Evaluate – An Innovative Service for Learning Performance Monitoring in Businesses

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Abstract. In this paper we present Evaluate, a platform for learning performance monitoring. Evaluate manages a number of artefacts that can be used to monitor learning performance, like metrics, measures, surveys, questionnaires, or reports. The portal serves various types of users such as business process leaders, monitoring project leaders, learners, and instructors. Based on a powerful modular component framework the processes supported include formative and summative course evaluation as well as sharing of survey instruments. Evaluate's business model is based on a number of advantages, such as a reduced effort for setting up learning performance monitoring projects, low costs for collecting empirical data, and support for benchmarking.

Keywords: Training evaluation, e-learning, learning management, software-as-a-service, performance monitoring

1 Introduction

In today's knowledge-driven society, human resources are increasingly considered as a crucial input factor for high performance. As a result, organisations have started to - implicitly or explicitly - identify *competency objectives* for their key processes. Based on these competency objectives existing employees are trained or new employees are recruited. Therefore, thoroughly planed learning processes and learning management have become important factors to generate competitive advantages. In this context, several studies have recognised corporate learning as an effective way to increase an organisation's overall performance [1].

Today, the predominant technology serving personnel development processes are learning management systems (LMS). An LMS supports an organisation in the administration of learning courses, the registration procedures for learners, and in the distribution of learning materials. In large organisations, LMS are frequently accompanied by specific modules of enterprise resource planning (ERP) solutions providing support for related processes such as performance appraisals.

However, such infrastructures often suffer from specific drawbacks. For example, in most cases LMS are solely focused on managing centralized corporate learning processes, but largely ignore the business processes they are supposed to support. In other words, LMS mainly focus on learning delivery, and lack support of processes that focus on the identification of learning needs, or the subsequent assessment of

learning transfer and performance improvement. Thus, the evaluation of learning processes demands for open systems that support the exchange of standardized measurement items as well as corresponding benchmark data. Moreover, support for the identification and definition of learning metrics and measures that can be used to collect data on intangible assets are also rarely found in current state-of-the-art tools.

In addition, deploying an in-house learning technology infrastructure is cost-intensive. For example, Brandon Hall recently reported costs ranging from $72,370.- (500 users) over 349,414.-(10,000 users) to $ 601,358.- (25.000 users) for installed implementations [2]. Together with the internal resource requirements for implementing LMS, these costs constitute a significant obstacle for professional personnel development. This is especially true for small and medium-sized enterprises which represent the majority of European businesses.

In this paper, we present a new learning technology infrastructure that aims to address the above mentioned shortcomings. The Evaluate platform provides a number of services for learning management and performance monitoring.

The remainder of the paper is structured as follows: In Section 2, we outline a methodological framework for learning and performance monitoring. In Section 3, an example case is introduced which motivates the application of Evaluate in a business setup. Section 4 describes Evaluate in more detail, following the design space framework for learning media. Based on the example case presented in Section 3, we illustrate a concrete implementation of Evaluate in Section 5. After giving an overview of the technological architecture in Section 6, Section 7 concludes the paper.

2 Methodological Framework for Performance Monitoring in Learning Environments

Evaluate provides different components for monitoring the performance of learning activities, the transfer of learning to the work environment, and the subsequent impact of learning on the corresponding business processes.

The PROLIX Methodological Framework for Competency Evidence Elicitation and Performance Monitoring distinguishes between the following five phases [3]: (1) learning process monitoring, (2) learning outcome monitoring, (3) competency monitoring, (4) process performance monitoring, and (5) business performance monitoring.

