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Abstract-- The educational impact of the COVID-19 pandemic revealed an alarming reality: academic backwardness among new students enrolled in the Mechatronics Engineering program, particularly at the Ciudad Juárez Institute of Technology (ITCJ). Faced with this problem, we devised an educational proposal focused on self-directed learning as a way to recover lost skills, promote academic autonomy, and reverse the educational consequences. The intervention, developed and implemented within the Tutoring course, consisted of a course hosted on the Moodle platform that promoted the development of self-regulated learning skills through specific activities, diagnostics, and self-assessments.

The design of this strategy did not arise from a generic recipe, but from the situated analysis of our students and the firm conviction that it is possible to relearn how to learn. The results obtained show significant improvements in planning, study habits, use of academic resources, and oral and written expression. This validates self-directed learning not only as a remedy for falling behind, but as a cross-cutting tool for university life. Experience leads us to affirm that training students to be aware of their own learning process is a commitment that transforms not only their academic present but also their future as critical and reflective professionals.

Keywords-- Lagging behind, self-directed learning, COVID-19.

Abstract-- The educational impact derived from the COVID-19 pandemic revealed an alarming reality: the academic lag in new students studying Mechatronic Engineering, particularly in technological contexts such as that of the ITCJ. Faced with this challenge, we designed an educational proposal centered on self-managed learning to recover lost skills, foster academic autonomy, and mitigate the effects of educational disruption. The intervention, developed and implemented within the Tutoring subject, consisted of a course hosted on the Moodle platform that promoted the development of skills for the self-regulation of learning through concrete activities, diagnoses, and self-assessments.

The design of this strategy did not arise from a generic recipe, but from the situated analysis of our students and the firm conviction that it is possible to relearn how to learn.

The results obtained show significant improvements in planning, study habits, use of academic resources, and oral and written expression. This validates self-managed learning not only as a remedy for lag, but as a transversal tool for university life. The experience leads us to affirm that training students with awareness of their own training process is a commitment that transforms not only their academic present,

but also, their future as critical and reflective professionals.

Keywords-- Lag, self-management learning, COVID-19.

INTRODUCTION

The COVID-19 pandemic has had multiple consequences in various areas: deterioration of physical and mental health, global economic crisis, domestic violence, and academic backwardness, among others. UNESCO (2020) warns that the closure of educational institutions affected more than 90% of the world's student population, creating unprecedented challenges for education systems. We were interested in academic backwardness as the focus of our research because we have considered a hypothesis to reverse it: teaching students to self-manage their own learning. To verify whether this hypothesis is viable, a research structure was developed that concludes with a proposal for intervention implemented in the 'Tutorials' course.

It should be noted that the intervention proposal was applied to a group of first-semester Mechatronics students at the National Technological Institute of Mexico, Ciudad Juárez campus, through a diagnostic questionnaire whose objective was to determine their prior knowledge of self-directed learning. For the intervention proposal, a course was designed that was included in the subject "Tutorials" and therefore retained that name throughout the project, not because it was a tutorial as such, but because it provided the space to carry out the project. In this vein, the course program was designed, the platform on which the program was uploaded, the results of the diagnostic questionnaire were obtained, and at the end of the course, the same questionnaire was administered in order to compare the results of the course, which constituted evidence of the students' progress in the subject.

General objective

To design and implement a course aimed at mechatronics engineering students, to reduce the academic gap caused by the COVID-19 pandemic, including self-directed learning strategies.

Specific objectives

• Conduct a literature review of previous research related to the academic gap caused by the COVID-19 pandemic.

• Diagnose the degree of academic lag after the pandemic among students at the Ciudad Juárez Institute of Technology, considering their institutional context.

• Develop a teaching proposal that incorporates self-directed learning strategies aligned with the curriculum content of the degree program.

• Apply this proposal in the development of the Tutoring course during the first semester.

• Analyze and verify the effect of the intervention by measuring academic performance after its implementation.

Justification

This work has its origins in the classroom, based on our direct experience as teachers in higher education. In this particular case, the research was carried out with new students entering the Mechatronics program at the National Technological Institute of Mexico, Ciudad Juárez Campus (García Cruz & Ríos Fernández, 2023). In the wake of the COVID-19 pandemic, all teachers have witnessed the impact it has had on our students' academic education: the loss of study habits, low or no motivation, the challenge of returning to the classroom, and, above all, a general academic lag (Chilean Ministry of Education, 2021).

