platform, a course developer can also publish it in the repository for learning opportunities at the OICS.

In the earlier presented prototypes, we have demonstrated how Learning Outcome Definitions (LOD) schema has been used during the design time of a learning design or learning opportunity. It became possible to reuse existing common learning outcomes stored in the OICS, like IEEE/ACM Computer Science knowledge and skill definitions, across universities and e-learning platforms during a publishing of a learning opportunity or creation/update of a learning design.

In the coming sub-sections, we focus on making use of learning outcomes metadata, added during the design time of learning design and learning opportunities, to enable users find relevant learning designs, opportunities and peers (via recommendation). We also, afterwards, present prototypes that track information the status and achievement of learning outcomes by learners using the Personal Achieved Learning Outcomes (PALO) schema.
3.2.4 Outcome-based finding of Learning Opportunities and Learning Designs

Search modules that enable searching and importing learning designs and learning opportunities based on their intended learning outcomes is implemented in several learning management systems. These modules use the metadata about learning outcomes represented in LOD schema and that is linked to metadata of learning designs (IEEE LOM) and learning opportunities (MLO) during the design time.

3.2.4.1 Outcome Based Search in Moodle

The purpose of this module is to enable learners and teachers find relevant learning designs based on their intended learning outcomes; in addition to other attached metadata properties like title and description or subject.

The search module lists learning designs that are relevant to a search query; like “writing”, see title of learning design.

Figure 13. It is possible to filter the query by focusing the query matching to a specific portion of metadata for the given search string, like description of a learning outcome or title of learning design.
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Figure 13: Learning design outcome-based search interface in Moodle at Umea University

Once the user identified and selected his relevant learning design from the list, more detailed information about the learning design is provided to help the user decide on the relevance of this learning design to her. Figure 14 shows a screenshot of the details of a learning design after the user clicked on one of the items in the query results list. Data about learning outcomes here is represented in LOD schema at the technical binding of the metadata instance and linked to LOM metadata record of the learning design using a URI. In this way, whenever, metadata about a learning outcome is changed, these changes will affect the metadata record of linked learning designs.
3.2.4.2 Outcome Based Search in Elgg

A teacher or course designer can create a new course from existing learning designs stored in OICS. Teachers search for a relevant learning design then make changes to the information of the learning design in order to adapt it to the new group of learners. This includes changes to teaching method, context or learning outcomes of the learning design. What is relevant to this report is the finding of learning designs based on its intended learning outcomes.

The implemented outcome based search extension to Elgg social platform enable teachers to search and filter learning designs based on metadata of their intended learning outcomes; see Figure 15.
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Figure 15: outcome based search in Elgg

If a teacher identified the relevant learning design, she can import it to her Elgg group (course). The users identify their relevant learning designs based on the metadata description of theses learning designs as shown in Figure 16. This metadata about the learning design includes a short description, teaching method of a learning design, intended learning outcomes and context. This information helps teachers to take a decision of the relevance of the learning design to them.
Learning Outcome Definition (LOD) is presented in learning design metadata instance. This instance conforms to Learning Object Metadata specification (LOM). The learning design metadata stores links to the Open Content Space (OICS) where the learning outcome descriptions are stored. In this way learning outcomes are always up to date in relevant descriptions of the courses.

If the learning design is suitable a teacher can start a new course, see Figure 15, by clicking on “Import to Elgg” link and select Import as a new course.

When the teacher is importing the learning design to Elgg, the data is mostly stored inside Elgg Group object ad metadata fields (specific to Elgg database structure and easy extension of metadata based on standalone metadata mapping logic). Prototypes prefer storing unique identifiers and most of the additional data retrieval is handled from the OICS retrieval web services of middle layer. The teacher continues searching and adds a few more learning designs to started course.
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Figure 17: course overview in Elgg

Figure 17 shows the view of course information. This includes a short description of the course. Intended learning outcomes, learning assessments, teaching methods and tags, etc., are gathered from all imported learning designs. If the learning design is an IMS LD package then its files are extracted under Group files section.

Recommendations of relevant learning designs to the current course are also provided in Figure 17.