At the time of writing Evaluate focuses on learning process monitoring: “Learning Performance Monitoring is concerned with tracking critical success factors of learning arrangements such as quality of learning material, empathy of instructors, or service quality. Learning process monitoring enables organisations to influence learning activities and the management of those, so that they produce better learning outcomes and enhanced competencies. Learning process monitoring can be performed at all levels ranging from informal evaluations of small learning activities (e.g. a tutoring session on a specific aspect of a software tool) over training and training programme evaluations, to a corporation-wide assessment of the effectiveness of learning management.” [3]

Monitoring of l*earning processes* can be done for example by performing course evaluations. In Evaluate the "Course Evaluation" service covers formative as well as summative evaluation [4]. *Formative evaluation* is performed in order to influence a learning experience while it is delivered. For instance, a formative evaluation helps a learner to reflect her learning goals before, during, and after a learning activity in order to improve the achievement of learning objectives. To thoroughly support formative evaluation, Evaluate provides a survey tool for carrying out expectation analysis, satisfaction analysis, and transfer analysis. The corresponding questionnaires mainly consist of open questions that help the learner (employee) to reflect on her goals. A s*ummative evaluation* is designed to assess the results of a learning process. In case of a summative evaluation, questionnaires based on standardised measures with closed questions are predominant. Such an instrument supports the collection of data that serves as a basis for target achievement and benchmarking.

3 An Example Case

This section discusses an example case where the adoption of both summative and formative approaches could yield benefits for the respective company. "Soft Solutions Ltd." is an SME providing customized ERP solutions in the print industry. Over the last five years, the company has quickly expanded in Central and Eastern Europe. The 2,000 employee company recruited up to 100 software developers a year, who had to be trained to build special purpose programming skills. In particular, Soft Solutions' Chief Technology Officer, Frida Smith, has identified the need of teaching the company's predominant development process, an approach based on the principles of "Extreme Programming", to new developers.

Those trainings are of paramount importance for the company's effectiveness. As a consequence, Frida decided to install a quality management process for learning activities. Together with the head of personnel development, trainers, and managers of her software development department, the following objectives were identified:

- Inform and track *learning transfer*, since this constitutes the ultimate goal behind the investment
- Measure the *usefulness* of different learning activities, since literature revealed that usefulness (especially in new media environments) constitutes a powerful key performance indicator for corporate learning [5]
- Observe *satisfaction* with learning offerings, since the learning activities are the first deep contact between Soft Solutions and its new employees, and employee satisfaction is an important factor to Soft Solutions' top management.
- Track *performance of instructors* since instructors are considered as a main driver for learning transfer and satisfaction.
- Gather data the *quality of learning materials*, since content quality constitutes a key influence factor for learning success, especially in learning environments where content-based learning is a predominant form of knowledge transfer – like it is the case with the learning offerings of Soft Solution.

In addition, the results should enable follow-up measures. For example, in case a certain maximum threshold is reached (e.g. 80% of course participants agree that

learning service was satisfactory), the team arranging and delivering the learning service is rewarded. On the other hand, measures are required to be taken (e.g. train the trainer activities, improved transfer support) in case the evaluation results for a learning arrangement are below a certain threshold.

4 The Web Portal Evaluate

In this section, we will describe Evaluate in more detail following the design space methodology. Before each of the instantiations of the four design spaces is described, the methodology itself is briefly described.

4.1 Design Spaces of Learning Media

As illustrated in Fig. 1., design choices are grouped into the following four design spaces: business model design space, organizational design space, artefacts design space, and agents design space [6]. A design space includes design issues in a system component that incorporates both a socio-economic as well as a technological perspective of the system.

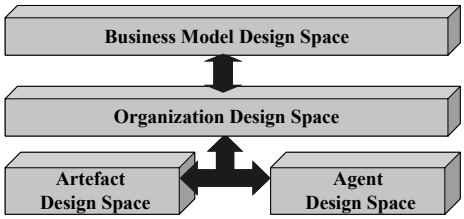

Fig. 1. Design Spaces of Learning Media [6]

Here, a *business model* represents a high-level architecture for product, service, and information flows, including a rough description of the various actors and their roles. In the business model design space, decisions concerning the learning media's position on the educational value chain [7] are taken. Therefore, the target audience needs to be specified (e.g. corporate learners vs. independent learners, or high school teachers vs. faculty of higher education).

