

# A composition of web services for pedagogical scripting

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**Abstract**—Teachers need to be supported during the creation of digital contents. Existing authoring tools do not offer the adapted support to teachers. This is why we create an authoring tool with two support mechanisms for the design task: the base of scenario models and the pedagogical validation. We implement this tool using the graphical modeling framework (GMF). In this paper, we present an adaptation for the web of our system. It is a composite application formed with five web services, and developed using the rich Ajax platform (RAP).

**Keywords**—Authoring system, pedagogical scenario, service oriented architecture, web service, GMF, RAP.

## I. INTRODUCTION

Since 2005, the Moroccan government has undertaken several initiatives to encourage the use of ICT in education: GENIE program, E-SUP, Nafid@ and Injaz. These initiatives fall within the scope of the Morocco Numeric plan 2013 whose main objectives are [1]:

- Position Morocco as a regional technology hub;
- Make ICT a vector of human development, a source of productivity and added value for other economic sectors and public administration, and a pillar of the Moroccan economy.

The programs Nafid@ and Injaz aim to help students and teachers to acquire computers and Internet access. The GENIE program, for primary and high school, and E-SUP for higher education and research, target [2]:

- The active participation of teachers in the integration of ICT in education;
- The contribution to improve the quality of teaching and learning by using ICT;
- The appropriation of multimedia tools by teachers, in order to an effective use in the classroom.

In 2008, the GENIE program has been evaluated for the first time. The result of this evaluation shows dissatisfaction with the educational impact of the first deployment phase of the program. Thus in 2009, a new roadmap for the program was launched. This second phase (2009-2013) emphasize the need for methodological and continuous support for ICT users. This support is essential for teachers designers of educational

content. Indeed, content creation is a complex process that requires knowledge in both instructional engineering and computer science. Thus, we aim to support the GENIE program, by proposing an authoring system, which assists the teacher during the creation of educational contents.

In this paper, we begin by presenting the context of our research. Next, we define the two main concepts of our problematic of research: the pedagogical scenario and the authoring system. Then, we introduce a state of the art of authoring systems dedicated to pedagogical scripting. After, we discuss our team's vision of e-learning platforms. This lead us to define the key concepts of the service oriented architecture (SOA). We end by presenting the new version of our system and details of its implementation.

## II. CONTEXT OF OUR WORK

Among the many approaches tested in education, one may wonder how to help the teacher to choose the most suitable approach for the learning situation, which he wants to script. Also, if the teacher needs to adapt these approaches to the context of e-learning, is there any tool to support him through this process? These questions are part of a more complex issue, which is the support for the design task. This problematic has become, recently, the main theme of research on authoring systems. Our team "Réseaux Informatiques Modélisation & eLearning" (Computer Networks Modeling & eLearning RIME) is among the first to be interested in this line of research. In 2004, Bennani & al [3] present a new vision of authoring systems, where the instructional designer supports the teacher through pedagogical scenario models. This model was extended in 2007 by Khalidi Idrissi & al [4] and resulted in the "atelier de production de contenu pédagogique" (workshop for production of educational content APCP), which allows, among others, to create educational content in IMS-LD [5] format. Our research is a continuation of this work, and attempts to create a suitable authoring system for teachers. This system has to allow teachers to create pedagogical scenarios by themselves, and without limiting their creativity.

### III. PEDAGOGICAL SCENARIO: CONCEPT AND OBJECTIVE

Known by different names such as: pedagogical sequence, lesson plan or storyboard, the pedagogical scenario has recently acquired great importance in the computer environment of human learning (C.E.H.L.) research community. It allows describing, for a given learning situation, the learning and the support activities, the roles, the target public, the prerequisites, the objectives, as well as the tools and the resources put in disposition for the accomplishment of activities [6]. Teachers use more scripting in learning situations, which are learner-centered, or involving digital contents.

