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AI-based Web platform for supporting teaching by study and research paths

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Introduction.

Study and Research Paths (SRP) are an inquiry-based teaching format proposed by the Anthropological Theory of the Didactic (ATD) (Chevallard, 2015). During the implementation of a SRP (Chevallard, 2019) in the classroom there are changes at the level of the three didactic functions: topogenesis, chronogenesis, and mesogenesis. Especially at the chronogenesis level, more time is required for teachers' work, both in classroom and extracurricular work, i.e., the time it takes for the teacher to analyze all the information produced in class in the short time available between one class session and the next, including the questions that derive from the generating question and the students' productions. For this analysis, which is usually conducted manually or without a defined digital medium, the teacher has to collect all the information generated on paper or in documents scattered across various media.

This work describes a Web platform developed to support the entire process of implementing SRPs in the classroom, covering all the activities that are performed by both teachers and students. This platform integrates an Artificial Intelligence (AI) component that provides assistance to teachers in analyzing the derived questions that arise during each class. Within the platform teachers can create a SRP as well as its individual classes. The platform offers a way for students to easily and collaboratively record class activities (questions that arose, results, resources for reference, such as books, websites, research articles, and others). This, in turn, enables the construction of AI-generated reports of class progress once the class concludes. That is, once the groups submit their class work, the teacher receives a report both on the platform and by email, providing an overview of the topics covered in the class for subsequent class planning based on the previous class. A key benefit of using the platform during the implementation of a SRP is the possibility of capturing and recording all the knowledge produced during the teaching-learning process, which is invaluable information for subsequent research.

Web platform functionality

The proposed platform is available at: <https://reis.apps.isistan.unicen.edu.ar/>, and it can be accessed using any device (computer, tablet or cellphone) with internet connection. As mentioned before, the platform is designed to manage the entire process of implementing a SRP in the classroom, including the activities carried out by both teachers and students. For this reason, the two main roles

identified within the system are teachers and students, each with specific responsibilities and allowed actions.

The most important functionality of the Web platform presented as well as the AI supported is described below according to the user roles involved in the process (teachers and students).

Teacher's view

Once registered in the system, teachers can create and manage SRPs and their associated classes. To do so, the system allows them to create, edit, and delete SRPs and classes within them. Figure 1 shows the user interface through which teachers create a new SRP and enter the SRP descriptors (SRP title, generating question, and a short description). For each SRP, teachers must create the associated classes, as shown on the right in Figure 1.

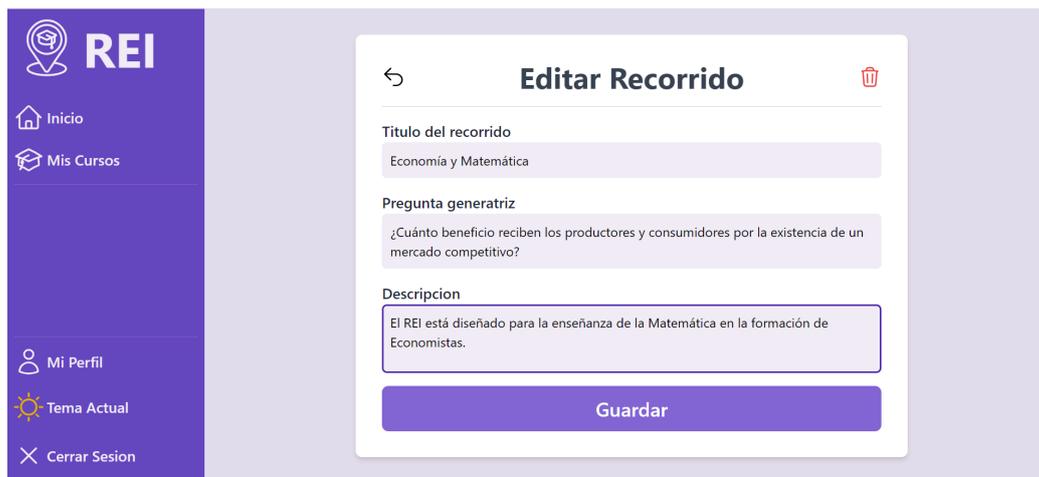


Figure 1: SRP creation and class creation within a SRP

Each class has a title, a description, a start date and time, and optionally an end date and time, as shown in Figure 2. When a class is created, the system assigns a unique class code, which students use to register into the class and begin uploading information about their work. One student per group is required to log into the platform and upload everything they have worked on during the class.



