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Prestación del servicio de producción de tecnología educativa con base en las buenas prácticas de la librería ITIL

Provision of Educational Technology Production Service Based on Good Practices of the ITIL Library

Fornecimento de serviço de produção de tecnologia educacional baseado em boas práticas da biblioteca ITIL

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Resumen

La Biblioteca de Infraestructura de Tecnología de la Información (ITIL, por sus siglas en inglés) está orientada a la gestión de servicios de tecnologías de la información (TI). Una de sus bases es la estandarización en la definición de procesos orientados a la calidad del servicio y se adapta a las necesidades de gestión de áreas que utilicen TI. Como marco de buenas prácticas, la ITIL permite definir un modelo de gestión de un determinado laboratorio en informática educativa con la misión de gestionar la producción de servicios de tecnología educativa de calidad.

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Como parte del propósito de esta investigación se creó un modelo de gestión y producción de servicios de tecnología educativa. Asimismo, una vez creado el modelo de gestión, se desarrolló una aplicación educativa interactiva sobre temas de razonamiento lógico y comprensión lectora. La aplicación fue utilizada por cincuenta niños de primer año de la Escuela Primaria República Dominicana, en Ciudad de México.

El modelo de gestión permitió llevar a cabo el servicio de producción bajo una buena práctica, que va desde la entrevista, la elaboración del acuerdo de servicio, la producción de la aplicación, las pruebas y la transferencia o entrega hasta la evaluación del servicio. Los resultados obtenidos a través del instrumento de evaluación del estudio de caso determinaron que la aplicación permitió mejorar el rendimiento de los niños en los temas de operaciones básicas y comprensión lectora en 95.6 % y 88.9 %, respectivamente. Por otro lado, los maestros y los padres consideraron que la gestión y la atención que se llevó a cabo para desarrollar e implementar la aplicación fue buena, por lo que solicitaron que se realizaran otros desarrollos para cubrir las necesidades de aprendizaje para los grados de segundo y tercer año. La evaluación del modelo de gestión para la producción de tecnología educativa se validó satisfactoriamente. En consecuencia, se considera que el modelo de gestión puede ser utilizado por cualquier comunidad educativa que desee llevar a cabo buenas prácticas con respecto a los servicios de tecnología educativa, específicamente en la producción de aplicaciones o recursos de didácticos digitales.

Palabras clave: buenas prácticas, gestión, librería ITIL, producción de aplicaciones educativas, tecnología educativa.

Abstract

The Information Technology Infrastructure Library (ITIL) is oriented to the management of Information Technology (IT) services. One of its bases is the standardization in the definition of processes oriented to the quality of service and adapts to the management needs of areas that use IT. As a framework of ITIL good practices, it allows to define the laboratory management model in educational informatics with the mission of managing the production of quality educational technology services.

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As part of the purpose of this research, a model of management and production of educational technology services was created. Also, once the management model was created, an interactive educational application on topics of logical reasoning and reading comprehension was developed. The application was used by fifty-first-year primary school children from the Dominican Republic school in Mexico City.

The management model made it possible to carry out the production service under good practice, ranging from the interview, the elaboration of the service agreement, the production of the application, the tests and the transfer or delivery until the evaluation of the service. The results obtained through the instrument of evaluation of the case study determined that the application allowed to improve the performance of children in the topics of basic operations and reading comprehension by 95.6% and 88.9%. On the other hand, the teachers and parents considered that the management and the attention that was carried out to develop and implement the application was good, so they requested that other developments be made to cover the learning needs for the second and third grades. Evaluating the management model for the production of educational technology has been successfully validated, so it is considered that the management model can be used by any educational community that wishes to carry out good practices with respect to educational technology services, specifically in the production of applications or digital teaching resources.

Keywords: good practices, management, ITIL library, educational applications production, educational technology.

Resumo

Infra-estrutura é orientada Biblioteca Tecnologia da Informação (ITIL, na sigla em Inglês) de gerenciamento de serviços de TI (TI). Uma de suas bases é a padronização na definição de processos de serviços orientados para a qualidade e se adapta às necessidades das áreas de gestão de usá-lo. Como um quadro de melhores práticas, ITIL para definir um modelo de um laboratório de informática educacional particular a gestão com a missão de gerenciar a produção de qualidade educacional serviços de tecnologia.

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Como parte do objetivo desta pesquisa um modelo de gestão e produção de serviços de tecnologia educacional foi criado. Além disso, uma vez que criou o modelo de gestão, um aplicativo educacional interativo sobre temas de raciocínio lógico e compreensão de leitura desenvolvido. O aplicativo foi usado por cinquenta crianças no primeiro ano da Escola Primária República Dominicana na Cidade do México.

O modelo de gestão autorizados a realizar o serviço de produção sob boas práticas, que vão desde a entrevista, o desenvolvimento do contrato de serviço, a produção do aplicativo, testes e transferência ou de entrega ao serviço de avaliação. Os resultados obtidos através do estudo de caso instrumento de avaliação determinou que o aplicativo melhorou o desempenho das crianças nas áreas de operações de compreensão de leitura básicos e 95,6% e 88,9%, respectivamente. Por outro lado, os professores e os pais sentiram que a gestão e os cuidados que teve lugar para desenvolver e implementar o aplicativo era bom, então eles pediram que novos desenvolvimentos serão feitos para atender às necessidades de aprendizado para as classes dois e no terceiro ano. modelo de gestão de avaliação para a produção de tecnologia educacional validado com sucesso. Consequentemente, considera-se que o modelo de gestão pode ser usado por qualquer comunidade educativa que deseja realizar as melhores práticas em matéria de serviços de tecnologia educacional, especificamente na produção de aplicativos ou recursos pedagógicos digitais.

Palavras-chave: melhores práticas, gestão de biblioteca ITIL, a produção de aplicações educacionais, tecnologia educacional.