Decisions taken in the business model design space will be the basis for the definition of hierarchies and processes in the *organization design space*. In addition, the organizational integration of the learning media and the different institutions has to be defined. In the organization design space, objectives for learning tasks are outlined. Based on these objectives, organizational competences are defined and workflow processes are designed. The resulting processes link learning agents and learning artefacts together.

In the *artefact design space*, decisions about the description of artefacts are made which influence the flexibility of the overall system. For example, the requirements

for the data model of a learning media are determined by the use cases it aims to support, and by the types of learning objects exchanged in learning processes. Selecting an appropriate set of attributes and attribute values for the description of artefacts has a significant impact on the ease of use of the learning media.

The *agent design space* defines the user roles supported by the learning environment. A learning environment can support roles such as learner, course instructor, teaching assistant, evaluator, administrator, etc. Registration and authentication processes also need to be defined here.

4.2 Artefacts

In Evaluate everything is centred on performance monitoring projects. A performance monitoring project represents a real world monitoring activity that has a beginning and an end time. It uses surveys in order to generate reports that provide the data for subsequent performance improvement measures, for example in the context of a course on software development methodologies.

Reports consist of multiple report items. For example, a report item can represent a certain metric that aggregates data from a particular data series. A data series is collected via surveys. When aggregated to a report item it can be displayed in multiple formats (e.g. via absolute values, or percentages).

Metrics and measures are key artefacts of Evaluate. A metric can result in different types of values, e.g. actual values, benchmark values, target values, or alarm values. Metrics based on empirical data sources constitute so-called qualitative metrics, like satisfaction with trainer, or usefulness of a learning activity for example. Quantitative metrics, on the other hand, refer to figures gathered by observing a process either financially or operationally - examples are total inbound costs, time-to-market, training budget, or number of courses attended.

In order to empirically capture data about qualitative metrics, validated measures are needed. Those measures consist of different measure items, which - in aggregated form - satisfy a particular information need manifested in the qualitative metric. Such measures need to be well defined in order to ensure precise measurement and comparability. A measure usually consists of an assertion (e.g. “I was able to transfer the knowledge gained in the course into my work environment”) and a predefined scale for answering (e.g. a 5-item Likert scale ranging from strongly agree to strongly disagree).

In Evaluate, questionnaires are used to collect measures. In addition to measure items, a questionnaire of a survey may also include additional questionnaire items. For example, open questions might be used for allowing respondents to express their opinion with a maximum amount of freedom. Other questionnaire items might be used to capture demographic information (e.g. sex, age) or other data to filter the results according to different target groups.

