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TETRAHEDRON CYBER DIPL TO IMPROVE TEACHING, LEARNING AND DIGITAL EQUITY IN THE INSTITUTE OF ARCHITECTURE

Research Article

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Abstract

This study is a research based on asking students questions and the conceptual framework developed by Houssaye (2000). The integration of a fourth pole into the Houssaye's pedagogical triangle (2000), as well as the survey carried out with 322 students, allowed us to develop a tetrahedron designed to improve teaching, learning, and digital equity in the institute of architecture, Ferhat Abbas University Setif 1 (Algeria). The tetrahedron is called tetrahedron Cyber DiPL with Di for Didactic, P for Pedagogy, L for Learning. The pole, as a device cyber including digital inclusion, is an opportunity to use Information and Communication Technologies (ICTs). According to knowledge types: know-how (Kh), knowledge practice (Kp), and theoretical knowledge, learned or scientific knowledge (Tk), tetrahedron Cyber DiPL includes Cyber DiPL to do, Cyber DiPL to practice, and Cyber DiPL to differentiate.

Keywords: Survey, Houssaye's pedagogical triangle, tetrahedron Cyber DiPL, teaching, learning, digital equity

1. Introduction

Algeria has set several Millennium Development Goals (MDGs) through its reports (Algeria Millennium Development Goals, 2016). While the country is making progress on several MDGs, the fact remains that the MDG on digital equity is not yet in place (Algeria Millennium Development Goals, 2016). If 3G and 4G mobile networks are expanding thanks to submarine cables linking Algeria to fiber optics, however, the institutes don't bother improving teaching, learning, and digital equity. Chalkboards are still used to communicate and teach. The white sheet and the ballpoint pen are still relevant (Algeria Millennium Development Goals, 2016). The Houssaye's pedagogical triangle (2000) is a tool frequently used (Seghroucheni, Al Achhab & El Mohajir, 2014), and it seems to go on forever!

The institute of architecture, for example, remains closed on digital equity, and yet means are not missing! In general, the computer, the printer, and the scanner equip some premises; the internet is only present in local administration, and research laboratories. At the level of classrooms and workshops, the computer and the internet are missing. Therefore, students must fend for themselves using their mobile phones if they have 3G and 4G mobile networks. For those who are not connected, they are simply forgotten! It is necessary to integrate technology in classrooms, workshops, research laboratories, and in teacher education programs (Mysore, 2018).

When considering the role of technology in development of the twenty-first century, we accept with Resta & Laferrière (2015) that digital equity and education continue to be areas of concern in the emerging knowledge-based society. For this reason, we can say with Schrum & Sumerfield (2018) digital equity is the civil rights of our time. However, we admit with Davis et al. (2007) that digital equity is not a product of consumption but an equitable distribution based on students' needs.

Though an exact definition of digital equity remains elusive (Davis et al., 2007), there have been various interesting academic meanings (Resta & Laferrière, 2015; Mysore , 2017; Reich & Iton, 2017; UNESCO, 2017; Adams et al., 2018; Howard, Schaffer & Thomas, 2018; Mysore, 2018; Passey et al., 2018; Quaintance, 2018; Resta, Laferrière, Mc Laughlin & Kouraogo, 2018; Tierney, Corwin & Ochsner, 2018; Treviranus, 2018 and Reich, 2019).

There are also topics which are widely accepted among academic communities such as:

- Digital equity considerations
- Technology policies and practices in higher education
- Digital inclusion in teaching and learning
- Strategies to avoid digital divide
- Digital equity for teaching and learning
- Representational issues in digital access in education, and so on.

In addition to the topics above, the current study also aims to suggest a tetrahedron improving teaching, learning, and digital equity in the institute of architecture. Although there are two main tetrahedrons recommended by Alava (2000) and Lombard (2003), fairly limited empirical research has been carried out in this particular topic; therefore, this study will contribute to the elimination of a gap in the literature.