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Introduction

The area in charge of managing information and communication technologies (ICT) in educational institutions is usually recognized for providing infrastructure services and systems development that support the administrative and strategic processes of the institution; all of which brings about an improvement in the operation. The growing demand for the use of ICT in academic and learning processes has generated the need to improve the management of the area of information technology (IT) in the aforementioned educational facilities. The foregoing has in turn forced the managers to implement best practices to provide a good quality service. And for this they have adopted ICT frameworks such as the Information Technology Infrastructure Library V5 (ITIL, for its acronym in English), which is oriented to the provision of IT services, and the guide Targets of Control for Information and Related Technologies V5 (COBIT, for its acronym in English), whose function is the evaluation of the management of IT services.

According to the survey carried out by Axios (2008), a company dedicated to the management of IT services, 64% of IT professionals have implemented or are successfully implementing ITIL in small, medium and large companies nationally and internationally. - An example of these companies where ITIL has been put into practice is Bancomer, leading financial institution in Latin America and Europe (BBVA Continental, 2017). Undoubtedly, the adoption of frameworks and their impact to improve the quality of the IT service in the business world has influenced the educational sector with great force, as can be seen in the following studies.

Firstly, Ayala (2016) identifies that the ITIL is a model of good practices that provides the confidence to work in a way oriented to the quality of the service. Tangible proof of the above is Zambrano (2014), director of the Autonomous University of Nuevo Leon (UANL), who achieved international certification of this institution with the help of ITIL. It is worth saying that thanks to this fact it was possible to add value to the UANL. Torres, Arboleda and Lucumí (2015), meanwhile, are a case of the implementation of ITIL in Colombian higher education institutions. Regarding strategic plans, the work of Duque and Eastman (2015), who developed the Strategic ICT Plan in the University Foundation of the Andean Area 2011-2015, aimed at the continuous improvement of their academic-administrative

processes. Finally, Gonçalves and López (2015), at the Federal University of Santa Catarina, conducted a study of good practices, and concluded that ITIL better covered their academic, computer and administrative requirements.

ITIL has also been implemented to provide very specific IT services. In the Autonomous University of Mexico (UNAM), for example, this set of concepts was adopted for the management of the network service. In this regard, Hernández (2014) considers that the implementation of the ITIL allows a greater control of the infrastructure and services, which generates a change when providing the latter.

The previous studies attest to how ITIL is a framework that can be adapted to the IT management needs of an educational organization. However, it is very important to note that the analysis of these studies also showed that ITIL has not been used properly for the management of educational technology services.

However, at the National Polytechnic Institute [IPN] (2018), the Computing and Communications Department is in charge of providing IT services to the academic units. Each of these has a computer unit that manages IT services to meet the operational needs of the institution. It is important to mention that it does not attend requests for educational technology. For the attention of educational technology in the academic units, there is the Educational Technology Unit and the Virtual Campus, which has as one of its functions to provide educational services with the support of ICT. Unfortunately, it does not do so with a framework for the production of educational technology that provides coverage and supports educational processes (Interdisciplinary Professional Unit of Engineering and Social and Administrative Sciences [UPIICSA], 2018). So for five years we have worked on educational research projects and technology, as well as the framework of good practices of ITIL to adopt it in the management of educational technology services.

The most recent of these efforts was the research project "Best practices for the management of educational technology services", whose main objective was to define the management framework of the latest generation of educational technology services, based on good practices in ITIL for the Mexican Thematic Network for the Development and Incorporation of Educational Technology [LaTE Mexico Network] (Gómez, 2018)

For all the aforementioned, the premise of this work was established: Management under good practices allows those responsible for the educational technology areas of academic institutions to improve the attention or provision of their services. Likewise, to verify the validity of this, the general objective of the research was established: Design and implement the management model in educational technology of the Research Laboratory in Educational Information Technology of the UPIICSA of the IPN. The particular objective, on the other hand, was established to design the management of the production of digital didactic resources and to take those management models to a case study that allows to evaluate the model.

The case study that was carried out had the purpose of showing the management of the proposed model, in addition to attending the request of the Dominican Republic Primary School, located in Mexico City. The requested service was the production of interactive educational applications with the aim of facilitating the logical reasoning and reading comprehension of children of the first year of primary school. The provision of the service was evaluated through the results of the evaluation instrument, which included aspects of management and operation of the service, as well as the quality and relevance of the application.

Methodology

For the development of the proposal of the educational technology management model, the framework of good practices of the ITIL was taken as a basis (Ríos, 2017). ITIL was developed by Johnson (2016) to cover the need of the UK Government in the late 1980s to standardize good IT practices. This set of concepts and good practices allows its adaptation based on the IT needs of the organization or institution. It is a library for free use and is currently in version three. The framework is oriented to the management of IT services covering all their needs in a holistic way. It should be noted that ITIL is grouped into five stages: strategy, design, operation, transition and continuous improvement.

The five stages of the ITIL framework for good practices

The service strategy

It is based on the Mintzberg proposal (2012) of the four pe: 1) the employer guides the development of policies that give the guideline of the functions of the area; 2) the planning gives certainty to the development of the activities; 3) the position allows defining the services and to whom they can be provided, and 4) the perspective supports the definition of the commitments that can be assumed according to the capacities.

The design of the service

It allows to classify the services through a catalog, defining the processes that will guide the provision of each of them. It includes the allocation of responsibilities, monitoring and support that gives continuity to the service.

The operation of the service

Based on the processes defined in the design of the service, the service request is attended, that is, each of the functions specified in the process is performed.

Service transition

The final activity of the service operation process is linked to the transition of the service, which refers to the delivery of the service, which implies the management for the installation, the tests and the release of the productions.

Continuous improvement

It begins with the application of instruments for evaluating the service provided. With the results, the quality of the service is measured and, where appropriate, the improvement plan is drawn up.

Case study

The case study was carried out in the Research Laboratory in Educational Technology of UPIICSA of the IPN.

As a first step, to identify the level of adoption of frameworks in the laboratory, interviews were conducted with the person in charge of the laboratory and with the developers of the applications or digital teaching resources. The analysis of the information obtained from the interview made it possible to identify that attempts have been made to produce resources or digital teaching applications in an orderly manner, using the hybrid methodology developed by the head of the laboratory. However, this has not worked. The use of the methodology allows the development of digital didactic resources, but not the management to achieve the adoption and transfer of production. It was concluded that the area does not have a framework of good practices that allows achieving the delivery of applications that generate value to the student sector. In addition, the documentation that supports the finished product is not generated and even the resources that are produced are not used.