3.2.5 Tracking Personal Achieved Learning Outcomes

Tracking and management of learners achievement is a core focus of this section. Once the unit of learning is completed in the learning management systems and depending on the local policy (e.g. after explicit clearance is given by the teacher, the institution, and/or the student), the Personal Achieved Learning Outcomes (PALO) profile of the learner is updated in the OICS PALO repository.
Data about the achieved learning outcomes (achievements) by learners is tracked and collected in several ways. In the coming sub-sections, we present how the tracking of achievement data in some of the implemented prototypes.

### 3.2.5.1 .LRN Assessment Module (developed by UC3M)

This prototype takes care of the publication of the achieved learning outcomes into a learner learning outcome profile on the OICS. After the completion of the course, and therefore the assessment activities, the teacher is provided with a list of the students of the course and the assessment result (grade) of each assessment activity carried out in the course. There is also a final grade automatically calculated as the arithmetic mean of all the results, but the teacher can modify it taking into account other factors. The teacher can also provide some textual feedback for any student’s final grade.

Once the teacher has finished this task, he can officially close the course and then the systems updates profiles of all the students passing the course (in this case it means a final grade of 5 or more because the prototype uses a grading scale 0 to 10, proper to the Spanish system) with the achievements of the course, that is, the intended learning outcomes of course (at this stage achieved). These achievements are also evidenced by an assessment record, see Figure 18, which is an official record corresponding to the final grade of the course and has the University as the assessing body. This process uses the service of the OICS middle layer that allows updating learner’s profile with assessment records and achievements. All this data about user achievement is represented in PALO data model.

![Figure 18: Tracking Assessment Achievement in .LRN](image)
3.2.5.2 Umeå Moodle Learning Outcomes Module

This module, implemented as a Moodle block, takes care of the publication of the learners' achievements. Once the learners complete a course (explicit clearance is given by the teacher), the learners can update their PALO profile in the OICS PALO repository. After importing a Learning Opportunity to a course, Moodle "knows" what outcomes are to be added to the PALO profiles of learners who pass the course, see Figure 19.

![Figure 19: Publish personal achievements in Moodle to the OICS PALO repository](image)

These published achievements are also evidenced by an assessment record, which is an official record with title, description, date, type and the University as the assessing body. The OICS-learner credentials needs to be provided to enable exporting the data to the relevant profile.
In the future the assessment records could contain more specific information, and in the optimal case this can be achieved fully automatically (more development needed for that). For instance, the learning design may include an IMS QTI compliant assessment resource (e.g. a multiple choice test on geography basics) that can be used by Moodle to do the actual assessment and subsequently automatically create an assessment record with information like scores, assessing body and verification date that forms an evidence for the achievement of specific learning outcomes.

### 3.2.5.3 CLIX Learning Management System

CLIX ICOPER (Clix, 2010) is a Java J2EE web application based on the CLIX LMS, i.e. on the PROLIX version of CLIX named LPEP (Learning Process Execution Platform). To use OICS related features, CLIX ICOPER user has to specify his OICS-profile credentials in his CLIX-account. The same counts for third party environments such as iGoogle, LinkedIn, etc.

In this application a learner work through a learning outcome-oriented learning opportunity (e.g. Master course “Organizational Management”) which contains learning content (e.g. Power Point slides) as well as Learning Tools (e.g. audio/video conference) and intended learning outcomes; see Figure 21. The successful completion of such outcome oriented learning opportunity means that a learner has achieved a particular learning outcome(s), e.g. “apply organizational theories to entrepreneurial issues”.

![Figure 20: SHL learning outcomes taxonomies in CLIX](image)
The CLIX ICOPER facilitates outcome-oriented learning as well as the storage, updating and publication of a learner’s PALO in the Learning Management System CLIX ICOPER itself, as well as exporting the data to the OICS PALO repository; see Figure 22.