2. Literature Review

According to Smyrnaoui, Riopel and Sotiriou (2016), models designed for diverse learning situations involving several interactors aren't numerous. However, in addition to the two main tetrahedrons' Alava (2000), and Lombard (2003) (which are developed below), other models deserve to be reported such as: Altet's (1997) systemic model, Rezeau's (2001) pedagogical square (including Teacher, Learner, Knowledge and Instrument), Ailincai's (2010) KITLoK model (with Knowledge, Instrument, Tutor, Learner, other Knowledge), and Poisson's (2010) tetrahedral model (with potential educational situations as the distance learning and the E-Learning). The models developed by the authors showed the use of interactions between learner-teacher, and teacher in instrumented learning situations. The models also determined the role of knowledge and the instrument (as a digital device) used during exchanges. The most preferred and most used instrument is the computer. The use of computers in learning situations creates a form of a dialectic between knowledge, and the reflection on how to do tasks. Therefore, it is an instrument of cognitive mediation and seems to promote communication, and social relationships (Smyrnaoui, Riopel & Sotiriou, 2016). Thus, the presence of the instrument within the interactive learning environment has led us to introduce the pole DC Cyber DiPL and emphasize its importance in our study.

3. Purpose and Research Question of the Study

The main purpose of this study is to present a tetrahedron designed to improve teaching, learning, and digital equity in the institute of architecture. The tetrahedron is called tetrahedron Cyber DiPL with Di for Didactic, P for Pedagogy, L for Learning. The tetrahedron is depicted with regard to Houssaye's pedagogical triangle (2000) that inspired it. Houssaye's pedagogical triangle can be developed taking into account students' wishes and needs; these wishes and needs can be identified through surveys. So, we integrated the fourth

pole into the Houssaye's pedagogical triangle in order to obtain a tetrahedron. Why a tetrahedron and not a quadrilateral or other four-sided figure? This is related to the tetrahedrons' geometry. A tetrahedron is a solid figure having four triangular faces. In other words, each face is a triangle. These are precisely the triangles that interest us in this study.

Houssaye's pedagogical triangle (2000) is a triangle with three corners: knowledge, teacher and pupil.

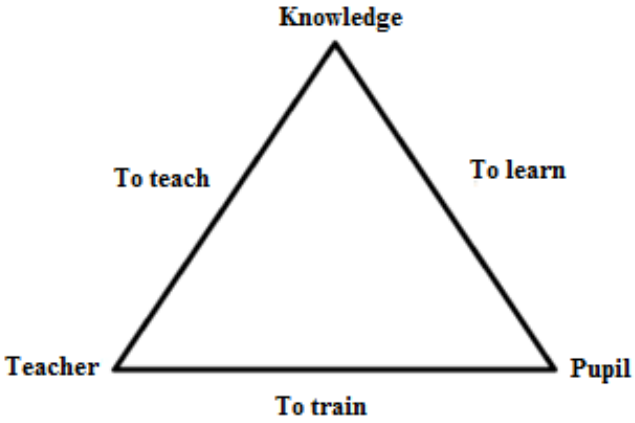


Figure 1. Houssaye's pedagogical triangle

Knowledge is the program to be taught, the content of the training. In a general way, the teacher makes learn and transmits knowledge. The pupil, for his part, acquires it. The sides of the triangle are the necessary relations for any pedagogical act. In this way, Houssaye distinguishes:

- The didactical relationship Teacher-Knowledge which allows the teacher to teach.
- The pedagogical relationship Teacher- Pupil which allows the pupil to train.
- The apprenticeship relationship Pupil- Knowledge which allows pupil to learn.

According to Houssaye (2000), in the pedagogical situation Knowledge-Teacher-Pupil, there can be only one relationship at a time. Two constitute, themselves, as subjects while the third tends to be forgotten or to fade away. In the didactical Teacher-Knowledge relationship centered on the training and learning program, if during the classroom, pupil is talkative, boisterous, and inattentive, it's because he tends to be forgotten. In the pedagogical relationship Teacher- Pupil, two actors are in action. And as the issue is at the level of pedagogical situations to be presented, some key points can be missed or misunderstood. In the apprenticeship relationship Pupil- Knowledge, it is the teacher who is missing and fading away. We then distinguish in the pedagogical triangle, three types of pedagogy: traditional, frontal, and not directive. For traditional pedagogy, priority is given to Teacher-Knowledge relationship. The pupil as an actor is put aside. In the frontal pedagogy Teacher- Pupil, it's the situation where some knowledge can be missed. In the not directive pedagogy Pupil-Knowledge, by building his own representations of knowledge, pupil can forget some of them. In the Houssaye's pedagogical triangle (2000), there are actors forgotten and tending to disappear, and the most important thing is that access to Information and Communication Technologies (ICTs) are missing. Therefore, the lack of digital equity is evident.

