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Pedagogical integration of digital technology in Algerian higher education: an exploratory study by the SAMR and TPACK models

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Abstract

This article is part of the field of teaching French as a foreign language (FFL) and digital pedagogy in Algerian higher education. It aims to analyze the degree of integration of digital literacy in the pedagogical practices of university teachers from the French department of the Yahia Farès University of Médéa by relying on two complementary theoretical frameworks: the SAMR model (Substitution, Augmentation, Modification, Redefinition) and the TPACK (Technological Pedagogical Content Knowledge) model. A mixed methodological approach was adopted, combining a questionnaire, semi-structured interviews, and a document analysis grid applied to five courses submitted on the Moodle platform.

Keywords: digital literacy; higher education; teaching practices; SAMR model; TPACK model; Algerian university.

1. Introduction

The digital transformation is gradually redefining higher education practices. In Algeria, universities are part of this dynamic through modernization policies aimed at developing digital uses and supporting the dematerialization of services (Dine, 2026). In the field of French as a foreign language (FFL), this evolution leads teachers to rethink their practices and to develop skills beyond mere mastery of digital tools.

Despite this evolution, several studies show that technologies are still mainly used to disseminate resources or facilitate communication, while their potential for educational transformation remains little exploited (Seddari, 2021; Benmammar & Sakrane, 2023). This gap between institutional orientations and practices raises the issue of digital literacy among teachers.

If the uses of digital technology in higher education have already been studied, few studies have analyzed the practices of university teachers by jointly mobilizing the

SAMR and TPACK models. This study seeks to fill this gap by examining both the level of integration of technologies in teaching practices and the technopedagogical skills that underpin them.

The research is guided by the following question: to what extent do FFL teachers integrate digital literacy into their teaching practices and how do the SAMR and TPACK models allow them to account for it? Three hypotheses guide the study: the uses are mainly related to the levels of substitution and increase in the SAMR model; the dimensions of the TPACK remain unevenly articulated; finally, training and institutional support strongly influence the development of these practices.

The article first presents the theoretical framework, then the methodology adopted. The results are then analyzed and discussed in order to identify the main contributions of this research.

2. Theoretical framework

2.1 Digital literacy as a professional skill

Digital literacy is now recognized as an essential skill in higher education. It goes beyond the mere mastery of technological tools and refers to the ability to research, evaluate, produce, and share information in a critical, ethical, and effective way in digital environments (Martin, 2008; Ferrari, 2013).

In the field of French as a foreign language , this skill is not limited to the technical uses of digital technology. It also influences teachers' pedagogical choices, the design of learning activities and the way in which they interact with students. Digital technologies thus become resources at the service of education, provided that they are mobilized in a manner consistent with educational objectives.

However, research on higher education shows that this integration remains uneven. If digital tools are now widely available, their use often remains centered on the dissemination of resources or communication, without leading to a significant transformation of teaching practices (Lameul & Loisy, 2014; Ghoul, 2022).

In this research, digital literacy is considered as a technopedagogical skill. It is apprehended through the way teachers mobilize technologies to design, implement and enrich their teaching practices. This perspective justifies the use of SAMR and TPACK models, presented in the following sections, which allow for an analysis of both the level of digital integration and the knowledge mobilized by teachers.

2.2 The SAMR model: analyzing the level of digital integration

The SAMR model (Substitution, Augmentation, Modification, Redefinition), proposed by Puentedura (2010), is one of the most used frameworks to analyze the integration of digital technologies in educational practices. It distinguishes four levels of use corresponding to an increasing degree of transformation of teaching activities.

The first two levels are part of a logic of improvement. The substitution corresponds to the replacement of a traditional tool by a digital one without modification of the task, while the increase brings functional improvements to an existing activity. The following two levels reflect a deeper transformation of practices. The change leads to rethinking the organization of educational activities, while the redefinition allows for the design of tasks that would be difficult to achieve without the use of digital technology.

This model offers a simple and progressive reading of the educational uses of technologies. It helps identify whether digital technology is mainly used to reproduce existing practices or if it contributes to transforming learning situations. Several authors point out, however, that it does not sufficiently take into account the pedagogical intentions of teachers nor the context in which technologies are mobilized. A high level of the model does not, therefore, by itself guarantee an improvement in learning.