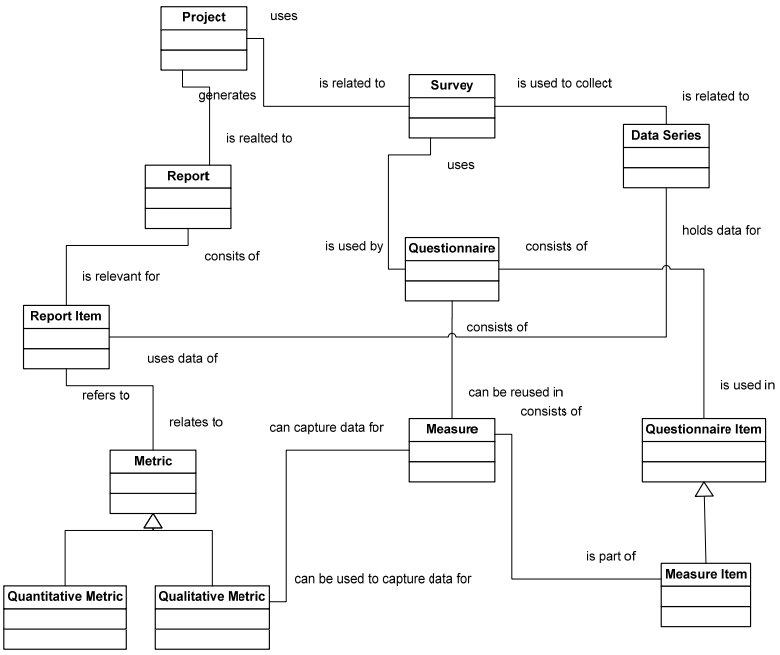

Fig. 2. Key Artefacts of an Evaluate Service

4.3 Users and Roles

From a user-perspective, Evaluate provides a Web-based portal which is managed by a portal management and is used by companies. From our experiences we assume that most services will use questionnaires to collect information from users (like employees, course participants, etc.). Thus, those "Survey Participants" also have to be represented in the model.

Portal Management
The *Portal Administrator* is responsible for general user administration and system operation. The *Portal Quality Manager* is responsible for the availability of quality metrics and measures which are used by the different Evaluate services.

Business Users
The *Business Process Leader* is responsible for ("technical") output and ("financial") outcome of the learning process. Usually she is the head of the business unit, in which the monitoring project is implemented. She has to coordinate the monitoring process

with the monitoring project leader. Additionally she has to ensure that all kinds of infrastructure (e.g. office space, hardware, IT tools, knowledge) are available to the team in order to achieve the best possible performance.

The *Monitoring Project Leader* can be an internal or external person supporting the deployment and maintenance of an Evaluate monitoring service. A person taking the role of monitoring project leader advises the business process leader in selecting metrics, choosing measures, designing reports, and creating follow-up action plans.

The *Learning Employee* - or Learner in short - is an actor in the business process that aims at acquiring knowledge, skills or a change in attitudes by getting involved in formal or non-formal learning activities.

The *Instructor* is the process leader of a particular learning activity. The instructor stimulates learning and hereby changes attitudes, abilities, or behavior of the learning employee.

Survey Participant

An *Anonymous Survey Participant (SP)* is able to fill in a questionnaire without any need for authentication. An *Authentication SP* is a registered and authenticated user. A *Self-Registered SP* is a mixture of the two types above. Here a SP has to create an account before filling in a survey. As the login data are not authenticated, the user can still remain anonymous.

4.4 Processes and Hierarchies

Formative and Summative Course Evaluation

The formative evaluation workflow of Evaluate is defined as follows: Once a learning employee books a learning activity, she first fills in an expectation analysis questionnaire, where she is asked to express her transfer intentions, for instance. Other potential questionnaire items are: related organisational and individual goals, or motivation to participate in the training. Subsequently, this information is forwarded to the respective instructor in order to properly adapt the corresponding training activity.

In case of an electronic learning environment, this information can be used to personalize the learning experience. In addition, the collected expectations are also forwarded to the instructors involved in the learning activity. After the learning activity is completed a learning wrap-up questionnaire is presented to the employee, where transfer intentions are again reflected. After a while - usually between 4 to 20 weeks - the learning transfer is evaluated by performing a transfer evaluation. The results of this process are documented in a report. This report is again forwarded to the respective manager and to the respective tutor, e.g. in case follow-up sessions are planned.

The “learning wrap-up” and “transfer evaluation” phases of the process sketched above can also be combined with a summative evaluation. A summative evaluation is designed to assess the results of a learning process. An ex-post assessment of learning activities evaluates the effectiveness of a certain learning activity based on the

identified metrics and corresponding measures. Kirkpatrick [8, 9] suggests to evaluate training on four levels: learner's satisfaction (reaction), learning outcome (change of attitudes, skills, knowledge), change in behaviour (transfer), and business impact (results).

The collected data is aggregated in a report and forwarded to the stakeholders. Company-internal and external benchmarks visualized in the scorecard help to interpret the benchmarks. Follow-up actions are defined in case the learning activity has not produced satisfactory results.