Therefore, the management framework for the production of digital teaching resources based on ITIL was defined.

Next, the management proposal of the laboratory is shown based on the theoretical framework already specified.

Management of the Research Laboratory in Educational Technology based on ITIL

Figure 1 shows the management proposal of the laboratory, which considers that the service strategy is applied, carrying out the definition of the policies and strategies that will guide the provision of the application production service. In the design, the catalog of services and the processes that define the way to perform each of them must be defined. The operation of the service is conformed by the request of the service, the interview with the user or client, the diagnostic evaluation of the capacities to meet the request and finally the production management cycle is carried out. In the transition phase of the service, the final product delivery is carried out and the evaluation is carried out through continuous improvement

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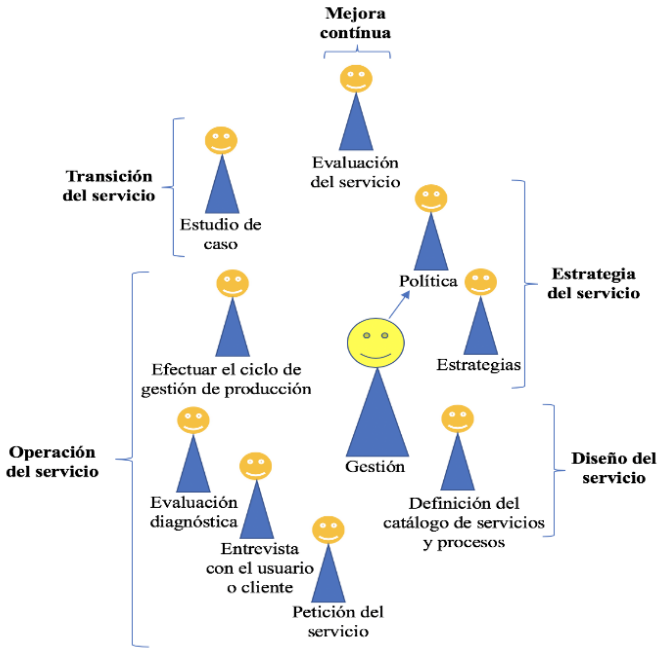
Figura 1. Proceso de gestión



Fuente: Elaboración propia

Definition of the service strategy in the case study

Politics

Attend the services of production of applications and digital didactic resources under the good practices oriented to the service that generates value.

Strategies

- Conform the work team, considering hiring and social service providers in the area of computer science and graphic design, as well as in the area of pedagogy and didactics.
- Document the processes of production, operation, transition and continuous improvement.
- Follow the defined processes through their visualization in posters in the laboratory.
- Carry out the service transition based on the service agreement.

- Carry out the evaluation of the service and continuous improvement considering the results of the service evaluation instruments.
- Follow up on the activities of the process using online project control tools.
- Definition of the catalog of applications services and digital teaching resources, which can be seen in table 1. In this, column one contains the service key; column two, the name of the service; the level that can be provided is indicated in column three, and finally column four indicates the client to whom the service can be given.

Tabla 1. Catálogo de servicios para la producción de aplicaciones de tecnología educativa

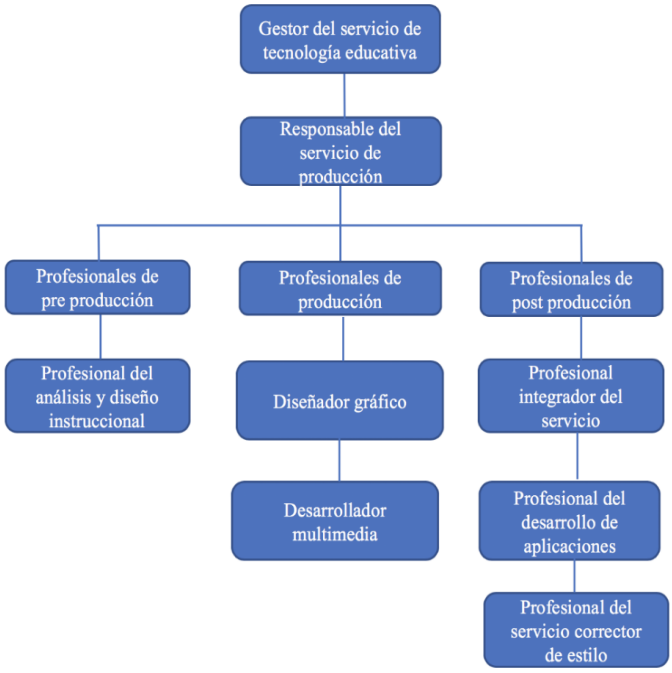
Catálogo de servicios de producción de recursos educativos			
Clave	**Servicio**	**Nivel**	**Cliente**
REI_PC **REI_DM** **REI_2D** **REI_3D** **REI_RV** **REI_RA**	Interactivos para PC y móviles (touch) Videojuegos 2D, 3D, Realidad Virtual y Realidad Aumentada	Nivel I Básicos Nivel II Intermedios Nivel III Avanzados	Educación básica, media, Media superior, Superior y Posgrado

Fuente: Elaboración propia

Laboratory flowchart

In figure 2, meanwhile, you can see how the laboratory government was made up: by the service manager, the production service manager and the service professionals, which make up the groups for the preproduction, production and postproduction In the preproduction is the analyst and instructional designer; in the production, graphic design professionals and multimedia developers, and finally in the preproduction are located the developer, the integrator and the style corrector.

Figura 2. Organigrama del Laboratorio de Investigación en Tecnología Educativa



Fuente: Elaboración propia

The framework of good practices recommends as part of the design of the service the definition of functions of each of the members of the team, so these are explained below and the responsibilities of each member.

Functions of the work team

The service manager

He is in charge of defining policies and strategies, as well as managing resources for the provision of educational technology production services. In coordination with the person in charge of the production service, they design the processes for the operation, transition and continuous improvement of the service.