This lag was not unique to our institution, as the education system at all levels faced significant consequences in the wake of the pandemic. It was and continues to be a global, cross-cutting, and entirely human phenomenon. In this vein, based on our professional practice, we believed it was possible to design a concrete, measurable, replicable intervention with future significance. We thought that if students were given the tools to learn independently, we could not only address the academic gap, but also strengthen their autonomy and retention at the university (Zimmerman, 2002).

This is when self-directed learning emerges as a viable and relevant educational solution. It was considered, given its characteristics, which are understood as an active process in which students set goals, monitor their progress, regulate their motivation, and adjust their strategies to achieve results independently (Cajal, 2022; He, Zhao, & Su, 2022). Panadero (2017) adds that this self-regulation of learning encompasses cognitive, motivational, and emotional components that strengthen student autonomy.

We believe that by fostering these skills from the early semesters, we not only contribute to improving immediate academic performance, but also promote a comprehensive education geared toward lifelong learning (Palmeros, Coeto, & Pérez, 2011).

DEVELOPMENT

The methodology that guided our research was qualitative, under the sociocritical paradigm and the action research approach (Arias, 2021). We worked with first-semester Mechatronics students at ITCJ, who underwent an educational intervention through the subject "Tutorials," structured on the principles of self-directed learning (García Cruz & Ríos Fernández, 2023).

First, an assessment of learning styles and study habits was conducted. Subsequently, as part of the intervention, a course was designed and implemented on the Moodle platform that included resources such as readings, videos, forums, self-assessments, and activities focused on planning and self-regulating learning. The digital platform was chosen for its ability to create personalized virtual environments that facilitate interaction between teachers and students (Cosano, n.d.). In fact, Dabbagh and Kitsantas (2012) argue that platforms such as Moodle can act as personal learning environments that promote self-regulation and autonomous learning.

Figure 1. *Course created on the Moodle platform*.

Source: *Own creation* (2023).

The Moodle platform allowed us to record student access and activities, making it easier to track their progress. Each activity is configured with instructions for completion, the time allocated for the activity, and a checklist for the activity.

As presented in the program, the course consists of four topics or units, which are shown below:

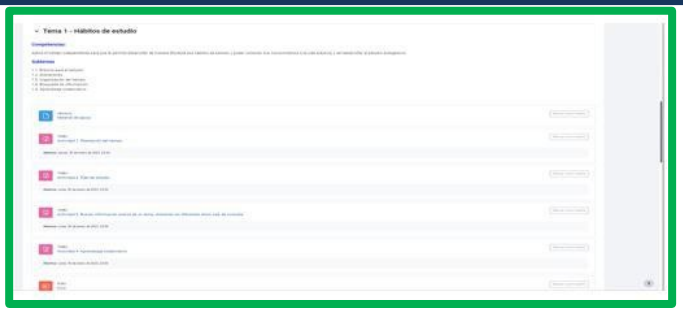

Figure 2. *Course activity program created on the Moodle platform*.

Source: *Own work* (2023).

In it, students completed the course activities, aids to carry them out, and additional activities to supplement the information, as well as tests, evaluations, etc., which they had the opportunity to do during the first semester of the degree program.

Based on the topics covered in the course, it was observed that upon completion, there was an increase in time management, the use of defined study spaces, and a greater willingness to collaborate. This is undoubtedly due to the way it was presented and the opportunity for collaboration among students, which is reinforced by the findings of Johnson, Johnson, and Holubec (1999), who emphasize that cooperative learning enhances understanding and knowledge retention. In addition, Boekaerts (1999) emphasizes that the dimensions of self-regulation include motivation, control of the environment, and monitoring of understanding, which are key aspects in this type of intervention.

The data provided by research, studies, and discourse confirm that an intervention based on self-directed learning not only improves academic performance but also strengthens fundamental skills for university, professional, and even personal life (Zimmerman, 2002; Góngora, 2005). For all the above reasons, it is considered appropriate to propose the intervention carried out through the proposed course as a model for other subjects and to promote an institutional culture that supports student autonomy and the construction of their own knowledge as the central axis of their education.