To understand why we create a pedagogical scenario, we analysed Leclercq [7] and Pernin & al [8] studies. According to Leclercq the purpose of pedagogical scripting depends on three parameters: the mode of training, the level of experience of the designer, and finally his community of practice. In the face-to-face or blended learning situations, we use scripting to improve learners' practices, to better plan activities, and finally to better determine the pedagogical objectives. In online situations, the pedagogical scenario helps better express the pedagogical strategies to adopt. Concerning the level of experience of the designer, the goal of pedagogical scripting, for the less experienced, is to enable them to better design their courses. On the other side, the most experienced use scripting in order to improve the student's learning. Finally, instructional designers try to create adaptable and reusable scenarios, which is not the case for teachers. This divergence between teachers' and instructional designers' expectations of pedagogical scripting, is analyzed further in Pernin & al [8]. Indeed, they found that for teachers, the pedagogical scripting is used in order to improve the quality of training and of student's learning; the cost is not the most important. While designing a learning environment is more rational for instructional designers, they prefer generic and economic solutions, even if they are not the best from a pedagogical perspective.

Therefore, we deduce from these studies, that we search through the pedagogical scenario, to better plan learning situations, and to improve student's learning.

### IV. AUTHORING TOOL: DEFINITION

An authoring tool is any system that enables creating digital learning systems. It is generally intended to designers, novice in software development, with different levels of knowledge of pedagogical strategies and standards. These systems, user-friendly for the most part, generate rich and attractive educational contents, playable by the learning management systems (LMSs). We distinguish two main categories of authoring tools: systems for creating educational contents and systems for pedagogical scripting. Systems for content creation avoid for the user the technological difficulty, related to the design of digital resources. However, the whole pedagogical difficulty of the design is supported by the user. The tools for scripting, in turn, support the teacher from a pedagogical perspective: they help to plan courses, and some

of them propose scenario models to implement. A part of scripting tools enables to create the pedagogical scenario of a course, and the corresponding educational contents. The others only allow creating the pedagogical scenario of a course, and attaching to this scenario, the educational contents produced with other authoring tools.

### V. AUTHORING TOOLS: STATE OF THE ART

Despite the growing number of authoring tools available on the web, their adoption, especially by teachers, remains difficult. This can be explained by their use of complicated educational modelling languages (EMLs) like IMS-LD [9], and their non-implementation of a support mechanism for the design task, adapted to teachers [10]. This has led many research laboratories to be interested in the problematic of pedagogical scripting, and try to create authoring systems more adapted to teachers. In the following we present some of these tools:

- Genscen' [11], whose main advantage is its user-friendly graphical interface. It is a classroom with all the actors, objects and tools usually present in this room. The terminology used at the interface was determined from a sample of text scenarios written by teachers, and classroom-based courses.
- REDEEM [12], which is an authoring environment including two applications: authoring tool and intelligent tutor. REDEEM interacts with a catalog of educational contents and allows a teacher, thanks to its authoring tool, to implement his teaching method on any content of this catalog. This adapted content will be presented to students, by the intelligent tutor, in the way specified by the teacher designer.
- Exploragraph [13], which enables to create pedagogical scenarios, according to the Pleiades formalism. It offers a support mechanism for the design task in four levels. The second level consists on proposing scenario models to implement. This mechanism is very interesting as it resolves many issues related to the pedagogical scripting. However the lack of an online demo, or screenshots of this mechanism, does not enable us to verify the level of implementation of the support in this tool.
- FLEXO [14], which allows creating two types of courses: course compatible with moodle or with IMS-LD format. The course designed for moodle is not encapsulated in a SCORM [15] or IMS-CP [16] package, but uses various services offered by this LMS: chat, forum, etc.
- ScenEdit [17], which is an authoring tool designed according to the ISiS model (Intentions, Strategies and interactional Situations). The web version currently available enables to create pedagogical scenarios according to a hierarchical tree, divided into steps. It is not possible to export the scenario created, in any format playable by the LMSs.