Given that information, the fourth pole (Device Cyber DiPL or DC Cyber DiPL with Di for Didactic, P for Pedagogy, L for Learning) was integrated within the Houssaye's pedagogical triangle to obtain a tetrahedron. Then, with knowledge types: know-how (Kh),

knowledge practice (Kp), and theoretical knowledge, learned or scientific knowledge (Tk), we discerned tetrahedrons Cyber DiPL to do, to practice, and to differentiate.

Cambridge dictionary online defines cyber as a prefix relating to computers, and especially to the internet. In other words, it is added to an existing word to transpose reality into cyberspace or to associate with it. Associated with DiPL, it concerns education sciences. It includes general digital resources and, digital teaching and learning resources. In these conditions, the device Cyber DiPL is defined as a lever for many educational activities in disciplines and learning for all ages, and whose interactions can continue through time and space. It brings together digital resources that are favored by Information and Communication Technologies (ICTs). The device Cyber DiPL can be favored by these resources which depend on educational networks set up by institutes, and training institutions.

According to these data, the research question guided this study is the following:

Can the tetrahedron Cyber DiPL be a pedagogical tool to improve teaching, learning, and digital equity in the institute of architecture?

4. Method

4.1. Participants

The selection has been focused on undergraduate students from the institute of architecture, Ferhat Abbas University Setif 1. 322 students have been randomly chosen from the 2018-2019 academic year (September 2018-June 2019); they were 146, 96 and 83 respectively from the first, second and third years at the time of data collection.

4.2. Data Collection Procedures

The data collection of the current study was executed by means of quantitative and qualitative methods. In this regard, we have developed a questionnaire composed of 8 items using a 5-point Likert scale, with Strongly Disagree to Strongly Agree. The Students answered these questions as: Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree in terms of their stance towards the item investigated. The closed questions which required a one-word answer included the following questions:

1. Is the internet important for you?
2. Are you finding the information you’re looking for online?
3. Are computers and the internet useful in classrooms and workshops?
4. Do you need peripheral devices?
5. Do you use the internet for your workshop project?
6. Do digital resources improve your research works?
7. Do you agree with teaching and learning practices in your institute?
8. Do you agree with current teaching methods using the design studio (research and project phases)?

Four open-ended questions were also added (item 9 to item 12). We encouraged students to give free-form answers including feelings, attitudes, and understanding of each item. This allowed us to better access the respondents' true feelings on an issue. The questions which required more thought and more than a simple one-word answer are the followings:

9. What do you want most in your institute of architecture?
10. What drawing software do you use for your architectural design studio?
11. What are the various types of classroom technologies that can be used to liven up a learning session?

12. What is the meaning of digital equity in higher education? (Give your own definition).

The survey was fielded from November 2018 to January 2019. Champagne's book (2014), *The Survey Playbook: Volume 1: How to create the perfect survey* and Sphinx iQ 2 have been of great use for our data collection.

4.3. Data Analysis Procedure

We also wanted for the present study answers which require more thought, and more than a simple one word. Instead of just yes/no which quantifies an opinion, it was necessary for students to reply in an open text format such they can answer based on their knowledge, feeling, and understanding. Although open-ended questions require lengthier responses, students did not skimp on answers. We wanted the output to be actionable not just measurable. Sphinx iQ 2 was used for the data analysis procedure.

4.4. Two similar tetrahedrons: Alava's and Lombard's tetrahedrons

Similar tetrahedrons are also analyzed to answer the research question. Alava (2000) integrated a fourth media pole into Houssaye's pedagogical triangle in order to have a tetrahedron describing it as an E-learning tetrahedron. With four actors (Learners, Knowledge, Trainer, and Media), the tetrahedron brought out four triangles: mediation triangle, pedagogical triangle (Houssaye's triangle), didactical triangle, and documentary triangle. With the E-learning tetrahedron, training was ensured and better-managed thanks to the Information and Communication Technologies (ICTs). Alava (2000) reported that teachers could improve their knowledge, and students should enhance their way of learning because of communication technologies and cyberspace. The tetrahedron he developed is as follows:

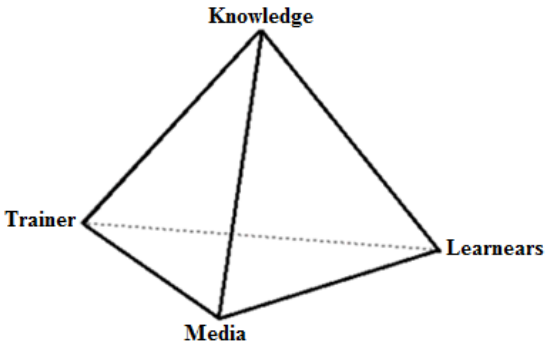


Figure 2. E-learning tetrahedron or Alava's tetrahedron

With the integration of a device-cyber-teacher, Lombard's tetrahedron (2003) (figure 3) allowed analyzing interactions between actors: Teacher, Pupil, Knowledge, and Device-Cyber-Prof. Lombard (2003) distinguished the following triangles:

- Houssaye's classical triangle: Teacher-Knowledge-Pupil.
- Cyber pure triangle: Pupil; Device-Cyber-Prof; Knowledge.
- Social triangle: Pupil; Device-Cyber-Prof; Teacher.
- Scientific triangle: Knowledge; Device-Cyber-Prof; Teacher.

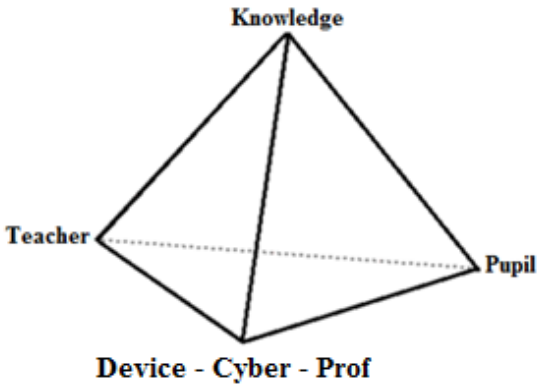


Figure 3. Lombard's tetrahedron

Lombard (2003) reported that Device-Cyber-Prof (DCF) was a technological device to improve teaching and learning, and to enhance digital equity in higher education. It was also a means of interactive communication through time and space promoting Information and Communication Technologies (ICTs). These two tetrahedrons helped us to develop our own one.

5. Findings and Discussion

The findings were based on:

- the survey carried out with 322 students from the institute of architecture;
- the integration of a fourth pole into the Houssaye's pedagogical triangle (2000).

5.1. Findings based on the survey

Findings based on closed questions:
They are presented in the following Table 1 as follows:

Table 1. *Findings for the items related to students' views*
(SD=Strongly Disagree, D=Disagree, U=Undecided, A= Agree, SA=Strongly Agree)
(n = number of participants, % = percentage)

Items	SD	D	U	A	SA
	n %	n %	n %	n %	n %
1. Is internet important for you?	2 0.62%	2 0.62%	3 0.93%	66 20.50%	249 77.33%
2. Are you finding the information you're looking for online?	9 2.80%	10 3.11%	6 1.86%	105 32.60%	192 59.63%
3. Are computer and internet useful in classrooms and workshops?	-	-	-	21 6.52%	301 93.48%
4. Do you need peripheral devices?	-	-	2 0.62%	8 2.48%	312 96.90%
5. Do you use internet for your workshop project?	-	-	-	100 31.06%	222 68.94%
6. Do digital resources improve your research works?	5 1.56%	7 2.17%	12 3.73%	167 51.86%	131 40.68%
7. Do you agree with teaching and learning practices in your institute?	168 52.18%	136 42.24%	7 2.17%	6 1.86%	5 1.55%
8. Do you agree with current teaching methods using in the design studio (Research and project phases)?	198 61.50%	122 37.88%	2 0.62%	-	-

The first item investigated the students' views on the importance of internet. The findings showed that most of the students agreed with the statement (A=20.50%, SA=77.33%). Only four disagree with the statement (D=0.62%, SD=0.62%), and only three were undecided (U=0.93%). The second item investigated the students' views on whether they can find information they are looking for online. Most of students agreed with the statement (A=32.60%, SA=59.63%). Nineteen students disagreed on the statement (D=3.11%, SD= 2.80%), and six were undecided on the statement (U=1.86%). The third item investigated the students' views on the usefulness of computer and internet in classrooms, and workshops. Most of the students agree with the statement (A=6.52%, SA=93.48%). The fourth item investigated the students' views on the need for peripheral devices. Most of the students agree with the statement (A=2.48%, SA= 96.90%). Two students were undecided on the statement (U= 0.62%). The fifth item investigated the students' views on whether they use the internet for their workshop projects. All students agree with the statement (A= 31.06%, SA= 68.94%). The sixth item investigated the students' views on whether they can improve their research works using digital resources. Most of the students agreed with the statement (A=51.86%, SA=40.68%). Twelve students disagreed on the statement (D=2.17%, SD= 1.56%), and twelve were undecided on the statement (U=3.73%). The seventh item investigated the students' views on teaching and learning practices in their institute. Most of the students disagree with the statement (D=42.24%, SD=52.18%). Seven students were undecided (U= 2.17%), and eleven students agree with the statement (A=1.86%, SA= 1.55%). Lastly, the eighth item investigated the students' views on current teaching methods using in the design studio (research and project phases). Most of the students disagree with the statement (D= 37.88%, SD= 61.50%). Two students were undecided on the statement (U= 0.62%).