In this research, the SAMR model is used as a descriptive grid. It does not aim to establish a hierarchy among teachers, but to situate their practices according to the degree of pedagogical transformation they reflect. This analysis is then completed by the TPACK model, which allows to examine the technological, pedagogical and disciplinary knowledge mobilized to implement these uses.

2.3 An articulation between the SAMR and TPACK models

Taken separately, the SAMR and TPACK models do not address the same dimensions of digital educational integration. The SAMR model makes it possible to situate digital uses according to their degree of transformation of teaching activities, while the TPACK model focuses on the knowledge that teachers mobilize to design and implement these uses. The two approaches thus answer complementary questions.

The use of the SAMR model alone would make it possible to describe observed practices without explaining their foundations. Conversely, the TPACK provides information on the technological, pedagogical and

disciplinary skills of teachers, but does not directly assess the impact of their articulation on the transformation of educational activities. Their combination therefore offers a more complete reading of teaching practices.

This complementarity is particularly relevant in the context of university teaching of French as a foreign language. It allows for a simultaneous analysis of the level of digital integration, the skills mobilized by teachers, and the factors likely to influence their educational choices.

In this research, the SAMR model is used to analyze the degree of transformation of practices based on questionnaire data and literature review. The TPACK model is used to interpret interviews and understand how teachers articulate the technological, pedagogical and disciplinary dimensions in their practices. The cross-analysis of these two models thus constitutes the conceptual framework of the study and guides the interpretation of all the results

3. Methodology

This research adopts an exploratory approach based on a mixed methodological approach in order to analyze the integration of digital technology in the teaching practices of university teachers. The aim is not to produce generalizable results, but to identify trends and better understand the mechanisms underlying these practices in a particular context.

To meet this objective, three complementary data sources were mobilized: a questionnaire for teachers, semi-structured interviews and a literature review of courses submitted on the Moodle platform. The cross-referencing of these data is part of a methodological triangulation logic, making it possible to compare declared practices, teachers' speeches and educational resources actually used. This approach reinforces the credibility of the results and offers a more nuanced understanding of the phenomenon studied.

3.1 Questionnaire

The questionnaire was distributed online using Google Forms. Adapted from the instrument developed by Bicalho & al. (2023), it was adjusted to the objectives of this research in order to assess teachers' digital practices according to the four levels of the SAMR model.

The instrument consists of two parts. The first collects the main socio-demographic characteristics of participants (age, sex and seniority), while the second has twenty-one items evaluated on a five-way Likert scale, going from never to always.

The questionnaire was sent to the 81 teachers of the French department at Yahia Farès University in Médéa. Twenty-four complete responses were obtained, a participation rate of about 30%. Participation was voluntary and anonymous.

Although this sample does not allow for the generalization of the results, it offers a relevant overview of the practices observed in the context studied. In accordance with an exploratory approach (Morse, 2000), these data are interpreted in addition to the interviews and the documentary analysis. However, a possible selection bias should be taken into account, as teachers who are most interested in digital technology may have been more inclined to participate.

The data were analysed using descriptive statistics. A weighted average was calculated for each item, then the scores were grouped according to the four levels of the SAMR model in order to obtain an average score by dimension and an overall digital integration index.

3.2 Semi-structured interviews

In order to complete the quantitative data, four semi-structured interviews were conducted with volunteer teachers from the French department. The choice of participants was based on the diversity of their profiles, particularly in terms of seniority and digital practices, in order to gather varied experiences.

The maintenance guide was developed from the TPACK model. The questions focused on digital uses, educational strategies adopted, technological skills mobilized, difficulties encountered and training needs. This approach aimed to understand how teachers articulate the technological, pedagogical and disciplinary dimensions in their practices.

Interviews, averaging 30 to 45 minutes in length, were recorded with the participants' agreement and then transcribed in full. The data were then subjected to a thematic analysis combining deductive coding, based on TPACK dimensions, and inductive coding allowing themes to emerge directly from the corpus.

This qualitative analysis completes the results of the questionnaire by providing explanations on the practices observed and the factors likely to favor or hinder the integration of digital technology.

3.3 The analysis grid for courses uploaded to Moodle

A literature review was also conducted to observe digital uses directly from the course materials available on the Moodle platform of the Yahia Farès University in Médéa.

To do this, an original observation grid was developed based on three complementary references: the TPACK model (Mishra & Koehler, 2006), the SAMR model (Puentedura, 2010) and the dimensions of digital literacy proposed by Ferrari (2013).