These systems are in the early stages; most of them do not generate packages playable by the LMSs, and are based on EMLs, which are not necessarily easier than IMS-LD (e.g. Pleiades formalism). We note nonetheless that REDEEM is different than other tools, as it allows the creation of intelligent tutoring systems (ITS). We chose to present it to draw attention to the existence of such tools. A well-known article of Murray [18] deals with the ITS authoring systems.

## VI. SOA VISION OF E-LEARNING PLATFORMS

Service Oriented Architecture (SOA) considers the information system as a set of independent and interoperable business services. SOA reduces development costs of new applications by reusing and integrating existing services. We can compare an e-learning platform to an information system of a company, who has to satisfy the same constraints of interoperability and scalability. This is among the issues that have led Khalidi Idrissi & al to develop a service oriented vision of e-learning platforms [19]. In the proposed architecture, they define communication services like chat and forum, and design services for the creation of digital contents. This architecture is transforming the role of the LMS from a simple player of digital contents, to a complete learning environment where the teacher can create, integrate and finally monitor his digital courses. The teacher can also use the communication services to contact other teachers. This will encourage them to adhere to the practices of sharing and reuse, which they are not used to [7], and create a community of practice around our team's platform, and more especially around our authoring system, as it will represent the design service of this platform. The sharing and reuse practices will save time and effort for teachers, and enable a better capitalization of their experiences. We believe that the community of practice approach is the best way to facilitate the adoption of our authoring system by teachers. Indeed, the teacher will find in the community a support adapted to his profile, and scenario models already tested and validated by his colleagues [20]. Thus, we adapt our authoring system in web services; which we will integrate in the e-learning platform of our team. Before presenting the new architecture of our system, we need first to define the key concepts of SOA.

## VII. SOA: KEY CONCEPTS

### A. Web service

SOA is essentially based on web services, for their ease of handling [21]. We choose the definition of web service proposed by the W3C [22]:

*"A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML*

*serialization in conjunction with other Web-related standards."*

Thus, Web services allow creating interoperable, reusable and scalable applications. These characteristics have become essential for applications used in business, but also for those that are involved in the e-learning platforms.

### B. SOAP

Simple Object Access Protocol (SOAP) is a protocol for exchanging data between applications. A SOAP message is structured according to the XML format, and is transported via HTTP. The use of HTTP enables that SOAP messages are not blocked by firewalls, and thus allow remote applications to communicate via the internet. Finally, the SOAP message is unidirectional, synchronous or asynchronous, and independent of platforms and programming languages [23].

### C. WSDL

Web Services Description Language (WSDL) is an XML formalism for describing web services. This description gives the features offered by a web service, its location, as well as the communication protocol and the message format to use to communicate with [23].

### D. UDDI

Universal Description, Discovery and Integration (UDDI) is a registry of web services. It is composed of white, yellow and green pages. The white pages contain information on the businesses that supply web services. The yellow pages are formed by the WSDL of web services. Finally, the green pages contain technical details on how to access web services [23].

### E. Orchestration vs. choreography

The web services meet needs, which are relatively simple compared to those that really exist in business. They are composed to provide more sophisticated features. A web service is called composite when it is formed with several other simple or composite web services. There are two methods for composition of web services: the choreography and the orchestration. With choreography, each web service knows its role, when to execute its operations, and the other web services which it must interact with. In the case of orchestration, a central web service, called orchestrator, coordinates all the interactions between web services. The advantage of orchestration compared to choreography is that it allows creating applications, whose development is easier to manage. Indeed, in a composition by orchestration, the impact of adding a new web service is located only at the orchestrator, while in a choreography, this addition must be followed by a review of all the web services. This is why we chose to create our authoring system by orchestrating a set of web services. We present this composition using BPEL, which is the most complete standard for describing business processes, and supported by most of development tools [24].