The person in charge of the production service

It supervises the execution of the processes and defines the catalog of production services. It is the main contact with the client or user, so it is responsible for addressing the requests, which are managed by assigning a ticket that establishes the order of service. With the user determines the requirements identifying the type of application to produce, with this the requirements format is required and the service provision agreement is drawn up. This documentation is channeled to the professional of the preproduction service and in coordination they carry out the analysis and establish development options, as well as assign the activities to each of the professionals, who must perform them according to the defined and documented process. At the conclusion of the service, it elaborates the office of term and satisfaction of the service.

Another no less important function is to supervise or monitor that each function is carried out according to the process and to mark the guidelines in critical and emergency situations; guidelines that guarantee continuity in the activities for the delivery of the service in a timely manner.

The team of service professionals

It is composed of the analyst / instructional designer, style editor, graphic designer, multimedia resource developer and the developer of the applications. Each of them performs the function corresponding to their profile. Their activities are interrelated and must maintain constant communication since the processes are precisely related.

Analyst / instructional designer

With the requirements and in contact with the user, he elaborates the instructional script, which gives an initial model of the application to be developed. The script contains the purpose, the theoretical contents, the learning sequence, the graphic elements and the multimedia resources that will make up the application. The user must give the approval to the model so that it can go to the production stage and be attended by each of the responsible parties.

The graphic designer

It is responsible for drawing up each of the graphic requirements, such as the identity of the resource, the iconography, the infographic and any graphic that is specified in the instructional script. Graphic production is delivered to the application developer.

Multimedia developer

Design and develop the multimedia resources that will be integrated into the applications. These can be from videos to games and video games, which is delivered to the application developer.

The application developer

It performs post-production activities, a phase that refers to the integration of the products generated in the production by the graphic designer and the multimedia developer. In other words, it is the one who makes the application.

The style corrector

Review and correct the design and instruction of each of the developments in order to avoid errors in writing and spelling.

The service professional called integrator

It is in charge of carrying out the tests of use and usability of the productions, which are carried out with primary, secondary and final users. In these tests it is verified that the requirements and specifications of functionality, user interface, content, instructional design and multimedia requested are met. Finally, it carries out the transition from the service to the user by delivering the folder in which the source, executable and documentation files (development and user manual) are located. Another activity of the service professional is the definition of processes.

Figure 3 shows the production request assignment process, which indicates each of the functions described above.

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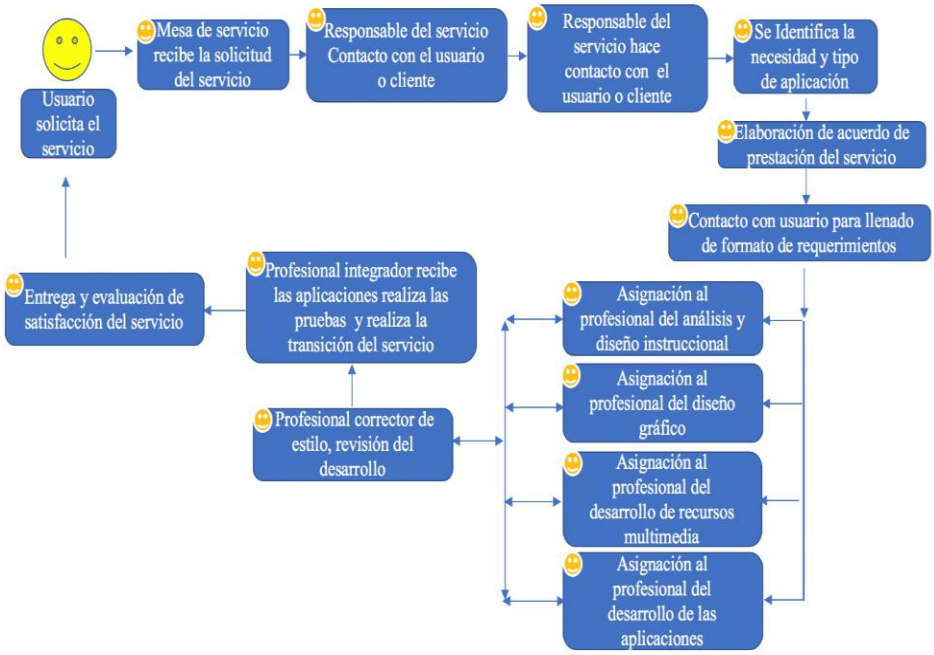
Figura 3. Proceso de asignación de solicitud de producción



Fuente: Elaboración propia

Process of production of applications and digital didactic resources

With the definition of functions, now it is time to show the process for the production of educational applications, for which the methodology of software engineering was used (Weitzenfeld, 2005). The stages of this methodology are the following: requirements, analysis, design, implementation and integration, testing, documentation and maintenance and allow to carry out in a logical and systematic way the activities of the development of projects.

It should be noted that the instructional design model was used to support the development of the application (Dick, Carey and Carey, 2001). This model is based on the relationship that exists between the design of the resource or didactic material and the response that the student has when using the resources. The phases that were used were the following: the identification of learning needs and goals; the analysis of the students and the context, and the selection of materials and multimedia resources. Likewise, the didactic

instructions that make up the application were reviewed; all this with the participation of the expert user (namely, the teacher who requests the production).

The process consists of three stages called preproduction, production and postproduction, as mentioned above, in which the stages of software engineering and instructional design are integrated.

The preproduction

Consider the activities of instructional analysis. The analysis includes the identification of educational needs: the definition of the purpose, the theme, the contents and the multimedia resources that will make up the application. The instructional design is also elaborated, which is represented by a didactic script. The didactic script contains the indications of graphic design, multimedia, visual interface and navigation that make up the application. This script is the output information for this stage and the input to the production phase.

The production

In this phase the service professionals design and develop each of the resources (iconography, infographics, graphic design of the identity, etc.) indicated in the didactic script. The resources obtained from the production must be reviewed by the user and approved. Once obtained this, you can go to the third stage.

Postproduction

It is the third stage. Here the application developer integrates each of the developments of the production forming the application, that is, the user interface of the application is generated using the programming and technological tools defined in the requirements.

A process is not effective if it is not put into operation: the operation of the process described above can be seen in Figure 4. It is important to remember that it consists simply in carrying out or executing the actions for the provision of the service.