Sharing of Measures

Many Evaluate services rely on validated measures for capturing data for qualitative metrics. Driven by this demand Evaluate offers a set of standard measures that are accessible for all participating companies on a "Public Measure Space". In addition to the standard measures, companies have the possibility to create and manage their own customized measures, for example by adapting standard measures to their specific needs. Such customizations create a measure in a closed "Company Spaces". In general, this results in two different options:

- A company creates new measure which can be added to surveys of monitoring projects.
- A company "imports" a measure from the public space and modifies it. Afterwards, the measure is added to surveys of monitoring projects.

In addition to importing measures, Evaluate enables users to "publish" user-generated measures from the company space to the public space. This way, new user-generated measures can be made accessible to other users. A motivation for sharing measures is the possibility of using public measures in related performance monitoring projects for benchmarking.

In order to ensure that only high quality measures are distributed via Evaluate, published measures have to undergo a quality check before being published. Therefore, Evaluate divides public spaces in a user-generated part and a standard part. Published measures are first stored in the user-generated measures section. The portal quality manager then approves and regulates the possible incorporation of a specific user-generated measure into the standard section.

4.5 Business Model

Evaluate provides a web-based interface that enables companies to perform high quality learning and competency monitoring. In particular, Evaluate aims to address shortcomings of current state-of-the-art learning management solutions. For example, Evaluate aims to provide:

- reduced effort for setting up learning performance monitoring projects through reuse of measures and questionnaires;
- reduced effort for collecting relevant data;
- increased data quality through validated measures;
- straightforward interpretation of reports as they can be enriched with benchmark data

- an hosted web-based service that is instantly available for "play" (no set-up costs)

At the time of writing we foresee a revenue model that is based on advertising and service fees. Service fees are charged per performance monitoring project. Advertising is foreseen for the publicly accessible measures that can be used for free.

5 How Evaluate Can Serve Soft Solutions Ltd.

Following the example case presented in Section 3, our CTO Frida asked her assistant to use Evaluate's "Course Evaluation" (CE) service for the monitoring process of the software development courses ("Extreme Programming for Beginners"). Every time a new group of learners is assigned to the introductory courses, a new CE-monitoring project is initiated.

Participants of the respective courses are then invited to fill in different questionnaires: one addressing expectations for the course (survey 1: before the course), a second regarding the learner's satisfaction with the course (survey 2: directly after the course) and a third concerning transfer into the workplace (survey 3: eight weeks after the course). Below, we address these surveys in more detail:

(1) *Survey* "Expectation Analysis"
uses a *Questionnaire* to collect data using the following items:
"Expectations about learning content" (free text), and
"Intensions to transfer learning to workplace" (free text)

Please note, that the questionnaire items of the first survey do not capture data for specific metrics. With these questions we mainly want to make course participants reflect on the training and to provide information for the trainer.

(2) *Survey* "Satisfaction Analysis"
uses a *Questionnaire* to collect data on
"Instructor competency" (5-item measure),
"Instructor learning techniques" (3-item measure),
➔ Capture data for m*etric* "performance of instructor"
"Learning material" (5-item measure),
➔ Capture data for *Metric* "quality of learning material"
"Service quality" (3-time measure),
➔ Capture data for m*etric* "satisfaction with learning offerings"

(3) *Survey* "Transfer Analysis"
uses a q*uestionnaire* to collect data on*:*
"Applicability of learning" (3-item measure)
➔ Capture data for m*etric* "usefulness"
"Actual transfer of learning" (5-item measure)
➔ Capture data for m*etric* "learning transfer"

During and after the evaluation process, the Course Evaluation Service will then provide Frida's team with a wide range of possibilities, for example:

- Trainers of a course receive the results of the expectation analysis in order to improve course preparation;
- Reports on transfer success as well as usefulness and learner satisfaction;
- Reflection for participants when filling out the questionnaires;
- Internal benchmarking: all courses of a year are compared and high performing courses are identified as best practises.