### VIII. SOA ARCHITECTURE FOR OUR AUTHORIZING TOOL

The first version of our authoring system is a rich client, developed with the eclipse framework GMF [25]. GMF [26] is a framework that enables the design of user-friendly and scalable graphical editors. We share our team's vision of an e-learning platform that supports the teacher designer during the design, the integration, and the monitoring of his digital courses. The proposed architecture for this platform is service oriented. Therefore, we convert our authoring system to a composite application "authoring service" formed with five web services: design service, model service, validation service, packaging service and rule service [fig. 1]. We will integrate this application in our team's platform.

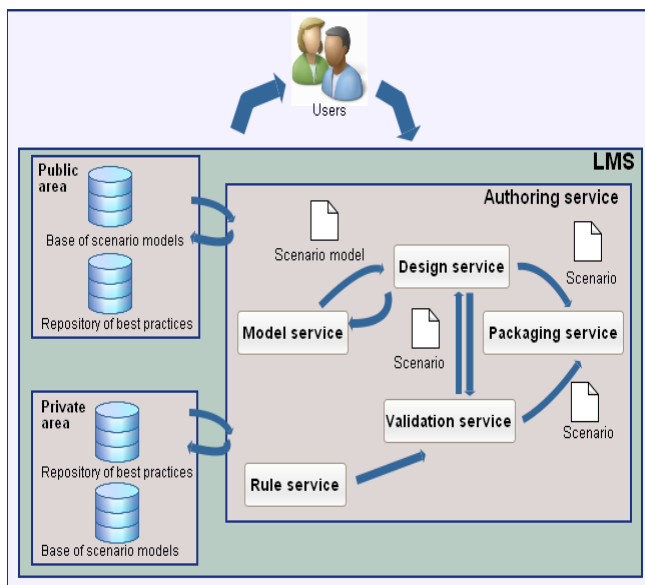


Fig.1. Architecture of our authoring service

We open our authoring system to the users: they can supply the bases of scenario models, and enrich the system with best practices in teaching, thanks to the rule service. We prefer to distinguish between the private area of each user, and the public area shared by all the users. Each user has his own base of models and his own repository of best practices in teaching. The user can create a scenario model that he may share or not with the other users. To make his model available for the other members, the user must publish it in the public base of models. Once the creation of a pedagogical scenario completed, the user can validate it according to his own repository of best practices in teaching. This repository is provided with the rules created by the user himself, through the rule service, or with rules imported from the public repository. This will allow the user to have a full control on the validation process, and to adapt it to his own vision of the pedagogical strategies supported by our tool.

Thus, our system will exist for and by the teacher, who will build a digital reputation that may increase the confidence of other members on his contributions in our system.

### IX. DESCRIPTION OF WEB SERVICES COMPOSING OUR SYSTEM

We prefer to use the graphical WSDL design view to present the WSDL document of the web services composing our system. The text view is less readable. Our authoring service is a composite application formed with five web services: design service, model service, validation service, rule service and finally packaging service [fig. 2].