Findings based on open-ended questions:

Two hundred and thirty-two students (74.04%) answered the four questions. One hundred sixty-seven students (51.86%) submitted meaningful replies to the questionnaire. Findings are presented in Table 2.

Table 2. *Main students' meaningful answers*

Number of students and percentage	Items	Man students' meaningful answers
232 students (74.04%) answered the four questions. 167 students (51.86%) submitted meaningful answers. We have selected the most interesting ones.	9. What do you want most in your institute of architecture?	- Adaptation of the institute to requirements of the digital age. - Innovative teaching strategies that emphasize enjoyable and relevant educational experiences. - Education that will meet students' needs in a constantly changing world. - Development of digital learning environments. - Incorporation of digital technology, digital media and challenging activities.
	10. What drawing sofware do you use for your architectural design studio?	Archi CAD, Auto Cad, HomeByMe, Kozikaza, Photoshop, Revit, Sketch Up, Sweet Home 3D, Viacad 2/D3.
	11. What are the various types of classroom technologies that can be used to liven up a learning session?	- Interactive whiteboard (IWB), interactive digital board (IDB), interactive educational board (IEB). - Videoconferencing. - Virtual field trip. - Computer simulation and Modelling (Modeling).
	12. What is the meaning of digital equity in higher education? Give your own definition.	- Equal access to internet and digital technology for everyone without exception. - Quest for digital knowledge for all university community. - Access to modern information and communication technology.

The above Tables 1 and 2 reveal the importance of internet and the online information with the statement (A=20.50%, SA=77.33%), (A=32.60%, SA=59.63%); the usefulness and the need of computer and internet in classrooms, and workshops with the statement (A=6.52%, SA=93.48%), peripheral devices with the statement (A=2.48%, SA= 96.90%), internet for workshop projects with the statement (A= 31.06%, SA= 68.94%), digital resources with the statement (A=51.86%, SA=40.68%); the uselessness of the current teaching and learning practices in the institute with the statement (D=42.24%, SD=52.18%), and teaching methods using in the design studio (research and project phases) with the statement (D= 37.88%, SD= 61.50%). Students wanted to use the internet, online information, computer, peripheral devices, and digital resources. It is vitally important that students learn to use them to improve their works in classrooms and their workshop projects. Access to higher education encompasses access to the technology, and connectivity necessary to access that education (Selwyn, 2016). Students didn't like teaching and learning practices in the institute and teaching methods using in the design studio (research and project phases) because IT tools and the internet are missing.

According to Table 2, students expected an adaptation of the institute to requirements to the digital age, innovative teaching strategies that emphasize enjoyable and relevant educational experiences, education that will meet their needs in a constantly changing world, development of digital learning environments, incorporation of digital technology, digital media, and challenging activities. They are using for their architectural design studio Archi CAD, Auto CAD, HomeByMe, Kozikaza, Photoshop, Revit, Sketch Up, Sweet Home 3D, and Viacad 2D/3D. These are software drawing applications using by architects. They help students to do graphic design, representational drawings, photos, and images. They also allow them to produce architectural project including, plans, elevations, sections, modelling (modeling), rendering, and 2D construction documents. The interactive whiteboards (IWBs), interactive digital boards (IDBs), and interactive educational boards (IEBs) are desired in classrooms by students as well as videoconferencing, virtual field trip, computer simulation and modeling (modeling). They have great potential as tools to enhance pedagogical practices in the classroom, and ultimately to improve student achievement (Lant & Lawson, 2016). Lastly, one hundred sixty-seven students (51.86%) defined digital equity in higher education as equal access to the internet, and digital technology for everyone without exception, a quest for digital knowledge for all university community or an access to modern information, and communication technology. These definitions although incomplete reinforce our belief that digital equity is essential in the institute of architecture. Thus, Table 2 leads us to say that teaching, learning practices, and digital equity should be improved in the institute of architecture.