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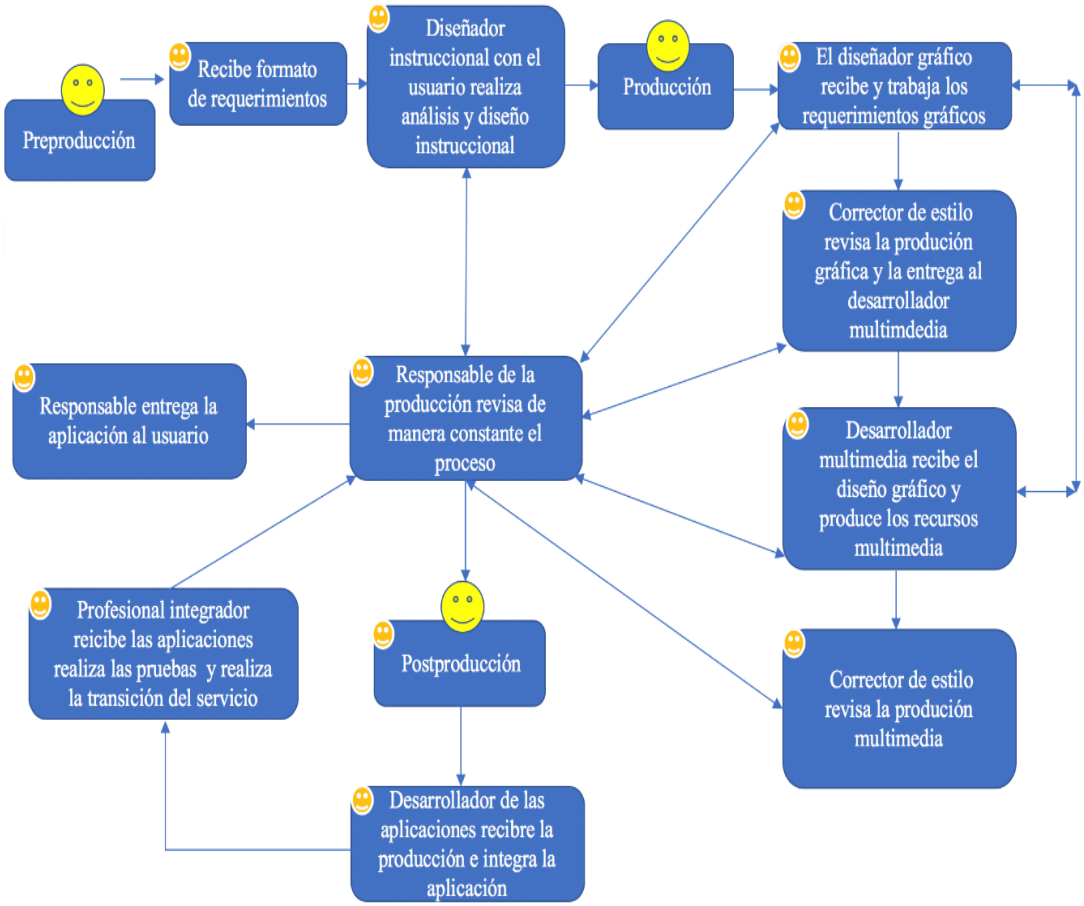
Figura 4. Proceso de producción

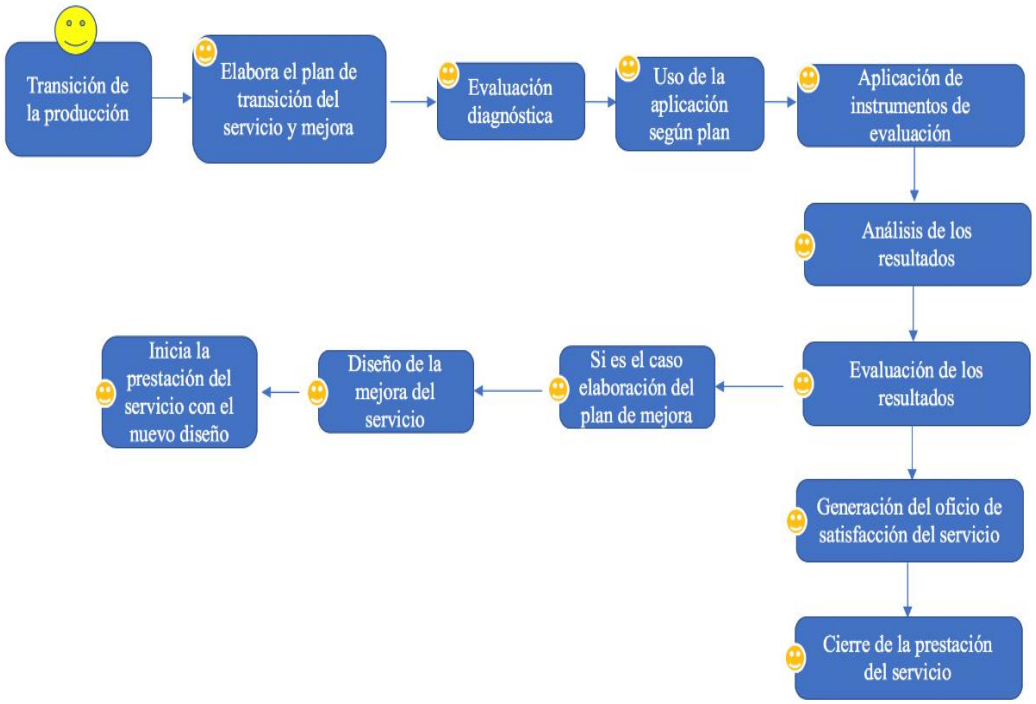


Fuente: Elaboración propia

To complete the process it is necessary to carry out the transition through the delivery and putting into operation of the development. To achieve this begins with the development of the transition plan and improvement of the service. The plan is prepared with the user who requested the production of the application. It integrates the diagnostic evaluation, the strategies of use of the application in the classroom and the application of the evaluation instrument to determine the results of both the effectiveness of the learning process and the design of the application. Additionally, an instrument for evaluating the provision of the application's production service is applied. With the results, the plan for the improvement of the service and, where appropriate, the design of the application is drawn up. Finally, the user must submit an office of term and satisfaction of the service. The person in charge of the

service must take the actions to improve the service, if that were the case, starting the cycle designed in figure 5.