This grid has a dual objective. It makes it possible to assess the quality of the technopedagogical integration of courses and to identify the digital skills likely to be developed among students.

Three axes structure the analysis.

The first concerns the TPACK model. It addresses the technological, educational and disciplinary dimensions as well as their articulation. The selected indicators assess in particular the mastery of digital tools, the pedagogical methods used, the scientific quality of the content and the coherence between these different dimensions.

The second axis is based on the SAMR model in order to situate each course on the continuum from substitution to redefinition.

Finally, the third axis is devoted to digital literacy. The analysis takes into account the possibilities offered to students to search for information, communicate, collaborate, produce digital content and develop their critical thinking skills.

Each indicator was evaluated on a qualitative scale consisting of four levels—low, medium, good and excellent—with observations to justify the selected ratings.

Five courses have been selected to represent different training levels, from the first year of a bachelor's degree to a master's degree, as well as several disciplines taught in the department: University Work Techniques, Phonetics, Oral Comprehension and Expression, psycholinguistic and didactic of the intercultural.

Two of these courses were taught by teachers who participated in the interviews, which allowed to confront their speeches with their actual practices. The other three were analyzed independently.

3.4 Participants

The study was conducted with teachers from the French department of the Yahia Farès University in Médéa. A total of 24 teachers responded to the questionnaire, a participation rate of about 30% of the 81 teachers solicited. Four of them then participated in semi-structured interviews, selected so as to represent various profiles in terms of seniority and uses of digital technology.

Participants have diverse characteristics in terms of age, professional experience and

familiarity with digital technologies. This heterogeneity is an asset for an exploratory study, because it allows to apprehend a plurality of practices and perceptions. The main characteristics of the sample are presented in Table 1.

3.5 Ethical considerations and study limitations

This research was conducted in accordance with the ethical principles applicable to the humanities and social sciences. Participants were informed about the objectives of the study, the voluntary nature of their participation and the confidentiality of the data collected. The interviews were recorded with their consent and then anonymized during transcription and analysis.

However, this study has some limitations. Carried out in a single university department, it does not allow the results to be generalized to all Algerian higher education. In addition, the use of volunteering may have encouraged the participation of teachers who are more aware of digital uses. Finally, the limited number of interviews and documents analyzed limits the scope of qualitative analyses.

However, these limitations are mitigated by data triangulation, which combines questionnaire, interviews and literature review. The cross-referencing of these sources reinforces the credibility of the results while offering a finer understanding of the pedagogical practices studied.

4. Results

The results present the main trends identified from the questionnaire, semi-structured interviews and literature review. Although this study is exploratory and carried out in a specific context, the convergence of the three data sources allows for a coherent reading of the ways in which digital technology is integrated into the teaching practices of FFL teachers.

4.1 Levels of integration according to the SAMR model

The analysis of the questionnaire shows that digital integration remains mainly focused on the first two levels of the SAMR model. The percentages presented in the table below correspond to the linear conversion of average scores on a basis of five (score × 20) and are provided for information purposes only, in order to facilitate comparison between the different levels.

SAMR Level	Average score (/5)	Percent
Substitution	2.99	59,8 %
Increase	2,62	52,4 %
Modification	2,00	40 %
Redefinition	1,99	39,8 %

Table 2. Integration levels according to the SAMR model

The substitution gets the highest average score, followed by the increase. These results indicate that teachers mainly use digital technologies to replace traditional media or improve certain existing activities, without transforming in depth the pedagogical approaches. Conversely, the levels of modification and redefinition remain underrepresented, reflecting limited recourse to collaborative uses, innovative projects or activities that would be difficult to carry out without digital technology.

The overall average of the four dimensions (2.40/5) thus confirms a generally moderate level of integration, more rooted in a logic of pedagogical continuity than of transformation of learning. This trend, however, masks a certain heterogeneity of practices. While some teachers report using collaborative online tools regularly, the majority say they rarely or never use them, which reveals that levels of digital appropriation still vary widely.

4.2 Articulation of knowledge according to the TPACK model

The thematic analysis of the interviews highlights an uneven mobilization of the different components of the TPACK model. The pedagogical dimension (PK) appears to be the most developed. Teachers explain how to adapt their didactic choices to the needs of students, their level and learning objectives. As one of them put it, "the pedagogical choices and the contents to be taught are adapted according to the needs of the learners." This concern is shared by all participants, who adjust their methods according to the content taught.