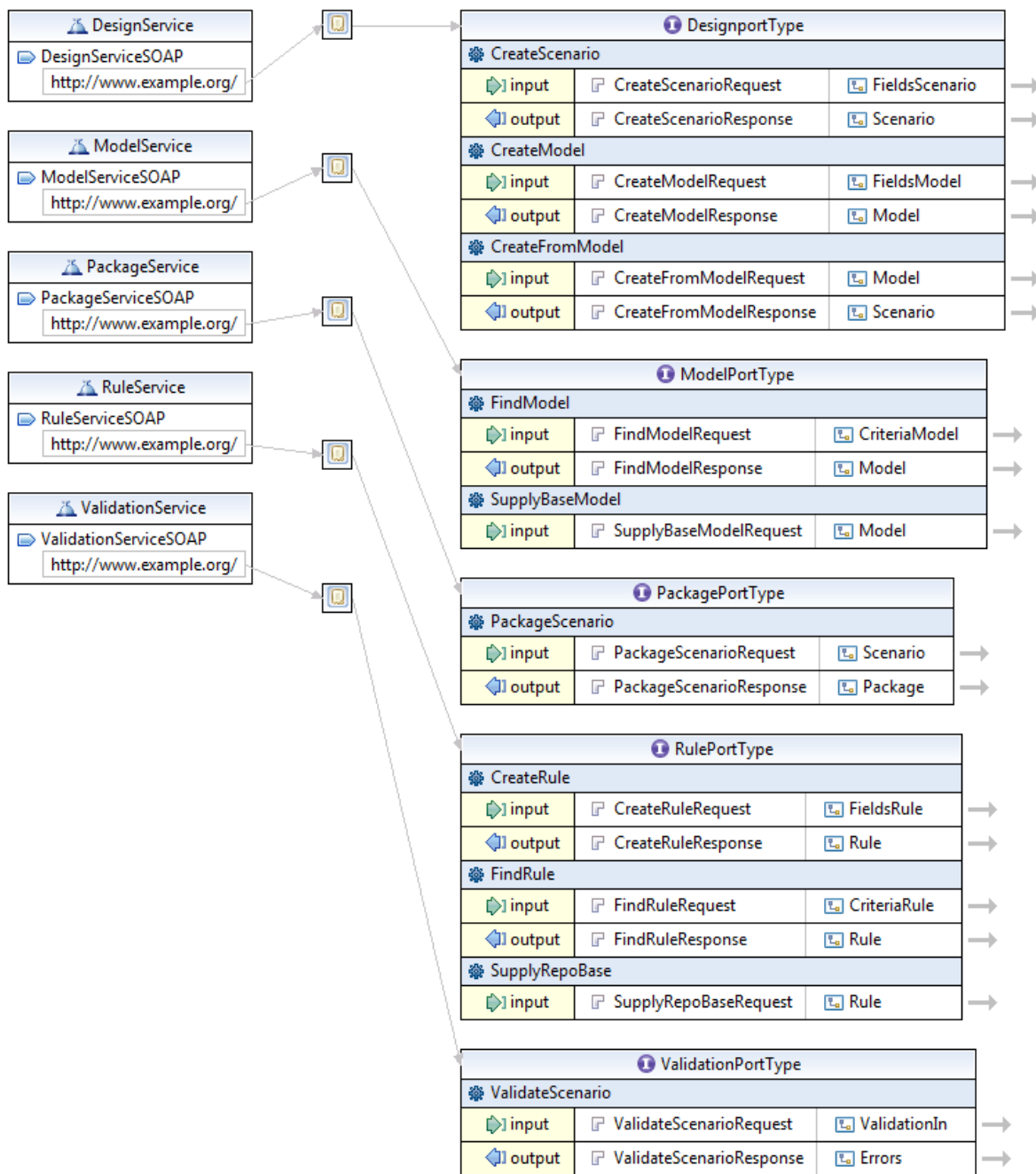


Fig.2. Description of web services composing our system

*A. Design service*

This is the main web service of our application. It enables to create pedagogical scenario models (CreateModel), and pedagogical scenarios from scratch (CreateScenario), or from a scenario model (CreateFromModel). Scenarios and scenario models created with our tool respect the meta-model presented in [27], and enable to describe the learning situation in terms of pedagogical strategy, activities, and supports.

*B. Model service*

It can be considered as the entry point to the model bases. This web service queries the model bases (public or private), according to the user's response to a questionnaire (CriteriaModel), to find the scenario model, which is the closest to the user's request. It also supplies the model bases with models created with the design service.

### C. Packaging service

This web service allows packaging the scenarios created with our system in a format playable by most of the LMS: IMS-CP.