DISCUSSION AND ANALYSIS OF RESULTS

This qualitative research began by forming a general idea of what academic backwardness is, exacerbated by the COVID-19 pandemic, where we gradually defined this backwardness and its context in relation to the need for students to manage their own knowledge as a tool that would be useful for them to address this backwardness. In this vein, a program was developed for a subject in which students can learn about the tools available to them.

discovering that it is possible and also necessary. It has also been essential to compare this with the information obtained from the literature review, which has proven that it is feasible to achieve self-directed learning that reduces the academic gap increased by the aforementioned pandemic. It is also taken into consideration that in the future it may become necessary to self-direct knowledge. (García Cruz & Ríos Fernández, 2023)

The results showed a significant improvement in students' self-management skills, reflected both in their academic performance and in their ability to organize learning activities independently. The techniques used were observation and surveys through applied instruments that allowed for the identification of progress in areas such as planning, self-regulation, use of technological resources, and autonomy in learning. These findings reinforce the viability of self-management study as an effective tool for reducing post-COVID-19 academic lag. In fact, recent research indicates that educational interventions designed to strengthen self-regulated learning skills improve students' academic performance and SRL abilities (He, Zhao & Su, 2022).

The results obtained before and after the implementation of the self-directed learning course (see Table 1) revealed significant changes in various dimensions of learning. Analysis of the 18 items revealed significant progress in the areas of metacognitive awareness, use of learning strategies, oral and written expression skills, and improved study habits.

Learning style experienced a significant improvement: 97% of students claimed to know their style before the course, a percentage that increased to 100% after the course intervention. This data indicates a consolidation of self-knowledge, a fundamental aspect of autonomous learning (Zimmerman, 2002). However, there were no variations in the identification of the predominant learning style (visual, auditory, or kinesthetic), which can be explained by the fact that the course was not designed to modify this personal aspect.

In terms of study strategies, a significant increase in their use was detected: before the course, only 57% reported using them, while after the course this figure rose to 94%. This finding reflects an appropriation of tools that can improve academic performance, in line with the findings of Monereo (2001), who points out that the explicit teaching of strategies enhances self-regulation of learning.

In the area of conceptualization of specific techniques, such as outlines and concept maps, notable improvements were also observed. Understanding of the concept of "outline" went from 20% to 88%, and that of "concept map" from 37% to 94%. This conceptual mastery is key to strengthening the organization of knowledge and the development of content, essential skills in university education (Novak & Cañas, 2008).

With regard to written and oral expression strategies, the data reflect a direct impact of the course. Before its implementation, 77% of students acknowledged having problems with the presentation of their written work, which was subsequently reduced to only 9%. Similarly, the number of students who experienced difficulties when speaking in front of a group fell from 46% to 9%, with reports of stuttering, forgetfulness, and stage fright being completely eliminated. These improvements suggest that the course provided effective techniques for strengthening academic communication, which is essential in university contexts (Cassany, 2006).

In terms of study habits, improvements were evident both in the creation of a study environment and in time management. The percentage of students who had a specific space for studying increased from 71% to 91%, while those with a defined schedule grew from 29% to 86%. In addition, there was an increase in the amount of time spent studying outside the classroom. These changes point to greater structuring of independent study, which is essential for meaningful learning (Pozo & Monereo, 1999).

Finally, indicators related to collaborative work also show progress. The number of students who meet in groups to study rose from 26% to 74%, and the percentage who consider this practice useful went from 80% to 94%. These data reflect a strengthening of cooperative learning as a strategy for understanding and deepening content, as emphasized by Johnson, Johnson, and Holubec (1999).

The results of the course show a positive impact on multiple dimensions of the educational process, which validates the relevance of designing teaching interventions focused on the development of self-management skills, aimed at improving both academic performance and student autonomy. Table 1 below shows a comparison of the responses before and after the course.

Reactivo	Antes del Curso	Después del Curso
Conocimiento del estilo de aprendizaje	97% conocía su estilo de aprendizaje	100% conocía su estilo de aprendizaje
Estilo de aprendizaje que conocen	51% visual, 29% kinestésico, 20% auditivo	Sin cambios
Forma en que recuerdan mejor	63% imágenes, 20% emociones, 17% sonidos	Sin cambios
Tipo de examen que se les facilita	91% opción múltiple, 6% oral, 3% escrito	Sin cambios
Uso de técnicas de estudio	57% usaban técnicas de estudio	94% usan técnicas de estudio
Estrategias de estudio utilizadas	46% resúmenes, 9% esquemas, 6% mapas conceptuales, 6% cuadros sinópticos, 34% otras	Sin cambios
Concepto de esquema	20% identificó correctamente el concepto	88% identificó correctamente el concepto
Concepto de mapa conceptual	37% identificó correctamente el concepto	94% identificó correctamente el concepto
Problemas con trabajos escritos	77% tenía problemas con presentación escrita	Solo 9% con problemas de presentación escrita
Problemas al exponer frente a grupo	46% tenía problemas al exponer	Solo 9% con problemas al exponer
Causas de dificultad en exposición	56% nerviosismo, 31% olvido, 6% pánico, 6% tartamudeo	Desaparecieron los problemas de pánico, tartamudeo y olvido
Lugar específico para estudiar	71% tenía lugar específico	91% tiene lugar específico
Tiempo dedicado al estudio extra	80% entre 30 min a 1 hr, 14% <30 min, 6% nada	Mayor tiempo de estudio extra
Horario de estudio extra	29% tenía horario específico	86% tiene horario específico
Fuente de información para tareas	97% usa internet, 3% libros	Sin cambios
Acción con la información obtenida	89% analiza y transcribe, 6% copia/pega, 6% otro	Sin cambios
Reuniones para estudiar en grupo	26% se reúne para estudiar	74% se reúne para estudiar
Utilidad de estudiar en grupo	80% considera útil el trabajo en grupo	94% considera útil el trabajo en grupo