Disciplinary knowledge (CK) is also well mastered and is most often linked to pedagogical dimensions (PCK). Teachers declare that they adapt their methods to the nature of the knowledge to be transmitted, without this adaptation leading however to a significant transformation of teaching practices.

On the other hand, the technological dimension (TK) remains more limited. The uses described are mainly based on accessible tools, such as audiovisual presentations,

messaging applications or the video projector, mainly mobilized to support already existing practices. Some interactions between the technological, pedagogical and disciplinary dimensions are perceptible, notably through the use of digital resources for phonetics or a few collaborative devices. However, the complete articulation of the TPACK components remains exceptional. As one teacher admits, "I have rarely combined pedagogy, content and digital in a coherent way."

Interviews also highlight several recurring obstacles. The lack of equipment, connection difficulties and insufficient training limit the development of technopedagogical skills. Several teachers point out that they have not been sufficiently supported in the use of Moodle and believe that the evolution of practices relies more on individual initiatives than on a structured institutional system.

4.3 Literature review of courses submitted on Moodle

The analysis of the five courses submitted on the Moodle platform at Yahia Farès University in Médéa confirms the trends observed in the questionnaire and interviews. The content is of satisfactory disciplinary quality: it is structured, progressive and based on relevant scientific references. However, the pedagogical integration of digital technology remains limited.

Course (level)	TPACK (high point / low point)	SAMR level	Digital literacy	Appreciation
Stady skills (L1)	Strong CK / Weak TK	Substitution	Weak	Medium
Phonetics (L2)	Strong CK / Weak TK	Substitution	Weak	Low[1]
Listening and Speaking. (L3)	Strong CK and PK	Average TK Increase	Low to Average	Average
Psycholinguistics (M1)	Strong CK / Weak TK	Substitution	Weak	Medium
Intercultural didactics (M2)	Strong CK and PK / Weak TK	Substitution	Low to medium	Average

Table 3. Summary of the literature review according to the TPACK and SAMR models

In all the courses analyzed, the disciplinary dimension (CK) is the main strength, while the technological dimension (TK) remains the least developed. Digital resources are most

[1] The lack of sound resources in a course dedicated to phonetics explains this lower overall assessment.

often limited to the provision of PDF documents, without significant use of interactive, collaborative or multimedia features.

The CEO course is an exception by integrating audio and video materials, which allows it to reach the level of increase of the SAMR model. The other courses remain at the substitution level, confirming that digital technology is mainly used to disseminate resources rather than to transform learning methods.

The analysis of digital literacy leads to the same observation. While some activities promote information retrieval, the dimensions related to digital communication, online collaboration and content creation remain underrepresented. The possibilities offered by digital environments for developing active learning are therefore still not fully exploited.

4.4 Institutional support

The interviews converge on the same observation: institutional support is perceived as insufficient to support a more ambitious digital integration. Teachers mention recurring difficulties related to the lack of equipment, the instability of the Internet connection and the absence of rooms adapted to digital educational uses.

Beyond the material constraints, several participants insist on the need for more structured support, both in terms of training and technical support. In this context, the integration of digital technology is mainly based on the personal commitment of teachers. The practices observed thus appear to be driven more by individual initiatives than by a coordinated institutional strategy.

5. Discussion

The results support the first two hypotheses of the research and partially confirm the third. Although this study remains exploratory and confined to a single university department, the observed trends are similar to those reported in the literature. Teachers mainly mobilize digital technology at the substitution and augmentation levels of the SAMR model, while the weak integration of the technological dimension of TPACK limits the emergence of truly transformative practices. The role of institutional support also appears to be decisive. However, rather than being an absolute obstacle, its inadequacy leads teachers to rely mainly on their personal initiatives to integrate digital technology into their practices.

This predominance of the lower levels of the SAMR model confirms that digital technology is mainly used to replace or enrich existing practices, without profoundly changing learning situations. This observation is in line with the analysis of Puentedura (2010), according to which levels of substitution and increase are more a matter of improvement

than pedagogical transformation. It is also in line with the work of Kirkwood and Price (2014), who show that, in higher education, digital technologies often extend traditional practices rather than redefining them.