Figure 2: Creation of classes within a SRP

The teacher can access the information associated with each class, view the different groups, and analyze how each group is doing. Figure 3, for example, shows the questions each group uploads to the system, associated with one of the SRP classes.

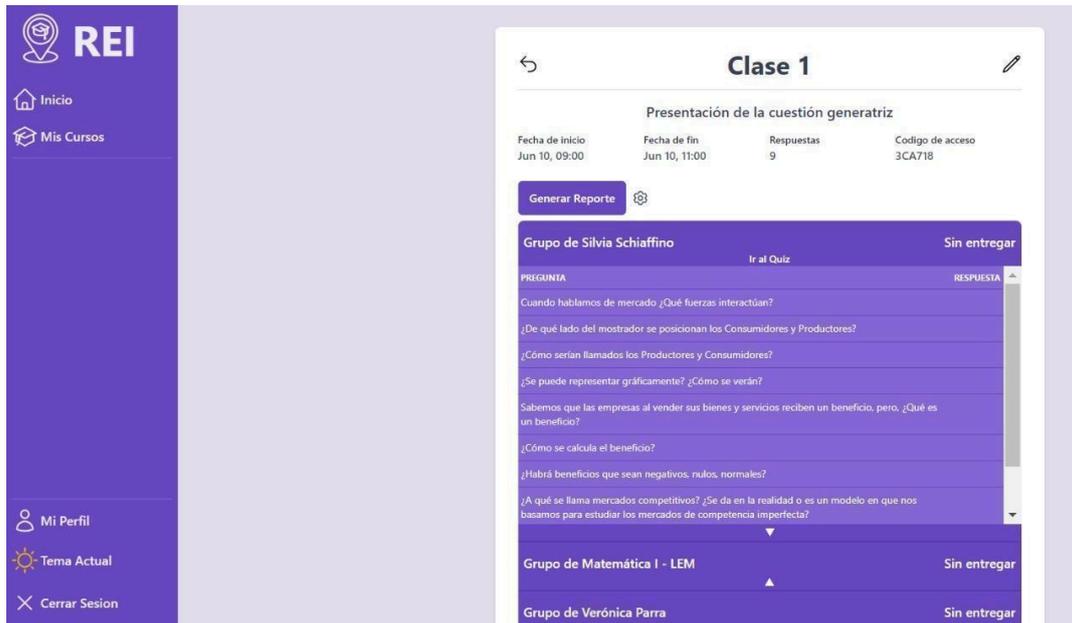


Figure 3: Viewing a group's work in a class.

After each class, the teacher can request a report from the system, which is generated using AI. This report enables teachers to analyze questions that have come up in class, categorized by themes or topics. A report generated by the system for a SRP is shown in Figure 4. Each topic is displayed in a different color, and the questions associated with each topic are listed. In this case, the system was able to identify three main topics, organized according to economic notions: supply and demand (Topic 1), market (Topic 2), and consumers and producers (Topic 3). Furthermore, for each topic, the system reports the number of times the questions are repeated across different groups.

In the AI-generated report, questions are organized into groups or categories using a combination of Natural Language Processing (NLP) and Machine Learning (ML) techniques (Parra et al., 2025). Specifically, we used *SentenceTransformers*¹ (a.k.a. Sentence-BERT or SBERT) (Reimers & Gurevych, 2019), a deep learning architecture for assessing the semantic similarity of a pair of phrases or sentences. A clustering algorithm groups questions into cohesive and well-separated clusters based on their semantic similarity. In this work, a classic algorithm such as *k*-Means was used for clustering and its results were evaluated with external clustering validation metrics (Jain & Dube, 1988) taking as reference the classifications made by a group of teachers for a set of questions. For example, questions such as “what is a model?”, “how can it be represented?”, “how does the state intervene?”, “what laws govern the model?”, among others, are grouped in the same category of “supply and demand” since they all refer to supply and demand models.

Based on the information provided by the system in the report, the teacher together with the students, decides which topic to continue in the next class (Figure 5). Once students register for the new class, the teacher can see both the questions that arise and the answers that students provide to the questions proposed by the teacher for that class. Then, the teacher can request a new report from the platform, in order to continue with the rest of the process in the manner described above. The cycle continues in the same way until ending the SRP implementation.