### Figure 21: Add communication- and collaboration-related learning outcome to IMS-LD Learning Design

![Add communication- and collaboration-related learning outcome to IMS-LD Learning Design](image)

### Open ICOPER content space

Main Site: icoper.user-service | Users: Patrick Pekaczynski | Personal achieved learning outcomes: Shaping Conversations | View

Shaping Conversations

![Shaping Conversations](image)

### Figure 22: a corresponding collaboration-/communication-related learning outcome in PALO OICS

![Shaping Conversations](image)

### 3.2.5.4 learn eXact Enterprise Learning Content Management System

learn eXact Enterprise® (2010) is a Learning Content Management System (LCMS), developed by eXact learning solutions (formerly Giunti Labs). This ICOPER prototype extends the basic LCMS via adding support for IMS LD compliant learning design and management of related learning outcomes.

This application is connected to the OICS repositories and able to search and retrieve contents directly from it using proper services. Information (metadata) about contents is retrieved as well.
An IMS LD compliant learning design can be imported into the system and related runs are inserted into courses. Learners will be able to play contents from assigned courses and annotate them with personal comments and notes. As learners progress into their courses, tutors are able to update students’ profiles with achieved learning outcomes. Users profiles on learn eXact Enterprise have been extended with information about achieved learning outcome as depicted by Figure 24.

Those personal achievement profiles are compliant to ICOPER PALO format and exported into the ICOPER OICS PALO repository.

### 3.2.6 Recommendation of Learning Opportunities and Peers Based on Learning Outcomes

After the learning design is successfully imported into Moodle, several benefits of data collected in PALO profiles of learners can be exploited. The system can keep a PALO profile of intended learning outcomes of learning designs that are – or have been – taught by a particular teacher registered to Moodle. Based on such data, Moodle can recommend other teachers who have
similar profiles of taught learning outcomes. This enables teachers to create practitioner communities around the learning outcomes they teach simply based on the intended learning outcomes linked to courses where they have a teacher role in Moodle; see teacher recommendation widget in Figure 25.

This OICS Teacher Recommendation Viewer widget follows the W3C Widget Specification and therefore the widget can be run in widget containers supporting this specification. We are using the Wookie Moodle plugin to include it in Moodle.

The other types of recommendation approach is to recommend learners other similar learners, e.g. who are currently working on achieving the same or similar outcomes; base on intended outcomes of courses currently being attended, and achieved learning outcomes already in the PALO profile of a learner.
Additionally, Moodle can recommend learning designs which address the same learning outcomes as the ones attached to the learning design currently followed by the learner. In this way, learners can have access to additional resources during learning; see Figure 26.

Recommendations of relevant learning designs based on intended/achieved learning outcomes are also implemented in Elgg system and is presented in Figure 17.

It is important to note that learners can only have access to their PALO profiles in OICS repositories via Moodle and Elgg systems by providing their OICS credentials.

### 3.2.7 Sharing Learner Achieved Learning Outcomes

In order to increase the employability of learners, they would need to share and import their achieved learning outcome profiles into recruitment and social applications. This requires representing the data about these achievements and related evidence data into an interoperable and widely used format. For this purpose, an Atom XML binding (ATOM, 2010) of the PALO schema was defined. This binding is used to publish PALO profiles to third party applications like Facebook and Google.

**Figure 27** shows Facebook application that views PALO Atom feeds of learners’ outcomes. The application retrieves the user public PALO profile and displays it in a separate tab of the personal profile page in Facebook. More than one feed can be viewed and merged into this application.
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Figure 27: PALO data viewed in Facebook

Thanks to use of the Atom syndication format of PALO, the same PALO instance of a learner is viewed into igoogle application in Figure 28.
Figure 28: PALO data viewed in igoogle

Once users click on any of the view details of the learning outcomes, data will be retrieved from the OICS as shown in Figure 29.

Figure 29: a learning outcome definition in OICS LOD repository
As far as sharing PALO data with ePortfolio systems, an OICS PALO profiles of learners can be viewed into Elgg system using a widget that was developed for this purpose; Figure 30.

As part of a proposal to CEN Learning Technologies Workshop (CEN WS-LT) to European standardization, PALO was proposed to be used and implemented to support the portability of achieved learning outcomes data with, for example, ELM Application Profiles for Europass Curriculum Vitae and the Certificate Supplement. Technical Bindings for the ELM Europass Application Profile specifications are also envisaged.