Figura 5. Proceso de transición



Fuente: Elaboración propia

Results of the application of management and application of the processes

The previously proposed management framework was implemented as of August 2017 in the aforementioned UPIICSA Educational Technology Research Laboratory of the IPN. The laboratory was created with the vision of being a space for the transfer of educational technology under the management of good practices. It has been operating for three years.

Interview with the laboratory manager

To identify the level of management, the responsible person and the three collaborators were interviewed. The information provided in the open questions of the interview was analyzed and categorized considering the management and operation of the service of production of digital didactic resources. Information about management was requested from question 1 to 4, and from 5 to 10 on how to respond to the request for the development of digital teaching resources. The questions and the answers are shown in table 2.

Tabla 2. Preguntas de la entrevista al responsable del laboratorio y a los colaboradores

Pregunta	**Respuesta**
¿La gestión del laboratorio se realiza bajo un marco formal de trabajo?	No, simplemente como informática y con conocimientos de didáctica y pedagogía se aplican metodologías para el desarrollo de recursos.
¿El laboratorio cuenta con un organigrama?	No, simplemente hay un responsable y tres colaboradores que prestan su servicio social y prácticas profesionales.
¿Cuáles han sido los resultados obtenidos con la forma de gestionar el laboratorio?	No muy buenos, se obtienen productos, pero no se logra la implementación de los mismos. Les menciono que incluso ya se tuvieron problemas por el porcentaje de derechos de autor, por no ver elaborado un documento formal para el desarrollo. En cuanto a la documentación y organización de los archivos fuentes y ejecutables de los recursos, no quedan debidamente organizados y al momento de retomarlos es difícil. Y finalmente se pierde el trabajo.
¿Ha intentado implementar algún marco formal de trabajo?	Se trabajó hace unos cinco años con el concepto de celdas de producción que diseñó el IPN. Los resultados fueron buenos, pero faltó apegarse a un

	marco orientado a los servicios de TI aplicadas a la educación. Se tiene en mente implementar el marco de buenas prácticas de la ITIL, pero se requiere de apoyo.
¿Tiene definido algún proceso de gestión?	Tenemos un proceso general que orienta el desarrollo de un recurso.
El laboratorio se dedica a la producción de recursos didácticos digitales, ¿es así?	Sí, la actividad principal es el diseño y desarrollo de recursos didácticos digitales.
¿Cuenta con una relación de tipos de recursos que pueden elaborar?	No, simplemente ofrecemos los tipos de recursos que hemos desarrollado. Un ejemplo de ellos son los interactivos.
¿Para la elaboración de los recursos utiliza alguna metodología?	Sí, se utiliza la metodología de desarrollo de *software* del ciclo de vida.
¿A qué problemas se ha enfrentado en la elaboración de los recursos?	No se cuenta con un perfil definido. Los colaboradores llevan a cabo funciones de diseño y programación con los requerimientos mínimos y no se logra la comunicación ni participación del profesor que dé la retroalimentación que permita lograr un buen recurso.
¿Los colaboradores tienen disposición para trabajar de manera ordenada?	Desafortunadamente no, les cuesta trabajo seguir acciones ordenadas o procesos; están orientados al desarrollo con pocos requerimientos.

Fuente: Elaboración propia

As a result of the interviews, it was identified that for the production of resources we work with software development methodology and attempts have been made to work in an orderly manner, but it is necessary to work with a formal framework that gives certainty in the management. Additionally, the lack of culture to perform functions guided by processes was

visualized. On the other hand, the problem of the poor implementation in the classroom of the resources that occur is presented.

Implementation of the management model

After the analysis of the answers, an appointment was made with the head of the laboratory, and based on the current management situation presented by the laboratory, it was proposed to implement the management model developed and based on ITIL. This model was used from August 2017 with the purpose of contributing to the achievement of its vision.

The person in charge of the laboratory considered that it is necessary to adapt the management he performs, so he agreed with pleasure.

The management model was used in response to several requests of higher level and basic level.

Top level

The production of three complete courses of Systems Analysis and Systems Design and Design Engineering of the academic program of Computer Science of the UPIICSA of the IPN was carried out. For these courses the production of resources of diverse nature was carried out: videogames, interactive and videos.

At the basic level

The request of the director of the Dominican Republic Primary School in Mexico City was met, which consisted of the development of an educational application capable of supporting the learning of the mathematical reasoning issues through didactic games. In addition to that, it allowed to develop reading comprehension through animated readings. In particular, the application should be aimed at children who are in first grade. Said request was based on the fact that the children have difficulty in adding, subtracting and reading comprehension.

Results of the service provided at a basic level

- Request for service: the request was received, which was registered and a care order was assigned.
- An appointment was made to carry out the interview with the principal of the primary school and three teachers.
- The interview was conducted. It was identified that the application that is desired must be interactive and to run on mobile devices. And through the game can add, subtract and understand the reading.
- To be able to carry out the transition of the application, it was necessary to know the level of knowledge that the children had regarding the topics, for which a diagnostic evaluation was made to 50 students: 25 of 1st B and 25 of 1. or C.
- The evaluation considered the understanding of basic operations and accounts with money. Here 46% of the children understood the topics and 54% presented difficulties.
- Regarding reading comprehension, 68% of children presented problems and 32% no problem.

Figura 6. Nivel de comprensión en operaciones básicas y cuentas con dinero

Fuente: Elaboración propia

Figura 7. Nivel de comprensión lectora

Fuente: Elaboración propia

- Additionally, a questionnaire was applied to teachers to know the level of use and adoption of technology by both teachers and children. This in order to make the implementation in the classroom a success, since if it was necessary the training would be included in the service transition plan. The questionnaire also included questions about what type of technological devices were available to them in the school, since the application would be implemented in them.
- The results of the questionnaires showed that 70% of the teachers handled both the fixed computing equipment and mobile devices: tablets and smartphones. As for the small ones, it was determined that 65% used said devices. Figures 8 and 9 show these results.