Similar trends are emerging in other educational contexts. Drabik's thesis (2025), devoted to primary education, also highlights a predominance of uses corresponding to the first levels of the SAMR model. Without establishing a generalization, this convergence suggests that the difficulties in achieving more transformative pedagogical uses go beyond a particular context or level of education.

The analysis based on the TPACK model provides additional insight. The teachers interviewed demonstrate a solid mastery of the pedagogical and disciplinary dimensions, but the articulation with the technological dimension remains incomplete. Digital technology is mainly mobilized as a support for existing practices rather than as a lever for educational transformation. This observation is in line with the analyses of Angeli and Valanides (2009), according to which the effective integration of technologies relies less on the mastery of tools than on their articulation with disciplinary and pedagogical knowledge.

However, a difference appears with the results of Bicalho et al. (2023), which report uses reaching the level of modification of the SAMR model. This discrepancy can be explained by the study contexts. Their research was conducted during the period of distance teaching imposed by the COVID-19 pandemic, an exceptional context that has fostered the rapid development of more advanced digital practices. Conversely, the data collected in this study reflect uses observed in a context of ordinary teaching, where the incentives to transform practices are less strong.

The identified limits therefore do not seem to depend on a single factor. Rather, they result from the interaction between several dimensions: training that is still insufficient for advanced pedagogical uses of digital technology, persistent material constraints, and limited institutional support. The convergence of quantitative, qualitative and documentary data shows that these factors are mutually reinforcing and hinder the evolution towards practices more focused on collaboration, creativity and student autonomy.

Given the exploratory nature of this research, these results should be interpreted with caution. Carried out in a single university department, the study does not make it possible to generalize the observations to the whole of Algerian higher education. The consistency of the observed trends with those reported in other works nevertheless suggests that the

identified mechanisms could exceed the context studied. This hypothesis deserves to be examined in comparative research involving several institutions and disciplines in order to better understand the influence of institutional, organizational and disciplinary factors on the pedagogical integration of digital technology.

6. Conclusion

This research aimed to examine the degree of integration of digital literacy in the teaching practices of university teachers by mobilizing the SAMR and TPACK models as complementary analytical frameworks. The results show that digital technology is now integrated into teaching practices, but its use remains mainly functional. Teachers mainly use it to disseminate resources, support their teaching activities and facilitate certain tasks, while the uses likely to transform learning situations are still not well developed.

The analysis according to the SAMR model highlights a predominance of substitution and increase levels, confirming that digital integration is more in line with educational continuity than transformation. The TPACK approach complements this observation by showing that, while teachers have strong disciplinary and pedagogical knowledge, the technological dimension remains more fragile and is difficult to articulate with the other two components. This separation limits the development of fully integrated techno-educational practices.

The results thus provide a nuanced answer to the research question. Digital literacy appears less as a simple mastery of tools than as a professional construction skill, based on the articulation between disciplinary knowledge, educational choices and thoughtful uses of technologies. Its development depends not only on the individual competences of teachers, but also on the institutional conditions in which they carry out their activity.

In this regard, the constraints highlighted—insufficient equipment, technical difficulties and lack of training—show that individual initiatives, although essential, cannot sustainably compensate for the absence of a structured institutional policy. Strengthening infrastructure, access to appropriate resources, and the generalization of continuing education in technopedagogy appear as priority levers to promote a more ambitious integration of digital technology into higher education.

However, this study has several limitations. Its exploratory nature, small sample size, anchoring in a single university department and reliance on largely declarative data suggest that the results should be interpreted with caution. However, the triangulation of the questionnaire, interviews and literature review reinforces the credibility of the trends observed.

Beyond these results, this research also makes a methodological contribution. The articulation of SAMR and TPACK models has proved relevant to simultaneously analyze the level of integration of digital technology and the technopedagogical skills mobilized by teachers. This complementarity offers an analytical framework that can be used in other research devoted to the digital transformation of higher education.

Studies carried out in other universities, disciplines or national contexts would make it possible to verify the transferability of the observed trends and identify the factors favoring more transformative uses of digital technology. Longitudinal research could also analyse the evolution of practices as training policies and institutional arrangements develop.

Ultimately, this study shows that the digital transformation of higher education does not depend solely on the availability of technologies. It is based on the articulation between teachers' skills, their educational choices and an institutional environment capable of sustainably supporting the evolution of practices. It is in this interaction that a digital literacy is gradually being built, likely to support the changes of the Algerian university.

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