3.3 **OICS Outcome-based Services**

The services that the ICOPER prototypes require have been bundled together into a Middle Layer API, see Figure 31. Its key focus is the integration of concepts and data related to the key processes in outcome-based education and it provides services for search and retrieval of learning resources, for publication, for the management of users and groups and for the
management of learning outcome profiles. This API has been implemented on top of the OICS repository.

The API is divided into three services:

- The User Management and Learning Outcome Profile Service defines methods for creating users and groups, getting information about them, adding users to groups with a certain role, adding achievements or assessment records to profiles, and retrieving profiles.
- The Search and Retrieval Service gives access to the OICS resources by providing specific access methods for the different types of objects (learning outcome definitions, teaching methods, learning designs and learner assessments). It also allows to retrieve metadata for objects and to resolve identifiers.
- The Publication Service allows publishing learning objects and metadata records. It also provides methods for updating and enriching, adding annotations and relations and deleting.
- The Recommendation service allows retrieving users based on the achievements stored in their profile.

The ICOPER prototypes consume these services via one of several bindings developed on top of the OICS repository: For the search and retrieval services, three bindings exist:

- The ATOM binding exposes all resources as ATOM feeds that can be filtered based on values in the LOM metadata.
- The JSON binding uses a REST interface and provides the results to the client tools in the JavaScript Object Notation data format. JSON is a lightweight data format heavily used by web developers due to its simplicity (e.g. native evaluation of results in JavaScript) compared to the traditional XML data format approaches, which often require cumbersome DOM-based processing.
- A PHP search script forwards Prolearn Query Language (PLQL) expressions to an SQI SOAP endpoint.

The publication service uses the Sword/AtomPub binding of the SPI specification (SPI, 2010), learning objects and metadata records can be published to collections. Extending the SPI specification, the OICS implementation allows updating and retrieving of parts of the metadata record thus making it very easy to query and manipulate individual metadata fields relevant in specific use cases.
3.4 Evaluation Results

The prototype evaluation was carried out at different sites. Basically, each prototype development partner evaluated their own prototype. However, as some prototype partners did not have resources for the evaluation, some help were provided by other partners, who did not develop the prototypes. An evaluation task force was created with the aim to provide general instructions for the evaluation process and also to allow the prototype partners and evaluators to discuss and share experiences during their evaluation. Weekly virtual meetings were organized during the whole evaluation period. Qualitative evaluation was the focus of this phase. The suggested target user groups were study program managers, faculty members and learners. Task descriptions for each prototype test were prepared. A general guidance for the structured interviews was also written and was shared among the evaluation task force and also all the WP leaders. The evaluators and WP leaders were encouraged to comment, modify some questions or
add more questions that are relevant to their corresponding WPs. During the evaluation test, the users (i.e., evaluation participants) were asked to carry out the tasks using the prototypes and then they were invited to participate in the interview. For the interview, the evaluators proposed to conduct the interview in English. However, if the interviewee did not feel comfortable or was not happy with speaking English or if the evaluator thought she could get more useful information when speaking in the local language, the interview could be carried out in that local language.

All evaluation tests were conducted from August to mid-September. The evaluation findings were summarized by the evaluators and uploaded to EducaNext. The summaries were consulted by the WP leaders and also by the editors when they prepared their deliverables.

One should bear in mind that the evaluations were carried out for the sake of all WPs, and in this section, only evaluation findings relevant to WP2 D2.3 were reported.

**Learn@WU**

Five (5) interviews were conducted for the Learn@WU evaluation with instructors of WU Vienna and each lasted between 40 to 70 minutes. The interviewees were working on some pre-defined tasks and were asked to give feedback to the functionality of the prototype and also to the schemas behind.

The interviewees identified the integration of the prototype into the existing eLearning platform as one of the main strengths because that would make the work with it easier and could therefore increase the effective usage. In the following more specific feature findings are provided:

- **Importing learning outcomes from the study programme (i.e. Instructors can browse through available learning outcomes of the study program and import them into their course):** In the current version, the instructors had to copy the programs learning outcomes from the website or another resource and paste them into their courses’ descriptions. Such workflow was not really convenient. Consequently, the instructors would appreciate the functionality that allows importing learning outcomes from a repository. With such functionality, they would be more aware of the learning outcomes at the programs level and would also easily see how their courses contribute to the program. Furthermore, they would get good formulated learning outcomes that could help improve the quality of teaching as such outcomes would reflect more on what the students should be able to do after a semester. Nevertheless, the instructors also mentioned a possible problem about how to address the learning outcomes in the course in case too many learning outcomes could be imported without thinking.