¹ <https://sbnet.net/>

Tema	Votos	Pregunta
1	1	¿Se puede representar gráficamente? ¿Cómo se verán?
1	1	¿De qué manera interviene el Estado?
1	1	¿Qué es un modelo?
1	1	¿Cuáles son los elementos básicos de la oferta y la demanda?
2	1	¿Qué es la oferta?
2	1	¿Qué es la demanda?
1	1	¿Cómo se caracteriza?
1	1	¿Cuáles son sus características?
2	1	¿Qué es la ley de oferta y la ley de demanda?
1	1	¿Cómo se mide?
1	1	¿Cuáles son sus determinantes?
1	1	¿A qué nos referimos con cantidad demandada?
1	1	¿Cuál es la ley de demanda?
1	1	¿Qué gráfica la curva de Demanda?
2	2	¿Cuáles son sus desplazamientos?
1	1	¿A qué nos referimos con Cantidad ofrecida?
1	1	¿Qué gráfica la curva de Oferta?
1	1	¿Qué entendemos por beneficio?
1	1	¿Qué entendemos por "Consumidor"?
1	1	¿Qué tipos de mercado existen?
5	1	¿En qué consiste el mercado competitivo?
1	2	¿Cuándo hablamos de mercado? ¿Qué fuerzas interactúan?
2	1	¿Cuándo un mercado deja de ser competitivo?
1	1	¿Cuáles son los supuestos de la competencia perfecta?
1	1	¿A qué se llama mercados competitivos? ¿Se da en la realidad o es un modelo en que nos basamos para estudiar los mercados de competencia imperfecta?
3	1	¿Cuándo se dice que un mercado competitivo se encuentra en equilibrio?
3	1	¿Qué es el Mercado?
2	1	¿Cuándo un mercado es competitivo? Cuando no ¿qué nos lleva a saber?
1	1	¿Cómo influye el mercado en la economía?
1	1	¿Cómo se analiza la influencia que aportan en el mercado competitivo?
1	1	¿Existe un mercado perfectamente competitivo?
1	1	¿Cómo se clasifican los mercados competitivos?
1	1	¿De qué lado del mostrador se posicionan los Consumidores y Productores?
1	1	¿Qué es un productor?
1	1	¿Y un consumidor?
1	1	¿Cómo serían llamados los Productores y Consumidores?
2	1	¿Cómo se relacionan los productores y consumidores dentro de un mercado?
1	1	Sabemos que las empresas al vender sus bienes y servicios reciben un beneficio, pero, ¿Qué es un beneficio?
1	1	¿Cómo se calcula el beneficio?
1	1	¿Habrá beneficios que sean negativos, nulos, normales?
1	1	¿Quiénes son los productores?
1	1	¿Quiénes son los consumidores?
1	1	¿Cómo controlan los vendedores el grado del precio?
1	1	¿Cómo hallamos el excedente del consumidor y del productor?
3	1	¿Qué papel cumplen los productores en el mercado competitivo?
2	1	¿Qué papel cumplen los consumidores en un mercado competitivo?
1	1	¿Cómo se calcula el beneficio obtenido por los productores?
1	1	¿Cómo se calcula el beneficio obtenido por los consumidores?
1	1	¿En qué nivel de producción se maximizan los beneficios en un mercado competitivo?
1	1	¿Cómo se comportan los Consumidores y los Productores?
1	1	¿Cómo se aumenta el beneficio en una empresa?
1	1	¿Qué beneficio obtiene el consumidor en contraste a un mercado no competitivo?
1	1	¿Cómo se maximiza el beneficio de una empresa?
1	1	¿Qué variables hay que tener en cuenta para el estudio de la maximización del beneficio en una empresa?
1	1	¿A quién denominamos productor?

Figure 4: Report generated by the AI approach

REI

Inicio

Mis Cursos

Mi Perfil

Tema Actual

Cerrar Sesión

Clase 2

Se realiza la puesta en común a partir del agrupamiento de preguntas y se decide empezar a responder sobre oferta y demanda. La actividad de esta clase consiste en responder, por grupos, las siguientes preguntas (más votadas del Tema 1 del reporte): 1. ¿Qué es la oferta? ¿Qué es la demanda? 2. ¿Qué es la ley de oferta y la ley de demanda? 3. ¿Cuáles son los desplazamientos de las curvas de oferta y demanda?