Figura 8. Nivel de adopción de tecnología en profesoras

Fuente: Elaboración propia

Figura 9. Nivel adopción de tecnología en pequeños

Fuente: Elaboración propia

- With the results of the interview, the application of the questionnaires of diagnostic assessment, adoption and use of technology, proceeds with the proposed management cycle.
- The service desk registered the request (considering the service catalog) with the key REI_DM of Level II Intermediates.
- The user is contacted and corroborates the classification of the type of development requested.
- A service agreement is drawn up.

- The user is contacted to fill out the requirements form, which are given through the sketches that are worked with the teachers.
- The storyboard is elaborated in coordination with the teacher and the instructional designer. At this point it is necessary to indicate the screen number or user interface level that is desired, as well as the instruction that should accompany the graphic.
- It is passed to the production stage and each professional of the service is assigned its activity and carries it out.
- The result of the production is each of the graphics that will later integrate the application.
- Periodic reviews by the style editor should not be forgotten or overlooked.
- The next stage is postproduction: the result is the application running. The testing (testing) is done by the integrator. The testing phase is carried out in two moments: the first is carried out by the integrator himself; the second, the teachers. The tests allow to evaluate that the application meets the initial requirements. If after these two tests there is some error or detail of content and interface, it is passed to the corresponding stage according to the error, it is corrected and the test is carried out again. Once the tests are finished, the application is released (it is delivered to the service manager)

After the release of the application and according to the good practices proposed based on the ITIL, the service transition was made through the following plan:

- The date and time of the case study was set (June 7, 2018 at 09:00 a.m.)
- The participants were the small ones of the groups 1º B and 1º C: 25 of each group.
- Parents attended to witness the use of the application and give their opinion.
- The application was installed on the mobile devices of the teachers and the small ones.
- Teachers were trained in the installation and use of the application.
- The small ones used the application autonomously; they were observed by the teacher and by the parents. When there were doubts, they supported the clarification.

- At the end of the use of the application by the children, the teachers asked questions directed to identify the learning achieved with the application.
- The evaluation instrument of the application was answered.
- The office of satisfaction of the service was elaborated.

We must not forget that another of the stages of the ITIL framework is continuous improvement, which is carried out depending on the results of the evaluation of service provision. Therefore, after completing the transition or implementation based on the previous plan, the performance was evaluated through the evaluation instrument, which was applied to the teachers and the principal. Specifically, the instrument measures the management process that was carried out to provide the requested service. The purpose was to evaluate the management framework based on the ITIL proposed and implemented in the laboratory. Table 3 shows the questions that measure the quality of the service.

Tabla 3. Preguntas del instrumento de evaluación de la gestión de producción

Atención en el servicio	**Categorías**			
	Malo	**Regular**	**Bueno**	**Excelente**
Considera que el proceso de atención a su solicitud fue…				X
¿Cómo considera el hecho de firmar un convenio de servicio?			X	
¿Los términos del acuerdo de servicio se cumplieron?				X
La atención que recibió por parte del personal fue…			X	
La gestión que se lleva a cabo en el laboratorio le parece…				X
Le agradecemos sus comentarios en cuanto a la calidad del servicio prestado. Se considera que cuentan con una buena gestión, ya que se parte de la presentación del equipo de trabajo hasta la implementación de la aplicación y dan un seguimiento a los trabajos. Nos gustaría seguir trabajando con ustedes para elaborar otros recursos, gracias por su apoyo.				

Fuente: Elaboración propia

Through the second instrument, for its part, it was requested to evaluate the design and interface of the application. The results of the evaluation of the user interface of the application are shown in tables 4. Teachers and 45 parents took part in it -five less than the total number of students, since not all the students were able to present themselves on the day the case study was carried out.

Tabla 4. Evaluación de la interfaz de la aplicación

Interfaz de la aplicación	**Categorías**			
	Malo	Regular	Bueno	Excelente
¿La interfaz es amigable?				X
¿La interfaz llama la atención de los pequeños?			X	
¿La navegabilidad permite el acceso fácil a los contenidos?				X
¿El nivel de interacción es el deseado?			X	
¿El diseño gráfico es el indicado en el guión?				X

Fuente: Elaboración propia

Likewise, the teachers were asked to evaluate the effectiveness of the instructional design of the application, considering the learning that the children managed to acquire with the use of the application. Table 5 shows the corresponding responses.

Tabla 5. Evaluación del diseño instruccional y el aprendizaje

Diseño instruccional	**Sí**	**No**	**Intervención**
¿En el rompecabezas se promueve el aprendizaje visual?	45		
¿A través de la interacción y la animación, se comprendió la lectura del cuento?	43	2	Sí
¿Al ganar las monedas se logra realizar las sumas o restas?	40	5	Sí
En la alcancía se clasifican las monedas, ¿los pequeños obtienen el total que ganó en los juegos?	40	5	Sí
En la tiendita hay productos etiquetados con su precio, ¿con lo ahorrado en los juegos el pequeño compra los productos que desea?	45		
¿En la compra de los productos logra realizar la suma o resta para saber cuánto puede comprar de acuerdo a lo que tiene de dinero?	40	5	Sí

Fuente: Elaboración propia

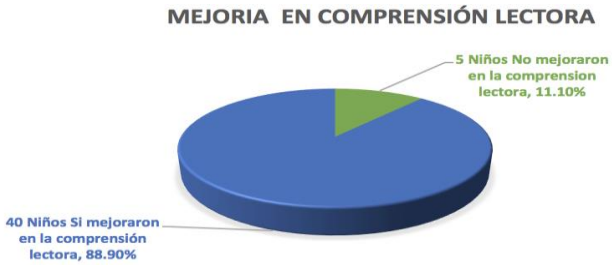
It is important to mention that the educational focus immersed in the application that the professors requested was the inverted classroom, which allows the student to carry out the previous study of the topics (Talbert, 2014). Therefore, in the case study, the children were left free to use the application. The parents observed and in their case they supported their children in the moments that required it. For this reason they were able to answer the questions of the evaluation instrument.

Figures 10 and 11 show that the design of the resource allowed to improve basic operational learning from 46% to 93.15%. Regarding the comprehension reading, we had a figure of 32%: with the application it improved and reached 95.5%.