5.2. Findings based on the integration of a fourth pole into the Houssaye's pedagogical triangle

The integration of a fourth pole into the Houssaye's pedagogical triangle (2000) gave a tetrahedron. The tetrahedron Cyber DiPL proposed will have the following geometrical shape:

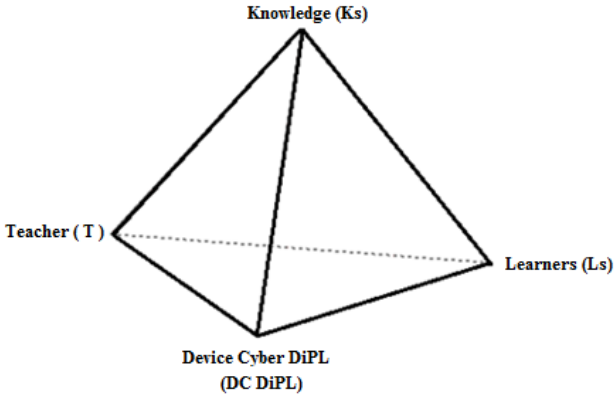


Figure 4. Tetrahedron Cyber DiPL

As mentioned above, Device Cyber DiPL (DC DiPL) is favoring by Information and Communication Technologies (ICTs). Communication technologies embedded in teaching or learning processes involve learning and development (Chai, Koh & Teo, 2018). They are a driving force in the process of transferring of worthwhile goals from a teacher to expected learners that would make them to be useful to themselves and the society at large (Akarowhe, 2017). Cyber DiPL tetrahedron can vary according to pedagogical situations and knowledge put forward. According to knowledge types: know-how (Kh), knowledge practice (Kp), and theoretical knowledge, learned or scientific knowledge (Tk), each tetrahedron provides three other triangles.

Thus, we discern for:

- Know-how (Kh): educational situation to do (ES to do).
- Knowledge practice (Kp): educational situation forged by experience (ES to practice).
- Theoretical knowledge (Tk): educational situation to differentiate (ES to differentiate).

An educational situation is defined as a triangle composed of three interrelated elements to each other to work. Educational situations according to types of knowledge are presented in Table 3.

Table 3. *Educational situations according to types of knowledge*

Knowledge / Triangles	Know-how (Kh)	Knowledge practice (Kp)	Theoretical knowledge (Tk)
Triangle of a didactic	Triangle of a didactic to do	Triangle of a didactic to practice	Triangle of a didactic to differentiate
Triangle of Houssaye	Houssaye's pedagogical triangle		
Triangle of a pedagogy	Triangle of a pedagogy to do	Triangle of a pedagogy to practice	Triangle of a pedagogy to differentiate
Triangle of an apprenticeship	Triangle of an apprenticeship to do	Triangle of an apprenticeship to practice	Triangle of an apprenticeship to differentiate
Educational Situation (ES)	**ES to do**	**ES to practice**	**ES to differentiate**

The educational situation (ES) (see Table 3) includes four types of triangles:

- Triangle of a didactic
- Triangle of Houssaye
- Triangle of a pedagogy
- Triangle of an apprenticeship

According to types of knowledge: know-how (Kh), knowledge practice (Kp), and theoretical, learned or scientific knowledge (Tk), each triangle also provides three other triangles and one Houssaye's triangle.

For the triangle of a didactic, the triangles are:

- Triangle of a didactic to do: for Know-how (Kh)
- Triangle of a didactic to practice: for Knowledge practice (Kp)
- Triangle of a didactic to differentiate: for theoretical, learned or scientific knowledge (Tk)

For the triangle of Houssaye: Houssaye's pedagogical triangle

For the triangle of pedagogy, the triangles are:

- Triangle of a pedagogy to do: for the teacher who has the know-how
- Triangle of pedagogy to practice: for the teacher who has knowledge practice
- Triangle of pedagogy to differentiate: for the teacher who has theoretical, learned or scientific knowledge

For the triangle of an apprenticeship: the triangles are:

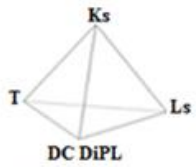
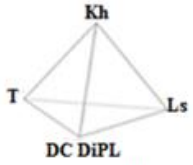
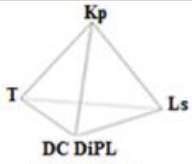
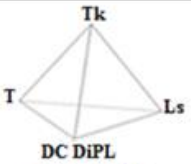
- Triangle of an apprenticeship to do: for know-how (Kh)
- Triangle of an apprenticeship to practice: for knowledge practice (Kp)
- Triangle of an apprenticeship to differentiate: for theoretical, learned or scientific knowledge (Tk).