6 Architecture

Evaluate is based on the open source Web application framework OpenACS[1]. Despite being an open source framework, OpenACS is developed and maintained by a community that primarily consists of professional software developers [10]. Figure 3 shows the conceptual structure of the Evaluate platform.

Evaluate uses AOLserver[2], a high performance Web server developed by NaviSoft, later acquired by America Online (AOL). In addition to commercial sites, AOLserver is used as the Web server for a number of non-commercial projects, as the DotLRN LMS framework [11] for example. OpenACS provides native Tcl [12] support for server side scripting.

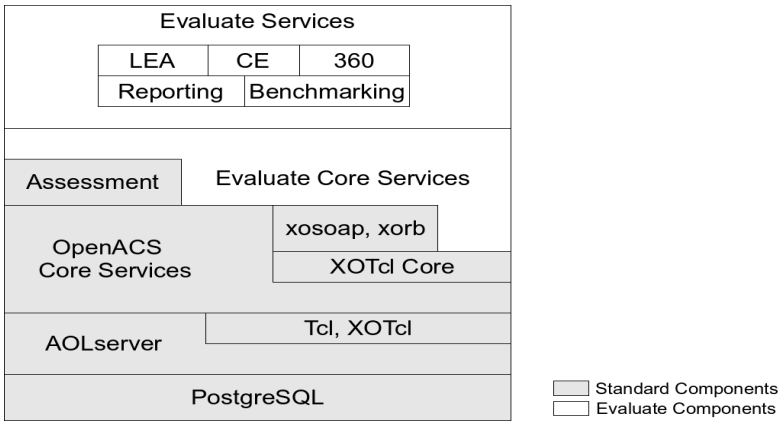

Fig. 3. Conceptual structure of Evaluate

The different Evaluate components are implemented in XOTcl (Extended Object Tcl). XOTcl is a fully dynamic object-oriented programming language [13, 14] that can be loaded in every Tcl compatible environment. Moreover, XOTcl can directly be integrated with arbitrary software components providing C or Tcl linkage, as

[1] http://openacs.org/
[2] http://aolserver.com/

AOLServer for example. The xosoap and xorb components provide functions that enable the communication with other applications that provide SOAP bindings.

The core services of Evaluate extend the functionality of the underlying components. Information about different types of Evaluate entities, e.g. companies, metrics, roles, or permissions, is captured via special purpose XOTcl objects. Each of the different Evaluate services, as "Course Evaluation" for example, is implemented as an own customizable software component, and each of these services seamlessly integrates with other Evaluate services.

The assessment component, shown in Figure 3, is an OpenACS component which can be used to perform surveys or tests of anonymous as well as registered users. The assessment component can be integrated with Evaluate core services to enable the administration of metrics.

As the Evaluate core services are based on OpenACS, each company can autonomously maintain its own company space, and enable or disable Evaluate services within its company space. Moreover, customization of the user interface is supported via a set of predefined templates.

7 Conclusion and Outlook

In this paper we presented the Evaluate platform for learning performance monitoring. Evaluate aims to reduce the gap between corporate learning offerings and knowledge transfer at the work place. We sketched the methodological framework behind Evaluate and described Evaluate along the different dimensions of the "design spaces for learning media" approach. Moreover, we motivated the application of Evaluate in a business context on an example case which uses the "Course Evaluation" service of the Evaluate platform.

Beyond "Course Evaluation", Evaluate supports a number of other performance monitoring methods. For example, we are currently working on the Learning Environment Assessment and the 360-Degree Assessment component. At the same time we continue to develop additional measures and extend the collection of corresponding benchmark data. In our future work, we plan to investigate critical success factors for the design of performance monitoring services as well as their impact on the adoption of such services. The benchmarking support foreseen in Evaluate shall help us to investigate novel methodologies of learning performance monitoring, such as control groups.

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