- **Changing imported learning outcomes (i.e. The title and the description of the imported learning outcomes can be changed so that it better corresponds with the course):** This functionality made sense to the interviewees, as the instructor could adapt the learning outcomes of the programme to her courses. This would show the students how the course contributes to the learning outcome of the program. However, if the learning outcomes
were changed very extensively, it may lead to a situation in which the program manager may not know which courses address which learning outcomes of the program.

- Create new learning outcomes in the course (i.e. The instructors have the possibility to create new learning outcomes and store them in the course): As a course could address learning outcomes which were not defined in the curriculum, it was perceived as useful that the instructor could add new learning outcomes to the “pool” of the course. However, if there were enough learning outcomes defined on the program level, an instructor would not need to define further learning outcomes.

**OpenGLM**

Eleven (11) interviews were carried out for the OpenGLM evaluation. Related to the task “Specifying intended learning outcomes for your learning design”, it was noticed that one interviewee did not know what learning outcomes meant. It resulted in the wrong interpretation of the corresponding sub-task. However, basically, the interviewees perceived smooth interaction with OpenGLM during their task. They reported that OpenGLM supported them well in completing the IRM-relevant sub-tasks, i.e. searching for existing learning designs in OICS, retrieving desired learning designs from OICS, specifying intended learning outcomes for the learning design based on learning outcome definitions offered by OICS, integrating good-practice teaching methods from OICS into the learning design, adding learning and teaching resources from OICS to activities in the learning design, and uploading the learning design to the OICS.

**UMU Moodle**

Four (4) interviews were carried out for the UMU Moodle evaluation. Following are the relevant findings

- Outcome based search in Moodle: The evaluation of the search feature showed that the users appreciated the possibility to find learning designs based on learning outcomes, but it also identified a lack of search options. It was suggested that it should be possible to search the OICS repository not only by free text search but also by selecting keywords (context and/or learning outcomes). Another suggested improvement was to implement instant search that shows results as you type.

- Learning Outcomes Module: The evaluation of the learning outcome view and export module identified some problems, but they were related to the user interface and not to the core functionality of the module. The placement of both the OICS login pane and the learning outcomes export button should have been made more visible.

- Teacher recommendations: The evaluation identified some user interface related issues. Better naming and placement of buttons as well as more informative form descriptions were suggested. Regarding the improvement to the core functionality of the teacher recommendation widget, it was suggested that it should be possible to trace the origin of
a certain learning outcome to find the corresponding learning design and maybe even courses where the design is being used.

**Elgg System**

- Five (5) testees conducted the test using Elgg. After the test, there was a session in which they discussed the prototype and the tasks. Many useful feedback were collected. The users stated that the prototype did not fit with the course design workflow they had in their mind. They wanted to start the course from the definition of the course title and description and maybe even to the setup of the learning outcomes for the course. In this prototype version, users could only import the learning outcomes with the existing learning design.

- They also had strong feeling that the search of the learning design was not learning outcome based but keyword based. They expected to see the list of learning outcomes as the result of the search and the learning designs were associated to the specific learning outcomes on the second level. They also wanted to have functionality for browsing the learning outcomes based on different taxonomies.

- Finally, the course structure after the import of learning design to Elgg was not satisfactory from their point of view. They wanted to see a clear course structure, i.e. the description of the learning design should have been connected with the course units, not with the entire course. They also wanted to have the functionality for changing the order of learning materials and learning activities inside the extracted learning design.

**AGH Facebook**

Ten (10) interviews were carried out for the AGH Facebook module evaluation. The most frequently discussed issue with interviewees was the grouping of learning outcomes, i.e. grouping should have been allowed to collect similar types of learning outcomes. This functionality would be useful when users publish their different profiles on different social websites. Depending on the type of their e-portfolio they could share specific learning outcomes. The classification possibility would give them a flexibility of developing their portfolios.