Table 1 summarizes educational situations according to the different types of knowledge:

- For know-how (Kh), ES to do encompasses triangle of a didactic to do, triangle of a pedagogy to do, and triangle of an apprenticeship to do.
- For knowledge practice (Kp), ES to practice encompasses: triangle of a didactic to practice, triangle of a pedagogy to practice, and triangle of an apprenticeship to practice.
- For theoretical, learned or scientific knowledge (Tk), ES to differentiate encompasses: triangle of a didactic to differentiate, triangle of a pedagogy to differentiate, and triangle of an apprenticeship to differentiate.

In the light of findings in Tables 3 and the tetrahedron's shape of the Figure 4, tetrahedrons Cyber DiPL and types of triangles are presented in Table 4.

Table 4. *Tetrahedrons Cyber DiPL and types of triangles*

Triangles & Tetrahedrons / Knowledge	Know-how (Kh)	Knowledge practice (Kp)	Theoretical knowledge (Tk)
Triangle of a didactic = T - Ks - DC DiPL	Triangle of a didactic to do = T-Kh-DC DiPL	Triangle of a didactic to practice = T-Kp-DC DiPL	Triangle of a didactic to differentiate = T-Tk-DC DiPL
Triangle of Houssaye = T - Ks - Ls	Houssaye's pedagogical triangle		
Triangle of a pedagogy = T - DC DiPL - Ls	Triangle of a pedagogy to do = T(Kh)-DC DiPL-Ls	Triangle of a pedagogy to practice = T(Kp)-DC DiPL-Ls	Triangle of a pedagogy to differentiate = T(Tk)-DC DiPL-Ls
Triangle of an apprenticeship = Ls - Ks - DC DiPL	Triangle of an apprenticeship to do = Ls-Kh-DC DiPL	Triangle of an apprenticeship to practice = Ls-Kp-DC DiPL	Triangle of an apprenticeship to differentiate = Ls-Tk-DC DiPL
 **Tetrahedron Cyber DiPL**	 **Cyber DiPL to do**	 **Cyber DiPL to practice**	 **Cyber DiPL to differentiate**

Tetrahedron Cyber DiPL to do (as ES to do) focuses on interactions between Teacher (T), Know-how (Kh), Learners (Ls), and device cyber DiPL (DC DiPL). It consists of:

- Triangle of a didactic to do: T-Kh-DC DiPL
- Triangle of a pedagogy to do: T(Kh)-DC DiPL-Ls
- Triangle of an apprenticeship to do: Ls-Kh-DC DiPL

In the tetrahedron Cyber DiPL to do: it is the example of teacher and the trainee teacher facing learners. Generally, they acquire somehow technological devices that exist. Technological devices can give teachers or trainee teachers the opportunity to encourage students to engage in explorations by simulations (Clarke, 2018). The teacher or the trainee teacher, by helping students to access numerical resources, increase their digital knowledge and contribute to the meaning of digital equity (Quaintance, 2018). This is an advantage that help students to use computer technologies and internet (Tables 1and 2) eliminating digital inequities within the institute (Mysore, 2017). It is also the pooling of knowledge that may help students facing for example new IT tools (see Table 2) as the use of interactive whiteboards (or interactive digital boards and interactive educational boards) (Al-Qirim et al., 2017), and digital information (Hatlevik & Hatlevik, 2018).