Figura 10. Mejora del aprendizaje en operaciones básicas

Fuente: Elaboración propia

Figura 11. Mejora en la lectura de comprensión



Fuente: Elaboración propia

Results

The result of this research was the implementation of the framework of ITIL in the provision of educational technology services, for which three years were spent on the government's definition of educational technology, as well as in the management framework. The processes that make up the management model were tested internally, as they were

designed in the UPIICSA Educational Technology Research Laboratory of the IPN. This allowed to achieve a sufficient robustness to use it safely in the attention of users or external customers. The management model obtained was carried out with an external client: the service was provided to the Dominican Republic Primary School in Mexico City. The evaluation carried out by the director and the professors corroborated the effectiveness of the management model, since the attention provided was carried out in a timely manner. Additionally, the learning process was generated with the production of the application, and the reading comprehension and execution of basic operations of the participating children was improved.

Conclusions and analysis

The management model based on ITIL for the attention of educational technology services proposed takes strength considering that the application of good practices is a current need. For example, in the aforementioned study by Ayala (2016) we can see the importance of defining the government of ICTs and their catalog of services. However, as already stressed, this proposal does not talk about educational technology services, but about ICT services -an example of such services is increasing bandwidth or establishing a data center, among others. Something similar happens with the management of the UANL, which manages, under the framework of the ITIL, to provide IT services by providing a guide for the measurement, monitoring and control of software development processes, among others. The elaboration of the strategic plan of the TIC in the University Foundation of the Andean Area, meanwhile, shows that you can not provide services without proper management. The other case studies mentioned in the introduction with which this work can be compared are no less important than those mentioned above, as they attest that the implementation of ITIL is increasingly necessary because it generates value to the educational institution in terms of quality IT service; although, once again, not all of its services are oriented to educational technology services, as is the case of the work presented here.

On the other hand, the investigation made it possible to identify that educational institutions are betting on the implementation of a framework of good practices for the adoption and use

of ICT to improve the management of their administrative academic processes. With regard to the adoption and transfer of educational technology, there is a long way to go: the gradual adoption of technologies has been achieved considering traditional management, which does not give very good results, since it remains in the provision of the service without get to the transfer. This does not generate value to the educational process, utility and efficiency are not measured.

Finally, it can be said that the adoption of good practices in the provision of educational technology services in educational institutions is currently a necessity if you want to be a pioneer in the provision of quality services. The proposal of management of the production service based on the ITIL is a valuable option, since it is oriented to the provision of services based on processes that form a cycle oriented to the quality of the service, and can be adopted by any institution that wishes it. and can even adapt it to your needs.

Future work

The next step is to implement the management model in the Educational Technology Unit and Virtual Campus of UPIICSA. Another one is to conclude the academic book that is being worked on with a view to its publication for the benefit of the academic community. And a final objective is to give the management model to the LaTE Mexico Network, in order to implement it gradually in the educational institutions that make up the network and that are interested in adopting it.

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References

Axios. (2008). Axios Systems ITSM & ITOM Software. Retrieved from https://www.axiossystems.com/hs-search-results?term=ITIL+adoption+surges+despite+confusi%C3%B3n-says-axios-survey-668.

Ayala, H. (26 de mayo de 2016). Impacto del gobierno de TI en las universidades. Ponencia presentada en la Reunión CUDI Primavera 2016. Mérida, del 25 al 27 de mayo de 2016. Recuperado de http://repositorio.cudi.edu.mx/handle/11305/1358.

BBVA Continental. (2017). Procesos ITIL. Recuperado de de https://sites.google.com/site/bbvaperudemo/carpetas/unidad-tye/procesos-itil.

Dick, W., Carey, L. and Carey, J. O. (2001). The Systematic Design of Instruction. Massachusetts, United States: Addison-Wesley Education Publishers.

Duque, E. A. y Eastman, C. P. (2015). Plan Institucional para uso y apropiación de las TIC. Pereira, Colombia: Fundación Universitaria del Área Andina.

Gómez, P. (2018). Mejores prácticas para la gestión de servicios de tecnología educativa. Ciudad de México, México: Red LaTE México.

Gonçalves, R. y López, E. T. (2015). Introduzindo ITIL no ambiente acadêmico. Recuperado de http://docplayer.com.br/3575101-Introduzindo-itil-no-ambiente-academico.html.

Hernández, E. (2014). Buenas prácticas para la gestión de redes. Revista Digital Universitaria, 10.

Instituto Politécnico Nacional [IPN]. (2018). Dirección de Cómputo y Comunicaciones. Recuperado de http://www.dcyc.ipn.mx/Paginas/Inicio.aspx.

Johnson, B. (2016). The History of ITIL - Part 1. Service Management University. Retrieved from https://servicemanagement.university/history-of-itil-part-1-brian-johnson/.

Mintzberg, H. (2012). La estructuración de las organizaciones. México: Ariel.

Ríos, S. (2017). ITIL v3. Manual Íntegro. Sevilla, España: Biable Management.

Talbert, R. (2014). Inverting the Linear Algebra Classroom. Problems, Resources, and Issues in Mathematics Undergraduate Studies, 24(5), 361-374.

Torres, A. A., Arboleda, H. y Lucumí, W. (2015). Modelo de Gestión y Gobierno de Tecnologías de Información en universidades de Colombia: Caso Instituciones de

Educación Superior en el Departamento del Cauca. Recuperado de http://documentas.redclara.net/handle/10786/1007.

Unidad Profesional Interdisciplinaria de Ingeniería y Ciencias Sociales y Administrativas [UPIICSA]. (2018). Unidad de Tecnología Educativa y Campus Virtual. Recuperado de de http://www.sites.upiicsa.ipn.mx/uteycv/.

Weitzenfeld, A. (2005). Ingeniería de Software Orientada a Objetos con UML, Java e Internet. México: Thomson.

Zambrano, A. (1 de octubre de 2014). UANL Premio Nuevo León a la Competitividad en TI 2014. Universidad Autónoma de Nuevo León. Recuperado de http://www.uanl.mx/universidad/universidad/uanl-premio-nuevo-leon-la-competitividad-en-ti-2014.html.

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