### D. Rule service

This web service enables to create rules (CreateRule), supply the public and the private repositories of best practices in teaching (SupplyRepo) and finally find a rule that meets certain criteria (FindRule). The rules used by this web service concern the following components of a learning situation:

- The adopted pedagogical strategy.
- The learners' learning styles
- The referred skills
- The learners' educational level
- The size of learner group

### E. Validation service

It enables to validate a pedagogical scenario according to the private repository of best practices in teaching, and following the method presented in [25]. Inconsistencies between a scenario and the rules of this repository are displayed to the user. The object 'ValidationIn' is formed with the scenario to validate, and an extraction of the private repository.

We describe separately each of the five web services composing our application. In what follows, we will see an example of collaboration of all these web services in a complex process.

## X. AUTHORING PROCESS

In this process, we use all the features offered by the web services presented above. We start by creating a pedagogical scenario from a model. Then, we validate it according to a set of rules. Finally, we export the validated scenario in IMS-CP package [fig. 3].

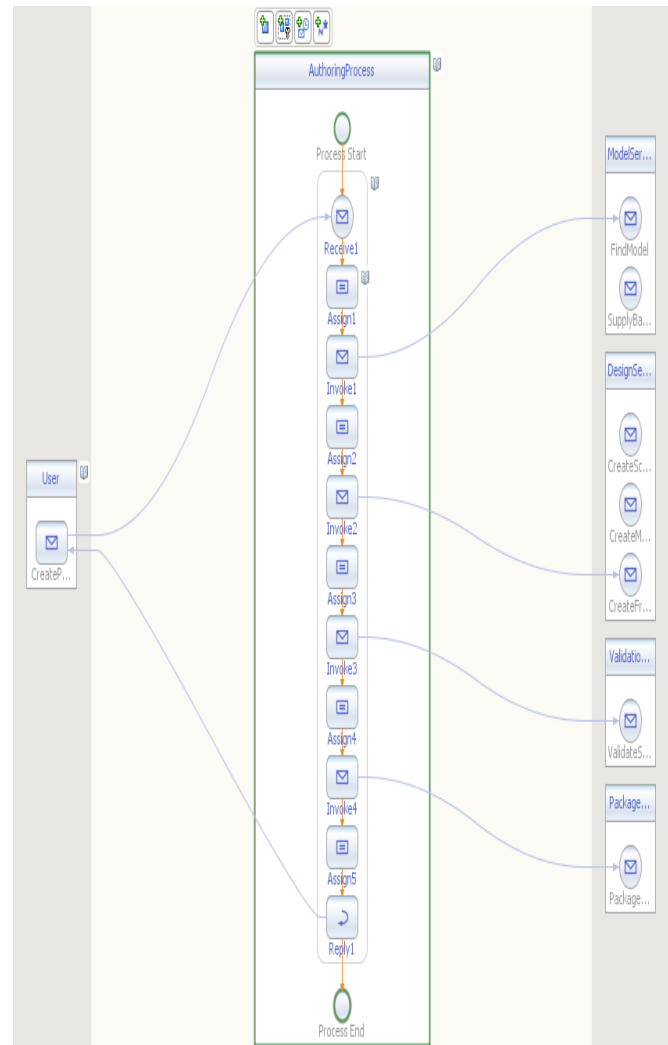


Fig.3. Authoring process

The process, represented in BPEL, begins by receiving the user's response to a questionnaire. Following this response, the model service, and more precisely the operation "FindModel", queries the model bases (public or private) to return to the user the model that best matches his request. This model is then instantiated with the operation "CreateFromModel" of the design service. It is now a pedagogical scenario that the user implements, then validates using the validation service. Finally, the user exports the validated scenario in IMS-CP package, thanks to the packaging service. This IMS-CP content can be integrated in most of the LMS.