Table 1. *Summary of results from the self-management study course*.

Source: *Own elaboration* (2023).

For this research, three studies with similar objectives were analyzed in relation to the lag caused by the COVID-19 pandemic, which accelerated an educational transformation, forcing the transition to distance learning modalities and highlighting the critical importance of self-directed learning and self-regulation skills in students.

In this context, the study entitled "Self-regulation of learning in times of pandemic: a viable alternative in the framework of current educational processes" concludes that self-regulation of learning is a viable and indispensable alternative for academic success in the context of emergency remote education, because it allows students to plan, monitor, and evaluate their own learning process, compensating for the loss of face-to-face and structured support in the traditional classroom. This highlights the need for institutions and teachers to promote the development of metacognitive skills (knowing and controlling one's own thinking), motivation, and time management in students. Thus, the results of this research indicate that the effectiveness of online learning depends directly on the student's ability to self-manage their personal and environmental resources. García Montero, I., & Bustos Córdova, R. B. (2021)

On another note, the study entitled "Self-learning as a process for knowledge construction in times of pandemic" complements the previous one, as it focuses on self-learning as an active process of knowledge construction. Its results point to a fundamental change in role, moving the student from a passive role as a receiver to an active protagonist in their education; determining that the success of self-learning is linked to intrinsic motivation, personal interest in the subject, and the appropriate use of technological resources. Although technology facilitated access to information, the human factor (the student's willingness and strategy) was the main determinant of effective knowledge construction. (Prince, 2020)

Finally, the research referred to as "Impact of the COVID-19 Pandemic on the Teaching-Learning Process" offered us a broader view of the overall impact of the pandemic, serving as a framework for understanding why self-regulation and self-learning became crucial. (Hernández Frayre, n.d.)

Compared to the studies by García Montero, I., & Bustos Córdova, R. B. (2021) and Prince (2020), the results of the present research coincide in the relevance of self-regulated learning as a key strategy to mitigate post-COVID academic lag. However, unlike previous studies, the present proposal showed specific improvements in academic planning and expression, suggesting a more comprehensive impact on student self-regulation.

CONCLUSIONS

Our research proposal was based on the idea of resolving the gap caused by the pandemic, but also of going further. By training students to generate their own knowledge, they are equipped with skills and tools that will enable them to overcome their own delays, learn what they need to learn independently, apply all kinds of learning strategies, and this will translate into academic and personal achievements for each of the students who participated in this research project.

Therefore, the development of this research led us to affirm that any student who knows the tools and study strategies for self-directed learning can exceed the required academic standards.

This work demonstrates that educational backwardness, a global problem that affects both urban and rural contexts, can be reversed through self-directed learning strategies. In this sense, Garrison (2003) argues that self-directed learning is especially relevant in virtual environments, where students must take greater control of their education.

Throughout this work, we have developed a training program that allows these students to access knowledge autonomously.

It was observed that the implementation of a self-directed learning program was effective in addressing academic backwardness among first-semester students at the National Technological Institute of Mexico, Ciudad Juárez campus. Self-directed learning allowed students to take an active role in their education, developing self-regulation skills and adapting to new educational contexts. It is recommended that this model be extended to other first-semester subjects and that teacher support continue to be strengthened in order to sustain the self-directed learning process in the long term.

FUTURE WORK

Areas for improvement in the educational proposal

Since there may be schedule adjustments for tutors and teachers during the first week of classes, it is advisable to start the course in the second week for first-semester students. It was found that most students were unable to complete the course activities due to lack of time at the end of the semester. Therefore, it is suggested that the course last 14 weeks. This recommendation is based on the results obtained from student evaluations.

Therefore, it is proposed that tutoring sessions last two semesters to ensure better course follow-up.

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