Another important issue was the lack of detailed course information of learning outcomes. The interviewees would like find out an origin of some specific learning outcomes. This could help students gain knowledge about how such learning outcomes were achieved and what they would do to obtain it.

4 **Recommendations**

In this section, we formulate recommendations in regard to learning outcomes and learning opportunity functions and specifications. Those recommendations are formulated based on the findings of the evaluation of user experience with developed prototypes. Each recommendation has
a unique number like “R2.1” (Recommendation number 1 in WP2) and can reference evidence statements from evaluation sessions with participants like “WU1” (participant number 1 from WU Vienna). The recommendation also states the target group of the recommendation.

### R2.1 A learning outcome matrix is needed to better understand and plan the alignment of learning outcomes to courses.

**Stakeholders: HE managers, Technology providers**

*We recommend providing a matrix that shows the linkage between learning outcomes and courses. This helps instructors and program managers understand what courses contribute to attainment of what learning outcomes [WU2, WU3, WU5]. This matrix would enable program managers to identify any gaps when a learning outcome is listed to be achieved by learners but not covered by any course at program. New course(s) can be then offered to cover the gap [WU2]. It would be even better if the relation between courses and learning outcomes can be visualized and controlled using an appropriate tool [WU5].*

*Such visualization of learning outcomes of courses help an instructor know which learning outcomes were addressed in the course before and which learning outcomes will be addressed in the course after. This approach will help to make the course delivery more effective in the way that a learning outcome is not addressed multiple times [WU2].*

### R2.2 Use of learning outcomes in program/courses description ensure targeting similar learning outcomes across courses and programs

**Stakeholders: HE Managers**

*Providing a clear outcome-based description of offered learning opportunities can help different teachers, who teach the same course, select content and activities that help attainment of learning outcomes of a course. Also the organisation would use the intended learning outcomes of courses to control and evaluate the instructors. It would also help comparison of programs and courses across competitive organisations [WU4]. An organisation that watches and addresses learning outcomes expected for a relevant employment is more competent than a traditional organisation.*
R2.3 A compulsory usage of an application for management and reference of common learning outcomes should be decided by program managers

Stakeholders: HE Managers, Technology providers

We recommend that program manager should decided whether teachers are allowed to select learning outcomes that does not belong to set pf learning outcomes stored in the central repository of learning outcomes of a university. Also should decide if they would allow teachers to change metadata of those learning outcomes [WU2, WU3].Two interviewee [WU3, WU5] proposed making usage of an application for assigning learning outcomes to course description compulsory.

R2.4 It should be possible to organize learning outcomes of one program in one collection

Stakeholders: HE Managers, Technology providers

We recommend that managers and instructor should be provided with tools that simplifies their work. We found it interesting that instructors can import and attach the learning outcomes from a central repository (collection), to their courses, and they do not need anymore to copy and paste from the website of the program [WU1, WU5]. However, they think that learning outcomes of one program should be organized in one repository [WU1]. In case new learning outcomes are added to the program repository, the application, prototype, should differentiate in the visualization between imported and new learning outcomes [WU5].

R2.5 Provision of a software that support defining and linkage of learning outcomes at course design can be perceived as a higher quality assurance

Stakeholders: HE managers

We recommend that software that enables easy storage, retrieval and linkage of learning outcomes to learning designs is provided. This could help instructors design outcome based learning courses and could result in an improvement of the teaching quality at the university [WU2, WU4, WU5]. Many instructors do not have any idea of how to formulate learning outcomes. Providing such support will help instructors think about the outcomes of a course and what the students should be able to do after a semester. Secondly, the instructors know how their course contributes to the whole program [WU2]. However, formulating learning outcomes in a good quality requires some experience. This can be ensured using common definition of learning outcomes of courses defined by international bodies like ACM/IEEE Computer Science Working Group. This working group defined learning outcomes of all computer science courses to be used by computer science teachers and pro-gram managers worldwide. the other option is to train teachers on formulating good learning outcomes.
R2.6 Providing a tool that allows access to a large pool of learning outcomes is not enough
Stakeholder: HE managers, Technology providers