Fecha de inicio	Fecha de fin	Respuestas	Código de acceso
Jun 9, 21:00	Finalizar	3	JK1740

[Generar Reporte](#)

Grupo de Silvia Schiaffino Sin entregar

Grupo de Verónica Parra Sin entregar

Ir al Quiz

PREGUNTA	RESPUESTA
¿Qué es la oferta? ¿Qué es la demanda?	La función de demanda Es una ecuación que explica cómo se determina la cantidad demandada de un bien. Esto, en relación a los precios del mercado y a la renta del consumidor. Cuando el precio (P1) es \$100, la cantidad vendida (Q1) es 100 unidades. Por ejemplo: Cuando el precio (P2) es \$50, la cantidad vendida (Q2) es 200 unidades. La función de oferta Es la ecuación que representa la cantidad fabricada de un bien en función de su precio y/o otras variables relevantes. En la función de oferta se pueden incluir factores como la tecnología, los precios de los insumos, el estado de la economía (recesión o expansión), entre otros.
¿Qué es la ley de oferta y la ley de demanda?	La ley de oferta y demanda es un concepto fundamental en economía que explica cómo se determinan los precios de los bienes y servicios en un mercado competitivo. Esta ley establece que a mayor oferta y menor demanda, los precios tienden a disminuir; y a menor oferta y mayor demanda, los precios tienden a aumentar.

Los desplazamientos de la curva de demanda pueden deberse a: El aumento de la

Figure 5: Creation of a new class based on the report and students' responses

Students' view

Students interact with the platform by participating in a SRP created by teachers, joining the classes through the code associated with each class that must be provided to them. To work in a class, students organize themselves into groups. Each group submits the questions that arise regarding the topic introduced by the generating question to the platform. A single question might lead to further questions or more specific sub-questions, which can then be added in relation to the initial inquiry (Figure 6).

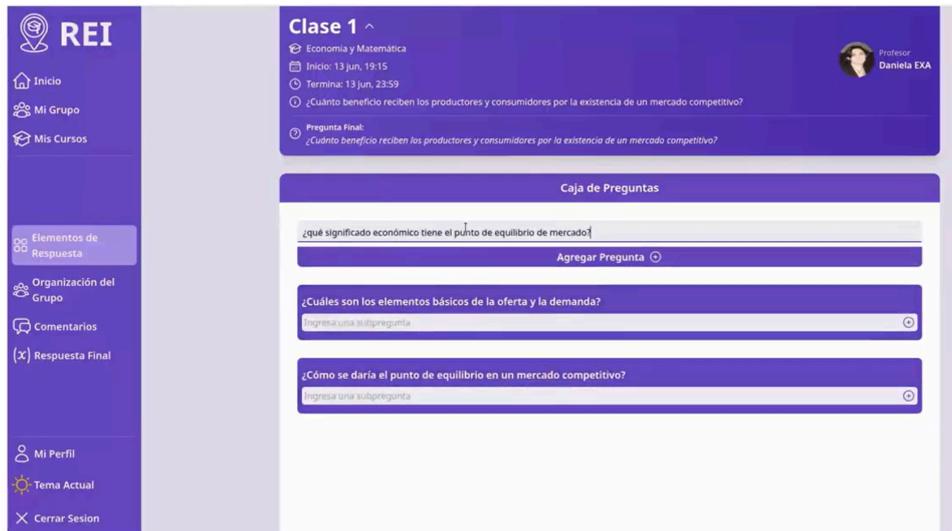


Figure 6: Loading questions and subquestions

As questions are progressively added, groups can access each of them to start working on their answers. For each question or subquestion, students can indicate whether they were able to answer it or not. Also, they can indicate and upload the sources they consulted to construct their answers. In turn, students can upload comments as they go through the class. Once the information sources and comments have been uploaded, the groups must indicate how they constructed their response based on the group's organization. At this stage, the platform offers three options: jointly, question distribution, or other.

Next, students must indicate whether they were able to answer the question that was originally posed or not (Figura 7). If the group answered positively, they can upload the work either in the text box provided for that goal or by attaching some additional documents. Finally, each group must indicate whether or not they successfully answered the SRP generating question. In such cases, similar to the derived questions, they must indicate their answer and/or attach a file.