## XI. DESIGN SERVICE

For the implementation of this web service, we choose to reuse the existing editor, developed with GMF eclipse framework [fig. 4]

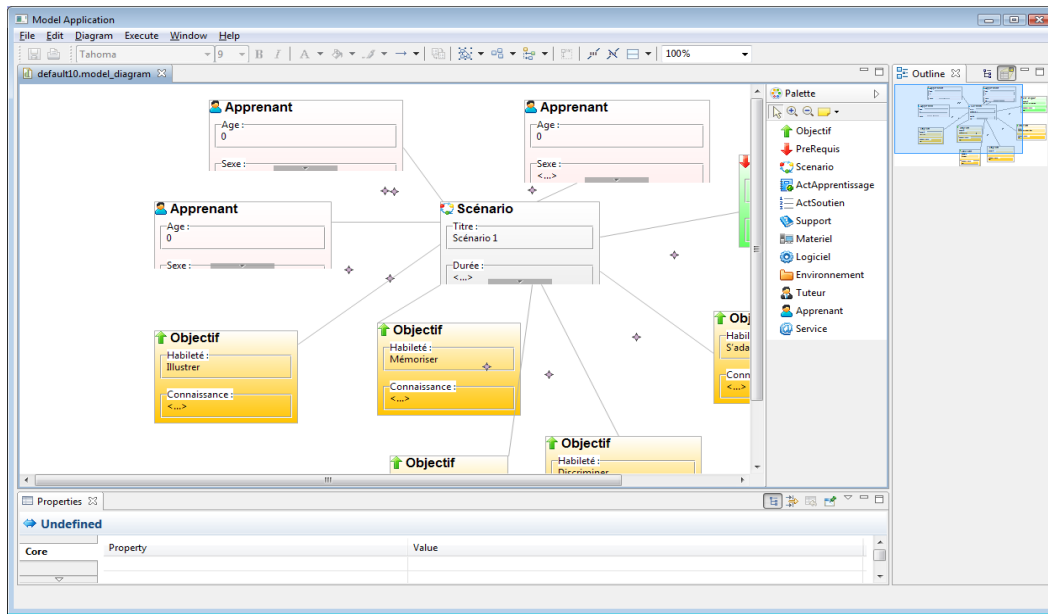


Fig.4. Rich client version of our authoring tool

In order to convert our editor to a web application, we use RAP [28]. RAP aims to enable software developers to build rich, Ajax-enabled Java applications that need both desktop-based and web-based front ends [29]. We obtain a web

application with few modifications in the source code of the existent rich client tool. In figure 5 [fig. 5] we test the creation of a pedagogical scenario with the web editor [fig. 5]:

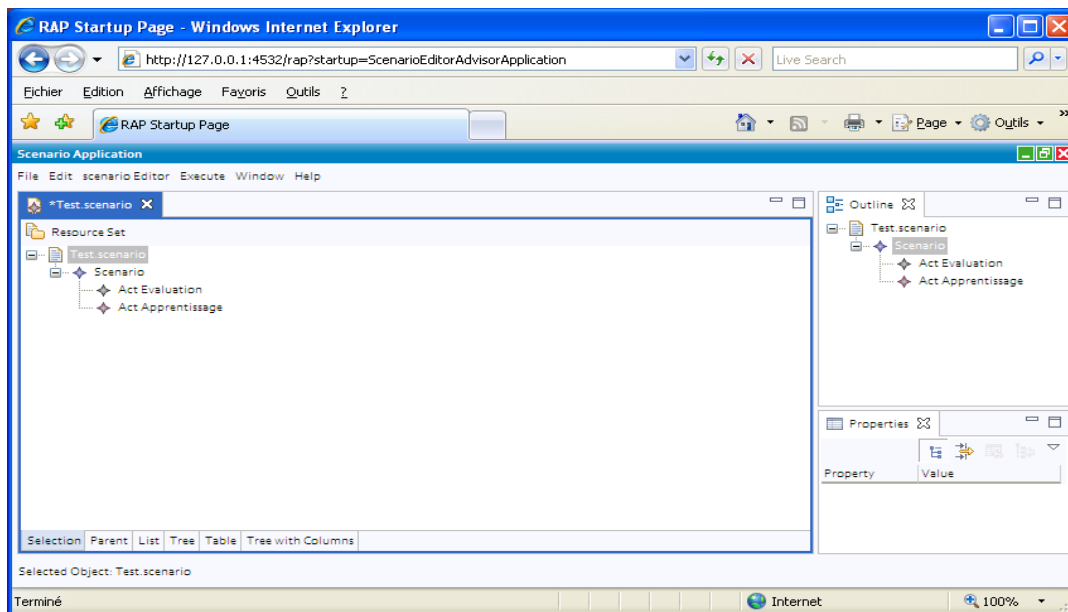


Fig.5. The web version of our authoring tool

The graphical interface of the web editor still needs some improvement, especially at the structure of the pedagogical scenario, which is a hierarchical tree. We present below the WSDL file of the design service [fig. 6]:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2012 rel. 2 sp1 (http://www.altova.com) by moi (moi) -->
<wsdl:definitions xmlns:soap=http://schemas.xmlsoap.org/wsdl/soap/
  xmlns:tns=http://www.example.org/NewWSDLFile/
  xmlns:wSDL="http://schemas.xmlsoap.org/wsdl/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema" name="NewWSDLFile"
  targetNamespace="http://www.example.org/NewWSDLFile/">
  <wsdl:types>
  <xsd:schema targetNamespace=http://new.webservice.namespace elementFormDefault="qualified">
    <xsd:element name="Model"/>
    <xsd:element name="FieldsScenario"/>
    <xsd:element name="FieldsModel"/>
    <xsd:element name="Scenario"/>
  </xsd:schema>
  </wsdl:types>
  <wsdl:portType name="DesignportType">
    <wsdl:operation name="CreateScenario" pattern="http://www.w3.org/ns/wsdl/in-out">
      <wsdl:input element="tns:FieldsScenario"/>
      <wsdl:output element="tns:Scenario"/>
    </wsdl:operation>
    <wsdl:operation name="CreateModel" pattern="http://www.w3.org/ns/wsdl/in-out">
      <wsdl:input element="tns:FieldsModel"/>
      <wsdl:output element="tns:Model"/>
    </wsdl:operation>
  </wsdl:portType>
  <wsdl:binding name="DesignBinding" portType="tns:DesignportType"
    type=http://www.w3.org/ns/wsdl/soap
    wsoap:protocol="http://www.w3.org/2003/05/soap/bindings/HTTP/">
    <wsdl:operation ref="tns:CreateScenario">
      <wsdl:input element="tns:FieldsScenario"/>
      <wsdl:output element="tns:Scenario"/>
    </wsdl:operation>
    <wsdl:operation ref="tns:CreateModel">
      <wsdl:input element="tns:FieldsModel"/>
      <wsdl:output element="tns:Model"/>
    </wsdl:operation>
  </wsdl:binding>
  <wsdl:service name="DesignService" portType="tns:DesignportType">
    <wsdl:endpoint name="DesignEndpoint" binding="tns:DesignBinding"
      address="http://localhost:8080/authoring"/>
  </wsdl:service>
</wsdl:definitions>
```

Fig.6. The WSDL file of the design service



The design service can be used separately by any other educational application, or within our authoring tool.

## XII. CONCLUSION

We adapt our authoring tool for the web in order to integrate it in our team's platform. The web version of our tool is a composite application based on five web services: design, model, validation, rule and packaging. We obtain the design service by converting our graphical editor, developed with GMF, to a web application, using RAP. For future work, we expect that a group of teachers, from different horizons, can test our system. But, we need first to improve our web editor. The objective is to have the same graphical interface and features in the both versions of our system: web and rich client. We have also to supply our system with more scenario models. We present in [30] a scenario model of the pedagogy of integration, adapted to the blended learning. We are working to model other pedagogical strategies.

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