*Providing a tool that allow instructors to have access to a large set of learning outcomes that can be relevant to a course should go side by side with provision of a well defined procedure for linking learning outcomes to courses [WU4]. It is not always obvious to formulate learning outcome which arise sometimes in a discourse. In addition to that good formulation of learning outcomes should be aligned with a procedure that ensure the achievement of those learning outcomes after successful completion of course and its related assessment [WU1, WU3]. Providing and following proper teaching and assessment methods and activities can overcome this challenge.*

R2.7 Course outcomes should be communicated to students
Stakeholders: HE managers, teachers, technology providers

*The addressed learning outcomes of a course (learning opportunity) should be communicated to students at beginning, and offering [WU3, WU4], of the course and evaluated by them at the end of the course. Collecting feedback of the students would help the instructors to find out how good the learning outcomes were achieved. Subsequently, also the organisation could get feedback about the quality of the courses [WU5]. The student’s feedback could in this way work as a tool for quality assurance.*

R2.8 Editing learning outcomes data ensures accuracy and relevance but could harm comparability
Stakeholders: Technology providers

*We recommend that it should be allowed that teachers edit titles and descriptions from imported learning outcomes. This is important for their accuracy but could harm the homogeneity/comparability of those outcomes across courses, programs, universities and sectors [WU1 - WU5]. The usefulness of changing the titles and descriptions of imported learning outcomes depends on the way they are formulated. If they were formulated very broadly it would make sense to change them afterwards. If the learning outcomes were formulated in the way that they are clear and unique it should not be possible to change them afterwards. A better solution would be that the program manager decides whether the titles and descriptions of the imported learning outcomes should be changeable in the course or not. This guarantees, at least, that learning outcomes are the same across courses of the program.*
### R2.9 Introduction of learning outcome aware systems requires training

**Stakeholders:** HE managers, Technology providers

We recommend providing teachers with training on how they design outcome based learning. That includes defining and linking learning outcomes to learning designs. It is important to align teaching activities to target the announced learning outcomes in the courses. Therefore, the idea of learning outcomes must become manifest in the heads of the instructors. Otherwise, the problem could appear that the instructors just import or define some learning outcomes but do not address these in the courses. To minimize this problem workshops and seminars should be offered, which address the outcome-oriented teaching [WU][WU3][WU5]. In these workshops, outcome based learning opportunities should be presented and demonstrations on how the relevant software work should also be included.

### R2.10 Multilingual metadata about learning outcomes is helpful

**Stakeholders:** Standards bodies, Technology providers

We recommend providing a user with an interface that allows her to describe learning outcome characteristics in multiple languages. This is important in such multilingual European context. Even in the same university more than one language can be used to provide information on learning opportunities, learning designs and their relevant learning outcomes. Also multiple definitions of learning outcomes increase their interoperability and re-usability across universities [WU1, WU2, WU5].

### R2.11 Learning outcomes should be linked to learning designs

**Stakeholders:** HE Managers, Teachers, Technology providers, standards bodies

We recommend should be linked to learning designs. Learning outcomes are first linked to learning designs of courses and then reused by several teachers to makes their own instantiation of those learning designs. The same courses might be given to several groups of students by several teachers, so a generic learning design can be implemented then every teacher may add/adapt the learning outcomes of his course when appropriate. This will allow teaching a course with same goals and outcomes and increase re-usability of existing learning designs [WU2, WU3].
2.12 Learning outcome indexation and finding should be simple

Stakeholders: Technology providers

We recommend that software tools used by teachers and program managers should be easy to use [WU3-5]. This can be done by automating the indexation of learning outcomes into learning outcome repository. Several existing interfaces ask teachers to provide lots of information about a learning outcome. This is not a good practice. The ideal situation is that learning outcomes are introduced automatically into the system by importing them from an ontology of learning outcomes or from a list of learning outcomes defined by a recognized body in the domain. In cases teachers need to introduce new learning outcomes, they interface should only ask them to provide the description and type, and maybe the title, of the learning outcome. The other information like identifier should be indexed automatically and hidden from the user.
5 References


D2.3 Report on implementation and validation of a standardized model for learning needs analysis and the provision of learning opportunities