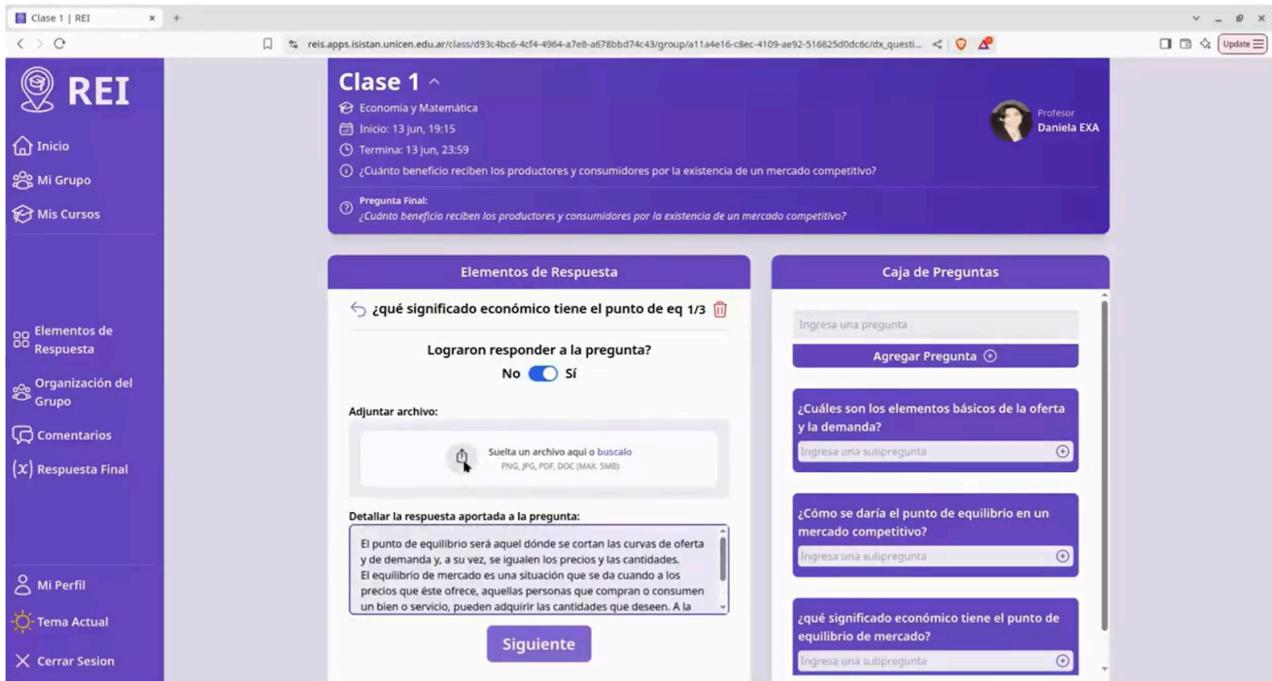


Figure 7: Response to a derived question.

Concluding remarks

This paper describes a web platform developed to support the entire process of implementing SRPs in the classroom, covering all the activities that are performed by both teachers and students. The use of this web platform enables the teacher to obtain, after each session, an AI-generated summary of each group's work, saving time for organizing and making decisions about how to continue with the SRP in the following session. One of the significant benefits of the platform is classifying questions derived from the generating question. However, the platform also reduces the time consumed in simple tasks, for example, recording student work (in paper or other media), collecting all the data, even digitizing them, and analyzing the events of each session.

It is important to highlight that the platform presented in this work is not an adaptation of a general-purpose platform to support teaching (like Classroom or Moodle), but a platform specifically designed considering the associated theory, characteristics, and dynamics of the SRP implementation process in classrooms. It has been developed in a way that can be easily extended to consider future requirements of the ATD community.

The generated report is based on a combination of advanced NLP techniques, primarily the use of language models to find semantic similarities between questions, and unsupervised clustering algorithms for their subsequent grouping. The clusters found may not entirely match the organization of questions a teacher would do (as in the mentioned example), as the latter is often guided by diverse criteria. However, it provides an initial solution that can greatly alleviate the teacher's work at this stage of the SRP. As a future work we plan to extend the use of AI for the analysis and visualization of the entire research path, mapping its evolution across different classes.

Acknowledgment

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