Tetrahedron Cyber DiPL to practice (as ES to practice) focuses on interactions between teacher (T), Knowledge practice (Kp), Learners (Ls), and device cyber DiPL (DC DiPL). It consists of:

- Triangle of a didactic to practice: T-Kp-DC DiPL
- Triangle of a pedagogy to practice: T(Kp)-DC DiPL-Ls
- Triangle of an apprenticeship to practice: Ls-Kp-DC DiPL

In the tetrahedron Cyber DiPL to practice, it is the accumulation of practices and experiences in which actors (T= Teacher and Ls = Learners) have already acquired knowledge from previous situations (from tetrahedron Cyber DiPL to do). In the institute of architecture, students wanted to use internet, online information, computer, peripheral devices, and digital resources. They didn't like teaching and learning practices, and teaching methods using in the design studio (research and project phases). They expected an adaptation of the institute to requirements to the digital age, innovative teaching strategies that emphasize enjoyable and relevant educational experiences, and so on. According to Tables 1 and 2, the institute of architecture needs an enhancement of teaching and learning, and the involvement of teachers. In an ever-changing technological environment, students and teachers could further strengthen their knowledge and know 'where' to use technology, 'what' technology to use and 'how' to teach, and learn with it (Kelly, 2008).

Tetrahedron Cyber DiPL to differentiate (as ES to differentiate) focuses on interactions between teacher (T), theoretical, learned or scientific knowledge (Tk), learners (Ls), and device cyber DiPL (DC DiPL). It consists of:

- Triangle of a didactic to differentiate: T-Tk-DC DiPL.
- Triangle of a pedagogy to differentiate: T(Tk)-DC DiPL-Ls.
- Triangle of an apprenticeship to differentiate: Ls-Tk-DC DiPL.

In the tetrahedron Cyber DiPL to differentiate: T (teacher) has a theoretical knowledge (Tk) that allows him, for example, to better manage a classroom that includes heterogeneous learners. In architecture, students need computer and internet in classrooms and workshops (Table 1). Therefore, teaching program should be a program which is developing digital learning environments, emphasizing enjoyable and relevant educational experiences, and incorporating digital technology as well as digital media, and challenging activities (Table 2). The teacher should adapt it because learners are not the same. There are those who have significant learning difficulties. Others take time to learn and those who learn quickly. It's a way of working for equity in heterogeneous classrooms (Reich & Ito, 2017). It is the situation that can remove Learners (students) from the routine which is a lack of motivation (see Table 1). There are no bad learners. It shall be up to the teacher to differentiate his method according to learning levels to make learners succeed (Castañeda & Selwyn, 2018).

6. Conclusion

The tetrahedron Cyber DiPL proposed focuses on the didactic-pedagogy-learning link by supporting it with a digital cyber device. This is an advantage that allows the teacher to adapt his program and his teaching method by exploiting new types of digital resources. This is an opportunity directing him towards digital technology as a process of digital inclusion. Digital inclusion refers to the policies that will bridge the digital divide. It tackles social inequalities by providing solutions for socially disadvantaged students to easily access and effectively use Information and Communication Technologies (ICTs) to improve their studies (Ragnedda, 2018). So, digital inclusion can be viewed as a framework for addressing the readiness of students to fully accept and prepare for the digital age. It is a means of reducing social exclusion (Hamburg & Lütgen, 2019).

By using the tetrahedron Cyber DiPL, the teacher may improve his teaching method by bringing it closer to digital technologies. It is a way to have a more sophisticated understanding of the role played by the new normal and emerging technologies (Dziuban et al., 2018). It is therefore up to teachers to make the necessary educational improvements to take advantage of this new technological era (Resta, Laferrière, Mc Laughlin & Kouraogo, 2018).

The tetrahedron Cyber DiPL can be highlighted in the institute of architecture by:

- the installation of more advanced and adequate digital equipments, and infrastructures;
- the strengthening of the internet flow;
- the improvement of traditional pedagogies used, teaching programs, and learning methods;
- the teacher training towards digital technologies.

In addition to the strengths stated above that may answer the research question, this study has limitations that need to be addressed in future studies. The first limitation is that all the participants were undergraduate students in the institute of architecture. Thus, the data sources were collected from one institute and discipline (architecture). The questionnaire-based survey can be expanded to graduate students, post-doctoral researchers, and other stakeholders in the educational setting from different disciplines and institutes to further improve the link students - digital equity. The second limitation, although in this study we tried to explain which triangles are formed in the tetrahedron from the interaction between Knowledge, DC DiPL, Teacher and Learners, a more elaborate discussion should be provided on the meaning and the function of each triangle, and its implications for digital equity. Just as each triangle could also be reinforced by significant examples. The third limitation is that the theoretical framework tetrahedron Cyber DiPL, and its links with digital equity should be supported by more meaningful examples in order to be validated. Accordingly, future research studies should include qualitative data such as interviews or other written feedback to explore the findings obtained from survey results.

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